CEDEFOP
European Centre for the Development
of Vocational Training

Skills for green jobs

Country report

Denmark

Preface

The world is coping with a host of environmental problems and an urgent need to reduce carbon emissions. A greener future also provides enormous potential for much needed employment growth. However, without suitable skills, this potential cannot be realised. Today, skills gaps are already recognised as a major bottleneck in a number of sectors, such as renewable energy, energy and resource efficiency, green building and retrofitting, environmental services, and green manufacturing. Training response measures are successful where they are coherent across policy domains, systemic and systematic, and targeted at disadvantaged groups. These training measures can only be effective if based on timely identification of skills needs.

The European Centre for the Development of Vocational Training (Cedefop) and the International Labour Organization (ILO) worked together in carrying out the project 'Skills for green jobs', identifying skills needed for greener economies with respect to structural shifts, and new, emerging and changing occupational profiles. The 'Skills for green jobs' study is embedded in the green jobs initiative, a joint initiative of the United Nations Environment Programme (UNEP), the ILO, the International Employers Organization (IOE) and the International Trade Union Confederation (ITUC), to assess, analyse and promote creation of decent jobs as a consequence of the needed environmental policies.

The Skills for green jobs - European synthesis report (Cedefop, 2010) covers six EU Member States: Denmark, Germany, Estonia, Spain, France and the UK, and Annexes 1-6 are summaries of the country reports. The ILO global synthesis report, Skills for green jobs: a global view (Strietska-Ilina et al., forthcoming), analyses the situation in all 21 countries involved in the study (Australia, Bangladesh, Brazil, China, Costa Rica, Denmark, Egypt, Estonia, France, Germany, India, Indonesia, the Republic of Korea, Mali, the Philippines, South Africa, Spain, Thailand, Uganda, the UK and the US). The reports are available at: http://www.cedefop.europa.eu (Cedefop's website; under 'Identifying skills needs', 'Skill needs in sectors') and: http://www.ilo.org/skills/what/projects/lang--en/WCMS_115959/index.htm (the ILO website).

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NB:

The six full country reports are unedited and available only electronically. They were used as background information for Cedefop's *Skills for green jobs - European synthesis report*. Citations from the country reports are not permitted. They can only be taken from the synthesis report itself, available from Internet: http://www.cedefop.europa.eu/EN/publications/16439.aspx [cited 17.8.2010].

Table of contents

List of tables and figures

Tables

Figures

Abstract

This country report identifies and provides an analysis of sectoral and occupational changes in Denmark impacted by the greening of the economy. It also discusses policy responses and actions taken to identify and implement appropriate skills responses to occupational changes in the labour market. The report first summarises the policy context, i.e. official green strategies and plans related to mitigation and adaptation to the effects of climate change. Second, it looks into the skills development strategy in response to greening. Third, it identifies and analyses structural and occupational changes in response to greening, the skills needs and requirements, and examples of relevant skills responses.

Executive summary

This country report looks into sector and occupational changes in Denmark impacted by the greening of the economy, and more specifically which types of policy measures have been taken to anticipate and address the impact of green restructuring as well as growth and job creation opportunities created by the greening of the economy. Case studies on skills responses accompany the report.

Policy contexts and policy responses to greening

The green focus in the energy policy is not a new phenomenon in Denmark. Already in the late '70s and '80s it became a key priority, though mainly driven by regulations and an active use of fiscal policies to further green behaviour among enterprises and consumers. Thus, the current focus on climate change and the efforts undertaken in this regard represents a continuation of a long term policy priority. Nonetheless, the global focus on climate issues combined with advances in research and development (R&D) technology that can reduce greenhouse gas (GHG) emissions, has moved climate change up the political agenda, with energy efficiency and renewables as key priorities. The area is also seen as an economic growth opportunity among policy makers, industrialists and unionists.

In 2008-09 the Danish Government published several strategies which form part of an overall climate change and energy strategy. The Danish Government's vision is that Denmark should ultimately become 100% independent of fossil-fuels. The overall national targets are that total gross energy consumption in Denmark should be reduced by 4% by 2020 (compared to a 2006 baseline), and that renewable energy should make up 20% of total gross energy consumption in 2011, and 30% in 2025.

The main priorities concern energy efficiency, renewable energy and R&D support into clean technologies (cleantech), as reflected in the Government's climate and energy policy, The energy agreement from 2008 (endorsed by all but one parties in Parliament), and the long-term prioritised research agenda for public research investment 'Research 2015'.

Measures to increase the renewable energy capacity focus on wind energy, biomass and biogas. Priorities and measures for energy reductions and energy efficiency focus on transport, construction and the retrofitting/renovation of existing buildings, energy technology and cleantech solutions. Specific measures regarding the reduction of GHG emissions have also been set out for a range of industry sectors as well as for the transport and building and construction sectors.

In contrast to most other countries, Denmark did not use the national growth stimulus packages as a means to facilitate a green restructuring of the economy. Thus, the national stimulus initiatives do not entail wider green measures. The Danish policy rationale

concerning the climate challenge is a dominant innovation and growth strategy which can lead to the creation of new jobs. To that end the Government launched a Business Climate strategy (October 2009). The intent is that good framework conditions for Danish industry will enable proactive market behaviour to exploit market opportunities as advanced global suppliers or first movers in emerging markets.

The skills response strategy in response to greening

In Denmark, no overall skills response strategy has to date been developed as part of a coherent policy response to climate change and environmental degradation. Whether such a skills responses will be formulated as part of a coherent country policy response in the future is a matter of conjecture. Individual strategies, however, occasionally state that the greening of the economy and/or priorities regarding climate change may or will impact future skills requirements.

However, the long term green focus in Danish policy is already reflected in the educational sector. Various IVET (Initial Vocational Education and Training), CVET (Continuous Vocational Education and Training), and tertiary programmes have over the years been adjusted to match the demand for skills and knowledge related to green technologies and aligned to the ongoing restructuring. Thus, in a range of executive orders for upper secondary VET (Vocational Education and Training) there is already a green occupational component in the outcome and competency based goals for the specific VET qualification in IVET as well as in CVET. Examples are: energy generation and the reuse of energy, waste management, construction, facility management, transportation, and agriculture.

In the past few years, some new programmes have been implemented in VET, CVET, and also in tertiary vocational education. These relatively new qualifications at the upper secondary VET level have been developed to comply with the increased focus on energy reduction and energy efficiency, and to exploit technologies that can be used to optimise and monitor energy consumption. A characteristic feature of these new qualifications is that they are usually driven by joint demand and supply side initiatives. Examples are cooling technician and building service technician. The building service technician occupation, at upper secondary level today, is an example of how the greening effect has increased qualification requirements. In addition to technical skills, the person should also possess a number of generic competencies relating to management, planning, and communication. Previously, the inspection and servicing of both public and private buildings was carried out by retired craftsmen or a semi-skilled workforce. In waste management similar developments are noticeable.

Universities increasingly offer courses which address the climate and energy challenge, from monitoring and analysing climate impacts and carbon cycling to the development of energy efficient solutions.

The skills responses seen in Denmark through the years have mainly concerned existing sectors and occupations. Consequently, the educational sector has a strong basis for meeting the renewed global and national focus on energy efficiency and renewable energy within the existing occupations, whereas it can be questioned if the right education programmes and CVET measures are in place to fully harvest the potential from, for example, cleantech and disruptive changes in business models (e.g. a shift away from product sales towards services, as shown by Danish pump supplier Grundfos ([1])) which do not follow the traditional sector logic.

In addition to the above, the Ministry of Education has taken various initiatives to integrate climate and energy topics in the existing curriculum, from compulsory school to higher education. The aim is to ensure that the climate agenda is not only covered in a focused and coherent manner but that it also stimulates climate-conscious behaviour and encourage more young people to choose a science education after compulsory education.

Occupational changes and new skills requirements – anticipation and provision of skills

In general, very little information (statistics, analyses, etc.) currently exists regarding the consequences of the greening of the economy on the Danish occupational structures and skills requirements. Only a few major initiatives have been conducted to follow up on the greening of the economy in terms of initiating anticipation of new skills needs. Lately, trade and union representatives have publicly tried to draw attention to the employment and job creation perspectives that the greening of the economy entails. The Danish Metalworkers' Union (Dansk Metal) and the union for unskilled workers (3F) have called upon actions to implement training activities which can stimulate job creation in cleantech and other 'green areas' with growth opportunities.

In Denmark, overall annual job losses have for several years totalled around 250,000 jobs, marginally lower than jobs created, both in periods of economic growth as well as downturns. However, over time jobs in manufacturing and process industries have declined (e.g. in metal, shipyards, and food processing industries) whereas there has been an increase in service jobs, and in service intensity in production. Emerging industries are cleantech and energy efficiency services to benchmark and monitor energy consumption across a range of sectors.

Restructuring is a gradual and ongoing phenomenon that in industrial terms goes back at least 30 years, driven by the combination of automation, cost-relocation drivers, and the developments in Danish labour market policies, notably the flexicurity model. Other factors

([1]) Grundfos, the Danish pump manufacturer, has just signed a major contract with German Railways to audit energy consumption patterns across all their activities and services with a view to making German Railways climate-efficient. This follows a strategic line in which Grundfos has become increasingly service-oriented in its fundamental business and value-added proposition.

are now at play in Denmark, namely the marked drop in productivity which might accelerate job losses during the current economic crisis. There is also concern that the crisis could be followed by a period of jobless growth, as some economists suggest. This would particularly affect both the low qualified and skilled workforce remaining in Danish process industries and manufacturing jobs. Consequently, labour market organisations have called upon actions to stimulate job creation in the energy sector which is regarded as the major growth area for job creation ([2]).

Within sectors, there has been a gradual greening of existing occupations with subsequent adaptation of curriculum starting already in the 80's and 90's. The labour market programmes (adult continuing training programmes for unskilled and skilled workers) have in this respect played a major structural and restructuring role, as the tripartite governance mechanisms make them very responsive to changes in the labour market. And the short duration and the adaptive character of the programmes enable people to move quickly into new job functions in the labour market. The CVET labour market certification furthermore counts towards credit in the ordinary system.

New green collar occupations have been identified in the energy sector, for example the wind energy operator and the Manager in Renewable Energy, and emerging occupations have been identified in cleantech companies ([3]). Cleantech enterprises are a convergence of four industries: energy, transport, water, and material production. Clean technologies comprise solar cells, wind power, bio-based plastic, advanced lithium batteries, nanotechnologies and nanocoatings, and plug-in hybrid cars, to name but a few. Some of the emerging occupations are completely new and other are 'hybrid' occupations, e.g. agricultural meteorologists, solar installers, bio energy technicians, energy assessors, green accountants, Manager in Renewable Energy, and inspectors on energy efficiency. This is confirmed by a study issued by the Ministry of Education on job functions in cleantech companies ([4]) which found that some occupations that have emerged as a result of an increased focus on energy efficient and eco-friendly solutions actually converge across existing industries.

The analysis of job functions in cleantech companies finds that the existing VET qualifications represent a solid foundation for providing the competencies for the emerging occupations in cleantech. Consequently, the study finds no justification for the development of completely new training programmes targeting cleantech. Instead it recommends that existing qualifications are modified to match the emerging skills needs from cleantech industries. The study suggests a revision of outcome-based competency goals in a number of upper secondary VET programmes: auto mechanic; technical insulation; electro technician; supply technician; cooling technician; plastics technician; metal technician; process

([2]) See: Strategy (November 2009) by DI, IDA, the Danish Energy Association; and the Danish Metalworkers' Union; and the Danish Metalworkers' Union's policy recommendations (2009): 50.000 jobs in the energy sector.

([3]) Brøndum og Fliess (2009) Cleantech – guldægget i dansk økonomi.

([4]) Brøndum & Fliess (2009) Erhvervs- og efteruddannelser i et cleantechperspektiv.

technician; wind technician; industry technician; industry operator; industry electrician; electrician; and automation technician.

In IVET and CVET, it is the trade committees and respective councils monitoring occupational changes that could call for development or adaptation of IVET qualifications and CVET certificates within the tri-partite governance framework. The trade committees do undertake studies on skills anticipation for a 'family of occupations' within IVET and CVET. To a limited extent they also carry out cross-sectoral studies to analyse the impact of technological convergence – for example cleantech – or regarding changes in particular work functions that may also be cross-occupational. The committees often buy in external expertise for particular studies. In a new national structure for CVET provision, 13 CVET competency centres have been formed to connect providers of CVET and basic adult education in a more transparent infrastructure. Those centres will also be responsible for anticipating and monitoring skills changes at the local level. Currently the Danish Technological Institute is preparing a guidebook of methods for anticipating skills needs.

The Danish VET system has, through a series of reforms since 2000, given increasing autonomy to the local level to adapt course curricula to labour market needs through outcome and competency based goals without detailed proscriptive curriculum requirements. It also uses a uniform description of IVET qualifications and CVET labour market certifications, so that CVET certifications can be integrated in IVET programmes and count towards credits in IVET. The main Act for VET and the descriptive framework for the executive orders were revised in 2007. After the revision the trade committees and the VET schools have substantial opportunities to adapt curricula without amendments to the main Act or the executive orders if the revisions remain within the description of learning outcomes ([5]). With the reform of 2007, the Minister can also upon recommendations from the National Committee for VET (REU) form temporary committees if occupational changes in the labour market suggest that there could be a need for new upper secondary VET qualifications. The tri-partite governance model that is characteristic of the Danish VET system and the statistical system in place to monitor supply demand factors have resulted in a rather adaptive and responsive VET system.

The occupational profiles analysed for the study on cleantech already include a green dimension in the description of learning outcomes in the executive orders for each of the 12 entryways in upper secondary VET. At this stage it is not known if the executive orders are perceived as sufficiently broad to accommodate the identified occupational changes, or if an amendment of the executive orders will be necessary. An amendment could either be induced by adding one or more learning outcomes to the occupational profiles, or by adding new specialisations or electives. Job creation could emerge from new demands for energy

([5])http://www.uvm.dk/Uddannelse/Erhvervsuddannelser/Love%20og%20regler/Bekendtgoerelser/Skabeloner%20til%20uddannelsesbekg.aspx

efficiency in public buildings and transportation with immense business opportunities for first movers with sufficient scale to operate across borders ([6]).

([6]) As exemplified by Grundfos' recent major contract for German Railways

1. Introduction

The purpose of this country report and the case studies is to analyse occupational changes impacted by the greening of the economy in Denmark and to identify strategic skill development responses. This includes:

(a) identification of challenges and priorities arising from climate change and the greening policies and strategies which have been formulated in response to the climate change agenda, including those caused by stimulus packages adopted in response to the current economic crisis;

(b) identification of major sectors with a greening potential and those particularly affected by green stimulus packages and programmes adopted in response to the crisis;

(c) identification of skills responses to greening and an analysis as to whether these skills strategies are incorporated into larger 'greening' policies and programmes. The specific skills responses are mainly addressed by the case studies. This includes analysis of the skill needs of new occupations, new skills for greening existing occupations and retraining needs in sectors undergoing structural change due to policy implementation and the introduction of greening technologies and practices;

(d) the case studies form the core of the work and cover the following fields:

  (i) two case studies of retraining for occupations subject to green restructuring/'green structural decline',

  (ii) two case studies of skills responses for new green collar occupations,

  (iii) two case studies of skills responses for greening of existing occupations.

The case studies provide examples of how the greening of the economy has been translated into education and training measures with a green component. They focus particularly on upper secondary VET and CVET, the governance framework, provision and delivery channels, and which actors have been involved/responsible for the skills response initiative. The case studies identify which methods, tools, systems and institutional frameworks have been used to anticipate and assess skills needs/gaps quantitatively and qualitatively to ensure that the skills supply meets current and future labour-market demands for a green-collar workforce at national, sectoral, regional, company, and training provider levels.

The country report and the case studies are based on intensive desk research, consultation of various relevant websites, and dialogue with representatives from different Ministries, organisations, educational institutions, and companies.

The Danish country study is impacted by a general lack of data (statistics, skills studies, anticipation studies on sectoral change pertaining to the theme of skills for green jobs). The lack of data has been confirmed through recent interviews with the Director Generals for

IVET and TVET in Denmark ([7]). Only a few Danish studies have so far specifically addressed the impact of the greening economy on existing occupations and emerging new occupational profiles as a result of the climate agenda and technological progress made, for example, through cleantech developments.

In general, what can be identified is an increasing awareness that 're-greening' of the economy could entail greening of existing occupations, emergence of new green occupations, and green restructuring of certain sectors. The term 're-greening' refers to the fact that the green focus in the energy policy was already a key priority in the early 80's, though this was mainly driven by regulations and active fiscal policies. The current focus on climate change and the impact on restructuring and subsequent changes in occupational profiles is to some extent a continuation of a development that started about thirty years ago in Denmark. However, this is now embedded in a broader process of globalisation, whereby production processes are becoming increasingly automated, supply chains extended and outsourcing of routine jobs is commonplace.

The changes in the VET system and the qualifications and certifications offered through the VET system mirror this long-term development in, for example, food processing, building and construction, agriculture, manufacturing, and waste and water management. It is quite likely that technological developments, for example regarding non-fossil fuels, cleantech, and energy optimisation in process industry and manufacturing, will lead to further revision of VET qualifications and the development of new qualifications. There are a few recent examples of new green collar occupations in the energy sector which have been followed up by specific skills responses, for example the wind energy operator and the Manager in Renewable Energy. The emerging occupations identified in cleantech have so far not been followed up by specific skills responses.

In IVET and CVET, it is the trade committees and the respective councils that monitor occupational changes that could call for development or adaptation of IVET qualifications and CVET certificates within the tri-partite governance framework. The trade committees do undertake studies on skills anticipation for a 'family of occupations' within IVET and CVET. To a limited extent they also carry out cross-sectoral studies to analyse the impact of technological convergence – for example cleantech – or regarding changes in particular work function that may also be cross-occupational.

The above issues imply that this country report mainly analyses the key developments in significant sectors or cross-sectoral impacts regarding job creation, changing occupational structures and work functions relating to the greening of occupations. The case studies deal in more detail with specific skills responses, including how the skills needs were identified.

([7]) On behalf of the Ministry of Education, Danish Technological Institute is undertaking the analysis and progress report on the Copenhagen Process, as the template includes a section on the effect of greening of jobs, and responses to the financial crisis.

2. Policy context

In a Danish context it is important to stress, that the green policy focus is not new. Already in the 70's and 80's it became a key energy policy priority though mainly driven by regulations and an active use of fiscal policies to further green behaviour among enterprises and consumers. Thus, the current focus on climate change and the efforts undertaken in this regard represents to some extent a continuation of a long term focus which today nevertheless is more innovation and market-driven.

With particular relevance to the present study, it is worth highlighting that green employment represented a key priority in the late 90s, reflected by a new law in 1997 regarding a pool for green employment (Lov om pulje til grøn beskæftigelse) which aimed to create new and enduring green jobs. From the period 1997-2001 a total of DKK 500 billion (approximately EUR 67 billion) was allocated to stimulate employment growth of green occupations ([8]). According to the official evaluation of the green employment pool, this initiative alone contributed significantly to the creation of new jobs, including at least 1000 new green fulltime jobs from 1997 to 2000, of which nearly 73% were created in the private sector (the rest were created in organizations and public institutions). Nearly 80% of the projects continued beyond the end of the financial support from the pool ([9]).

2.1. Key challenges and priorities for the green economy

2.1.1. Mitigating the effects of climate change

The Danish Government's vision is that Denmark should become 100% independent of fossil-fuels.

Today, almost 85% of total energy consumption in Denmark is supplied by fossil fuels, much of which provided by national oil and gas reserves. However, in the near future these reserves will be emptied. To avoid foreign energy supply dependency and challenges related to energy supply safety, the development of alternative energy sources is a high policy priority. Denmark has chosen an ambitious approach in its efforts to reduce GHG emissions. These complementary priorities – energy supply security and reductions in GHG emissions – are the point of departure for the formulation of more specific policy objectives and priorities.

The main priorities to mitigate the effects of climate change concern energy efficiency, renewable energy, and R&D support to research cleantech and other climate related research

([8])http://www.fm.dk/Publikationer/1997/Samfundsoekonomisk%20vurdering%20af%20groenne%20initiativer.aspx?mode=full

([9]) http://www.casa-analyse.dk/default.asp?Action=Details&Item=554

topics, as reflected in the Government's climate- and energy policy and The energy agreement from 2008 ([10]) (endorsed by all parties in Parliament except one) as well as the research priorities stated in Research 2015 ([11]) – the Danish Government's prioritised research agenda as a follow up to the Implementation of the Globalisation Funds.

The national targets are for total gross energy consumption to be reduced by 4% by 2020 (compared to a 2006 baseline), and for renewable energy to make up 20% of total gross energy consumption in 2011 and 30% in 2025. Measures to increase the share of renewable energy focus on wind energy, biomass and biogas. Priorities and measures for energy reduction and energy efficiency comprise transport, construction and retrofitting/renovation of the existing building stock, energy technology, and cleantech solutions. Targets regarding the reduction of GHG emissions have been formulated for different industry sectors and for transportation and buildings and construction as a whole. Measures are also taken in a range of industries to offer inspection services on CO_2 emission and energy efficiency in public buildings – factors which impact changing demands to occupations within building and construction.

The transport and building management sectors are particular targets for GHG emission reductions. The challenge in the area of transport is reflected in the fact that traffic in Denmark has increased by more than 50% in the last 20 years and is set to continue to increase at the same rate in the foreseeable future ([12]). Private car usage has increased substantially over the years, despite heavy taxation on cars for private purposes and massive investments in public transport and infrastructure to connect Denmark in an efficient manner through high speed trains and bridges CO_2. The transport sector currently accounts for approximately 25% of Denmark's CO_2 emissions – a figure set to rise in the years to come. Energy consumption in buildings still represents nearly 40% of total energy consumption in Denmark and accounts for a high share of total CO_2 emissions, despite efforts to limit energy consumption through climate-friendly solutions that reduce the amount of CO_2 emitted from buildings.

The Government has a strategy focus on 'green growth', i.e. that efforts to mitigate the effects of climate change go hand in hand with economic growth and job creation in green growth industries. The policy approach should be seen in the context of 250,000 jobs disappearing annually, and a little more being created annually – starting late in the '70s with restructuring of the textile sector through outsourcing of low-qualified and codified routine jobs and automation of production processes and the supply change.

([10]) The energy agreement (February 2008).

([11]) Research 2015 catalogue (2009).

([12]) The Danish Government's strategy (December 2009): Sustainable transport – better infrastructure.

2.1.2. Adapting to climate change

Climate change adaptation constitutes a minor part of the overall Danish climate change strategy. However, a specific adaptation strategy has been developed. This identifies a number of targets of particular importance in a Danish context including: coastal management; buildings and construction; water supply; energy supply; agriculture and forestry; fishery; nature management; land use planning; health; rescue capacities; and insurance aspects. In this context it should be noted that Denmark already invested substantially years ago in waste management and waste water management through recycling and reuse as clean energy which should increase these sector's overall resilience to climate impacts.

2.2. The response strategy

2.2.1. General environmental strategy

2.2.1.1. Mitigating the effects of climate change

During 2008 and 2009, the Government published a number of strategy documents that address the main priorities and plans regarding mitigating the effects of climate change, with energy savings and efficiency and renewable energy as the main focal points. In February 2008, the Government settled a broad national Energy Agreement ([13]) in the Danish parliament for the period 2008-11, with the objective to reduce dependency on fossil fuels, oil and gas. This policy contains the overall national measures regarding reduction of gross energy consumption, energy efficiency and renewable energy. Initiatives to support the growth in renewable energy capacity within the Agreement include:

(a) changes in existing regulations and increased financial support to increase biomass and bio-waste – and reduce fossil fuels – in power plants' energy production;

(b) the establishment of a 'green fund' and increased financial support to onshore and offshore wind energy production;

(c) two new offshore wind farms;

(d) increased financial support of biogas production;

(e) financial support to replace oil-fired boilers with heat pumps;

(f) financial support to promote small scale renewable energy technologies;

(g) initiatives to promote district heating and cooling companies owned by municipalities.

([13]) The energy agreement (February 2008).

In addition, the Agreement contains new energy taxation measures, including:

(a) increased taxes on carbon dioxide;

(b) new taxes on nitrogen oxide;

(c) increased financial support for RD&D (Research, Development and Demonstration) of new and more energy efficient technologies;

(d) transport measures such as targets for biofuel levels in transport, zero-taxation on electric and hydrogen-fuelled cars, and initiatives to promote electric cars and plug-in hybrid cars.

As mentioned, transport represents a highly prioritised area in terms of reduction of GHG emissions. As part of a wider strategy concerning infrastructure and transport – Sustainable transport – better infrastructure (December 2008) ([14]) – various measures aimed at reducing transport-associated CO_2 emissions and promoting greener vehicles have been introduced. These include: lower taxes on energy-efficient cars; intelligent road pricing and traffic systems; investments in rail transport and better conditions for cycling to promote and increase growth in usage of public transport and bicycles; and initiatives to support Denmark becoming a green technology test-bed for transport (fuel efficiency, electric and plug-in hybrid cars). A green investment plan is to finance the initiatives.

Buildings and construction represents another key area in the Danish overall climate change strategy, as reflected in the Government's publication of a specific strategy focused on reduction of energy consumption in buildings (April 2009) ([15]). The strategy contains 22 initiatives aimed at reducing the level of energy consumption in new and existing buildings and ensuring a high level of knowledge and innovation in relation to energy efficient construction. The initiatives comprise three categories: strict energy requirements in new buildings, energy saving in existing buildings and innovation, R&D and education.

As mentioned, the Government's R&D strategic catalogue Research 2015 ([16]) has a strong focus on climate, energy and the environment. The Research 2015-catalogue is a systematic, forward-looking basis for prioritising future public investments in R&D strategic research. The catalogue is the result of one year's work during which a range of stakeholders contributed to the identification and prioritisation of the 21 most promising future research areas for Denmark. The catalogue was followed up in 2009 by significant earmarked funding to strategic R&D in topics on:

(a) climate, energy and environment, DKK 738 billion in 2009 & 2010 (~EUR 100 million);

(b) future energy systems, ~EUR 80 million;

(c) future climate adaptation (focusing on Greenland), EUR five million;

([14]) Sustainable transport – better infrastructure (December 2008).

([15]) Strategy for reduction of energy consumption in buildings (April 2009).

([16]) Research2015 catalogue (2009).

(d) competitive technologies, ~EUR seven million.

2.2.1.2. Adapting to climate change

The adaptation to climate change strategy ([17]) proposes a number of initiatives in sectors where climate change may have serious effects:

Coastal management: rising sea levels and more frequent storms will require new coastal management initiatives such as dismantling or renovation of dykes or port installations based on risk analyses. In addition there is a need for ongoing adaptation of rescue and storm surge preparedness as well as information on conditions significant to planning coastal constructions in future risk areas.

Buildings and construction: it is estimated that in the short term there is no need to change legislation concerning building safety under extreme weather conditions, but specific initiatives and new construction technology solutions as a means of avoiding extreme indoor temperatures during heat waves may be needed. Road regulations and rail standards as well as extension and renovation of roads and railways must be adapted to expected climate changes. Road drainage systems must be considered in light of the risk of increased precipitation intensity.

Water supply: measures to ensure the supply of drinking water are needed, taking into account future groundwater resources and the water flow/quality of watercourses and wetlands.

Energy supply: ongoing replacement and adaptation of plant are required (taking into account energy plant investment horizons of 10-30 years).

Agriculture and forestry: various climate change consequences concerning agricultural production may require adaptation of existing regulations.

Fishery: adaptation and development of new management systems is expected to occur within the present international cooperation on fisheries management and marine ecosystems. There will be a need for models and databases to quantify and qualify the significance of climate change. It is expected that fish and shellfish cultivation industries in fresh and salt water will need restructuring.

Nature management: a number of activities are already underway to ensure a healthy and robust natural environment under changed climate conditions. For example: restoration of selected river valleys to natural wetlands; efforts to reduce oxygen depletion in the sea; preventing and combating invasive species. Such activities will continue to have high priority.

([17]) Strategy for adaptation to climate change in Denmark (March 2008).

Land use planning: state authorities will continually assess whether there is a need to draw up requirements for municipal planning. Risk analyses will be included as an important decision-support tool in the form of a risk map. It is further expected that the European Floods Directive will lead to designation of areas at potential risk of flooding and, in the longer term, risk management plans for these areas will need to be developed.

Health: adaptation of programmes for public health emergency management, prevention and treatment, infectious disease monitoring, etc., may be relevant in connection with more heat waves and other health risks associated with climate change (infections, allergies, etc.). There may also be a need for increased information efforts targeting risk groups. Attention to health is otherwise integrated into many other sector efforts.

Rescue preparedness: ongoing adaptation of rescue preparedness is underway. This development will continue on the basis of observed weather events.

Insurance aspects: climate change will entail higher premiums and/or coverage exemptions from the insurance companies, and it may be relevant to develop new financial instruments for risk transfer between non-life assurance companies and the rest of the financial sector. Sector Ministries are responsible for ensuring the necessary sector-specific adaptations to climate change. Adaptation to climate change will often be cross-sectoral, requiring inter-ministerial coordination. This will be ensured by the cross-sectoral Coordination Forum for Climate Change.

2.2.2. Green response to the current economic crisis

In contrast to most other countries, Denmark did not use the national growth stimulus packages as a means to facilitate a green restructuring of the economy. In spring 2009, the Danish government introduced two bank support packages in order to provide the necessary cash availability and cash-flow, particularly for SMEs. These national growth stimulus initiatives in response to the current economic and financial crisis do not entail wider green measures. A third stimulus package targeted the construction sector. Citizens could apply for grants for renovation/retrofitting of their houses, and applications that would improve energy efficiency were prioritised ([18]).

However, this does not imply that the Danish Government has not sought to combine economic policy and climate and energy policy. To stimulate alignment of efforts to mitigate the effects of climate change with growth and innovation policies, the Government has developed a Business Climate strategy (October 2009) ([19]). The intent is for good framework conditions to be established through coherent policy coordination to enable Danish industry to exploit market and growth opportunities offered by global climate and energy challenges.

([18]) Agreements of financial stability packages, see http://www.oem.dk/sw22992.asp.

([19]) The Green Business Strategy (erhvervsklimastrategi).

The strategy sets out broad, overall targets for the entire economy, public institutions, private households, business and industry and contains six fields of actions:

(a) new cleantech solutions and innovation through regulation;

(b) more successful cleantech entrepreneurs;

(c) increased utilisation of climate solutions;

(d) business-driven climate responsibility;

(e) export of climate solutions;

(f) green alliance.

The strategy 'Denmark out of the crisis', developed by the Danish Growth Council Committee and endorsed by the current government, calls for specific measures in education and training and continuing training to stimulate job creation by exploiting green technologies further ([20]).

2.3. The skills development strategy in response to greening

In Denmark, no overall skills strategy has been formulated as part of a coherent policy response to climate change and environmental degradation. Whether such skills responses will be formulated as part of a coherent country policy response to climate change and environmental degradation in the future is a matter of conjecture.

Some individual strategies, however, do include statements about the greening of the economy and/or priorities regarding climate change which may impact skills requirements. For example the:

(a) Business Climate Strategy states that insufficient professional awareness of existing opportunities for energy efficient solutions forms a barrier to increased demand. To improve this, a green component should be integrated into different vocational education and training programmes and further education is needed for workforces in different trades, advisers in the building and construction sector, and employees in maritime sectors;

(b) Strategy for Reduction of Energy Consumption in Buildings states that energy efficient renovation and construction of buildings requires new skills and knowledge for all people involved. Energy efficient construction requirements could entail a green up-skilling at different qualification levels, as the strategy suggests. The strategy has been followed up by an overall strategic skills response initiative (see case study). This skills response represents the only example of a coherent skills response that forms part of a

([20]) See http://www.stm.dk/multimedia/Danmark_styrket_ud_af_krisen_resume.pdf.

wider strategy regarding the greening of the economy and/or priorities regarding climate change.

While Denmark has not formulated a new overall skills strategy, the long term green focus in Danish energy policy is nonetheless visible in different ways across the education sector, from the school curriculum through to university qualifications.

Various IVET, CVET, and tertiary programmes have been adjusted over time to match the demand for skills and knowledge related to green technologies and aligned to the ongoing restructuring. New programmes have also been implemented in recent years in IVET, CVET, and also in tertiary vocational education. It is characteristic of these initiatives, that they are usually driven by joint demand and supply side initiatives. The skills responses seen in Denmark through the years have mainly concerned existing sectors and occupations. This will be further outlined in Section 3.

The Ministry of Education has taken various initiatives to integrate climate and energy topics in the existing curriculum, from compulsory school to higher education. The aim is to ensure that the climate agenda is not only covered in a focused and coherent manner but that it also stimulates climate-conscious behaviour and encourage more young people to choose a science education after compulsory education. All measures take the point of departure in five themes adapted to the specific educational programme, subject matter and level of education:

(a) a knowledge perspective – what do we know about climate and factors that impact climate? What are the effects of climate change?

(b) action and attitude perspective – what can be done to reduce the effects of global warming?

(c) technology and societal perspective – which technologies and production forms and processes can reduce the global warming effect and CO_2 emissions? What are the socio-economic factors that affect a broader implementation of climate-friendly technologies and production forms?

(d) a futures perspective – future sustainable technology and behaviour;

(e) societal perspective – problems associated with climate change including health.

The initiatives comprise:

(a) a national dissemination and network site has been established ([21]). It includes resource materials for teachers, network of climate teachers, access to climate-friendly and cleantech companies for educational purposes, virtual learning networks, and other resources;

([21]) www.klimaundervisning.dk.

(b) a dedicated climate theme on Denmark's educational web portal ([22]) targeting compulsory school, upper secondary vocational programmes, and upper secondary general programmes;

(c) collaboration between projects regarding climate education and education for sustainable development ([23]);

(d) financial support to a range of projects which will be available on the web as they develop, such as www.klimaundervisning.dk (see box below);

(e) the Climate Caravan bus has visited 50 schools across Denmark with different events to engage pupils and teachers in a broader debate and make them interested in the climate change questions;

(f) in October 2009 the Ministry also hosted an international conference on Climate including master classes.

www.Klimaundervisning.dk is a project run by Danish Natural Science Association in collaboration with the Ministry of Education. The purpose is to stimulate interest among teachers to teach climate-related topics. The target groups are teachers in compulsory school, the upper secondary programmes, and short-cycle higher education. The website gives access to a range of links relevant to climate education as well as resource materials from a range of sources. The project includes two networks: for climate teachers and for climate specialists who produce educational resources and also offer training for climate teachers. Up to COP15 in Copenhagen, the website was responsible for collecting and disseminating educational resources relevant to the climate debate.

www.ubuportalen.dk – run by the Danish Ministry of Education in collaboration with UNESCO, this website addresses themes and challenges concerning the distribution of global natural resources. The portal contains material on climate change with access to different role games and where citizens can engage in a broader debate about climate issues.

www.groen-skole.dk/klima/science.htm – a range of municipalities have initiated specific educational measures and project with focus on climate.

The UN agenda for sustainable development is visible in a range of activities and dissemination activities launched by the Ministry of Education and published through the website on sustainable education ([24]).

In connection with the Copenhagen COP15 Summit in December 2009, the Danish educational portal (EMU) ([25]) presented a theme relating to the climate summit. This included a range of links and resources specific to the educational level.

([22]) http://www.emu.dk/tema/klima/.

([23]) www.ubuportalen.dk.

([24]) http://www.ubu10.dk/home/index.asp.

The above examples illustrate that the green dimension in different sub-sectors of the education system and in different vocational and professional occupations has been implemented prior to the Climate Change agenda. Consequently, the Danish educational sector has a strong basis for meeting the renewed global and national focus on energy efficiency and renewable energy within the existing occupations. What can be questioned is whether the right educational programmes and CVET measures are in place to fully harvest the potentials from, for example, cleantech and disruptive changes in business models which do not follow the traditional sector logic.

([25]) http://www.emu.dk/tema/klima/.

3. Anticipation and provision of skills

To date, relatively little information (statistics, analyses etc.) exists regarding the consequences of the greening of the economy on Danish occupational structures and skills requirements. Only a few major initiatives have been conducted to follow up on the greening of the economy in terms of initiating anticipation of new skills needs.

In IVET and CVET, it is the trade committees and the respective councils that monitor occupational changes that could call for development or adaptation of IVET qualifications and CVET certificates within the tri-partite governance framework. In support of this, the trade committees also carry out skills anticipation at occupational levels in a 'family of occupations' within IVET and CVET. To a limited extent they also carry out cross-sectoral studies to analyse the impact of technological convergence – for example cleantech – or regarding changes in particular work function that may also be cross-occupational. The committees often buy in external expertise for particular studies. Thus, some studies have been undertaken to anticipate skills needs for new growth industries in alternative energy by the Industry Trade Committee and with the use of external expertise ([26]). In a new national structure for CVET provision, 13 CVET competency centres have been formed to connect providers of CVET and basic adult education in a more transparent infrastructure. Those centres will also be responsible for anticipating and monitoring skills changes at the local level. Currently Danish Technological Institute is preparing a guidebook of methods for anticipation of skills needs.

The Industry Trade Committee has recently published a catalogue on existing qualification and certificates also of a cross occupational and cross sector character to address climate topics, energy efficiency, and the environment, and the Committee is also currently developing a range of certificates covering the same topics ([27]).

The anticipation studies and certificates under development illustrate that the greening of the economy already has impacted existing occupations and job functions, but also that new occupations may emerge as the result of the greening agenda. The existing comprehensive public CVET certificates and the certificates under way illustrate that the tri-partite system recognises that the green agenda has an occupational impact, and that the CVET system with certification of labour market courses is a strong mechanism to respond quickly to changing labour market demands.

Nevertheless there are relatively few published Danish skills anticipation studies on the consequences of the current greening of the economy. And no major initiatives regarding skills anticipation and skills needs in response to the greening of the economy have been taken yet (and no such plans seem to exist). Most initiatives regarding skills anticipation and

([26]) http://www.industriensuddannelser.dk/iu-projekter/afsluttedeprojekter/.

([27]) http://viewer.zmags.com/publication/01000326#/01000326/16.

identification of skills needs are part of the continual monitoring and development of educational and training programmes in the formal educational system that meet the needs of the labour market. Also some skills initiatives have been initiated as joint small-scale supply and demand side initiatives regarding specific skills for a particular occupation or sector.

The sub-sections below focus on key developments identified concerning sectoral and occupational changes in light of the greening of the economy. Section 3.1 looks into green structural change and (re)training needs and Section 3.2 looks into sectoral changes regarding new green occupations and greening of existing occupations.

3.1. Green structural change and (re)training needs

This sub-section looks into occupational consequences of green structural change and the following re-training needs of workers in relevant sectors.

In a Danish context it is important to stress that the green restructuring is to a certain extent a continuation of a development which started already 30 years ago. It is a gradual and ongoing phenomenon that has been driven by a combination of automation, cost-relocation drivers, developments in Danish labour market policies, major impacts of industry composition, growth of the services sector and an increase in service intensity in other sectors ([28]). Overall annual job losses have for several years totalled around 250,000 jobs, marginally lower than jobs created, both in periods of economic growth as well as downturns. The steel cluster ([29]) in Southern Jutland is an example of a successful and gradual restructuring process that led to the steel cluster becoming a global player within the process industry value chain. Low-value, routine work has been outsourced or automated, leaving high value work in Denmark. Other restructuring factors are now at play in Denmark, namely the marked drop in productivity which might accelerate job losses during the crisis.

Previous OECD economic reviews have concluded that the Danish flexicurity model combined with high CVET participation rates explains the success of the Danish economy prior to the crisis, and that processes of restructuring have been on-going and supplemented by a high absorptive capacity in labour markets. Currently, policy makers and economists strive to understand what went wrong in the Danish policy approach, which has left Denmark among the countries in the EU with the lowest productivity. Some economists suggest that the current economic and financial crisis could be followed by an almost jobless recovery, and thus long term structural unemployment ([30]). This would particularly affect the low qualified

([28]) Serviceinnovation - dynamikker og konsekvenser i forhold til den fremadrettede virksomhedsnære innovationsstrategi i Danmark (2008). Background working paper to the Danish national innovation strategy by the Agency for Research and Innovation.

([29]) http://www.staalcentrum.dk/files/pdf/dokumenter/00120.pdf.

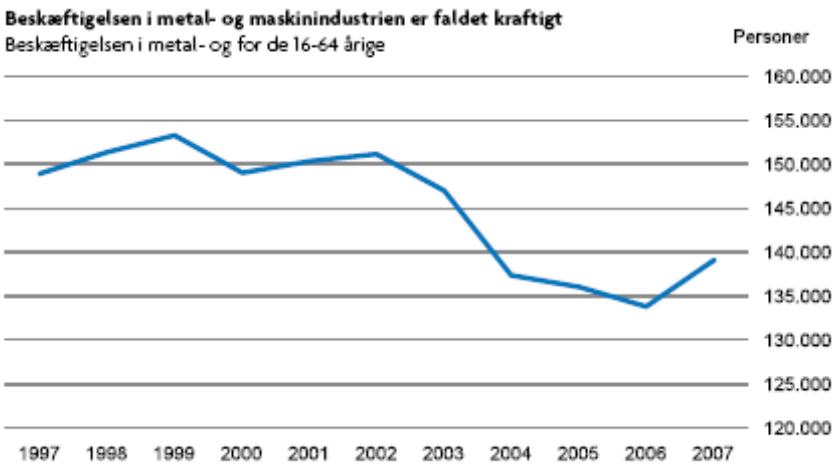
([30])https://www.nationalbanken.dk/DNDK/Publikationer.nsf/(sysPrintViewDefault)/0173CFC02B6CB6C9C12573B4004E2DAF/$file/2007_kvo4_Flexicurity_047.pdf

and the skilled workforce in the process industry and manufacturing jobs left in Denmark. Concerned with this scenario, 80 work council representatives from all the major Danish industries met in January 2010 to discuss actions that could prevent long term structural unemployment for the industry workforce, reproaching the government that the current accelerated pace of job losses during the crisis is not a law of physics ([31]).

3.1.1. Green restructuring and its impact on the labour market

As mentioned, Denmark has undergone a series of restructuring phases over the past thirty years with outsourcing of jobs in manufacturing and process industries, for example in metal, shipyards, and food processing industries, and with creation of jobs and occupational profiles that are more service intensive, even in process industries and manufacturing. As an example, the figures below firstly show a decline of around 10,000 jobs in the Danish metal- and machinery industry between 1997 and 2007, followed by a comparison of how this decline in jobs compared to total Danish employment.

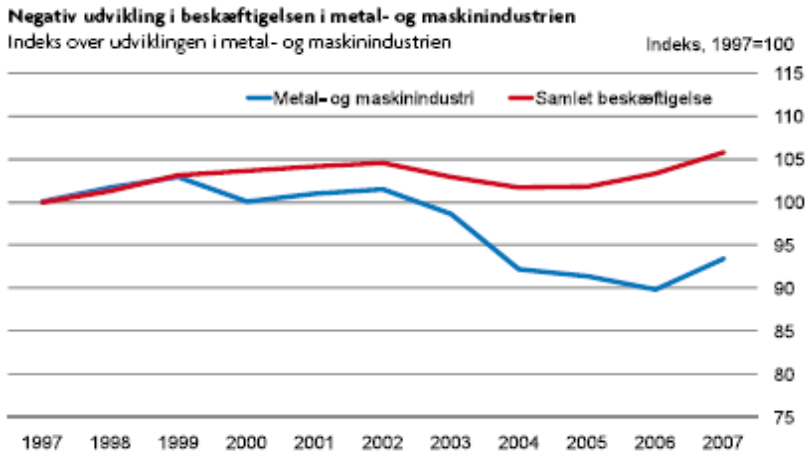
Figure 1: Employment in the metal- and machinery industry, 1997-2007



Source: Statistics Denmark

([31]) http://www.fyens.dk/article/1403156:Business-Fyn--Tillidsfolk-samlet-paa-Lindoe-skaeldte-ud-over-regeringen

Figure 2: Employment in the metal- and machinery industry compared to total Danish employment, 1997-2007 (index, 1997=100)



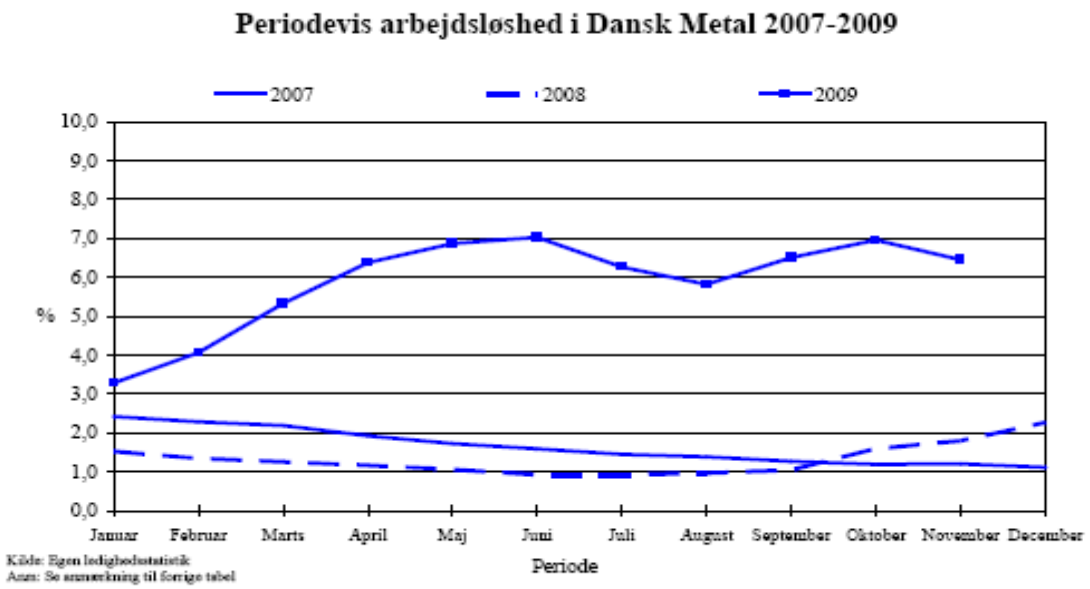
Source: Statistics Denmark

The labour market programmes (adult continuing training programmes for unskilled and skilled workers) have played a major restructuring and structural role, since they can respond very quickly to new societal needs, with a comprehensive offer of certifications that counts towards credit up to the level of a skilled worker.

Whilst some sectors of the economy could experience employment gains due to emerging new global markets to improve energy efficiency, the overall effect of restructuring in the wake of the climate change agenda will most likely lead to further job losses. The potential job loss is reinforced by the aforementioned marked drop in productivity and the general economic crisis.

The Danish Metalworkers Union expects significant job losses in traditional industries and occupations held by their members in the wake of green restructuring. They have called for actions both to ensure the creation of jobs in the energy sector and in support of the potential need for retraining of their members for those jobs. As the figure below illustrates the unemployment levels of the Union's members has increased significantly from 2007-09.

Figure 3: Unemployment figures for metal workers, 2007-09



Source: www.danskmetal.dk

Emerging green industries are cleantech and energy efficiency services ([32]). Employment gains might not only emerge with cleantech and alternative energy solutions, however, but also through the creation of technology-intensive service jobs to monitor and optimise energy use across different sectoral contexts. Thus, job creation and employment gains could emerge from new demands for energy efficiency in public buildings and transportation with immense business opportunities for first movers with sufficient scale to operate across borders. An innovative example is the Danish manufacturing company Grundfos – a global producer of pumps. In January 2010, Grundfos signed a contract with Deutsche Bahn (German Railways) for an expected value of EUR 20 million over the next two years to carry out an analysis of the energy consumption in all the activities of the Deutsche Bahn with a view to improving energy use. Grundfos expects that this could turn into a major new global service market to analyse and improve energy – and it is noticeable that the contract does not include any obligation to buy the core product of the company – pumps! ([33]) The contract awarded to Grundfos suggests a need for new cross-sectoral qualifications combining deep technical and analytical skills for new service occupations to optimise energy use, possibly with a skills elements somewhat similar to the occupational profile of a building service technician.

([32]) Brøndum og Fliess (2009) Cleantech – guldægget i dansk økonomi.

([33]) http://www.energy-supply.dk/portal-b2b/article/view.html?id=43855.

3.1.2. Identification of (re)training needs

No major coherent initiatives have been taken as yet to analyse the labour market consequences and identify the (re)training needs in the wake of the greening of the economy and the green restructuring of industries.

Major employees' and employers' organisations (notably the Danish Confederation of Trade unions (LO), the Danish Metalworkers' Union (Dansk Metal) and 3F) have publicly tried to draw attention to the employment and job creation perspectives that the greening of the economy entails. The debate was particularly intense when the closing of the last big shipyard in Denmark 'Lindø Skibsværft' was announced. Both the opposition and the union representatives advocated that the shipyard should be turned into a knowledge, innovation and education centre for Green Technologies and jobs (see case study). Lately, the Danish Engineering Confederation has hosted a number of arrangements with a focus on climate to discuss the impacts on engineering professions. Likewise the LO has arranged a conference to discuss green jobs. Dansk Metal and 3F have called for actions which can stimulate job creation in cleantech and other 'green areas' with growth opportunities – Dansk Metal have developed specific recommendations which according to their estimates would create up to 50.000 new jobs in the energy sector ([34]).

3.1.3. Skills response

The educational system and the labour market have through the years been adjusted to adapt to the ongoing restructuring of the economy. The Danish flexicurity model and the comprehensive CVET supply and uptake have sustained the occupational changes in several phases of restructuring and will continue to play a significant role in the ongoing restructuring.

The successful structural and restructuring role of CVET programmes has to do with the tripartite governance mechanisms which make them very responsive to changes in the labour market. In addition, the short duration and the adaptive character of the programmes reduce a person's training to the undertaking of new job functions in the labour market. The CVET labour market certification furthermore counts towards credit in the ordinary system.

The changes in the VET system and the qualifications and certifications offered through the VET system mirror the long-term green policy focus in for example food processing, building and construction, agriculture, manufacturing, and waste – and water management. Thus, various IVET, CVET, and tertiary programmes have through the years been adjusted to match the demand for skills and knowledge related to green technologies and aligned to the ongoing restructuring. It is quite likely that technological developments, for example regarding non-

([34]) The strategy by DI, IDA, the Danish Energy Association; and the Danish Metalworkers' Union (November 2009), Energisatsning til gavn for klima, vækst og beskæftigelse; and the Danish Metalworkers' Union's policy recommendations (2009): 50.000 jobs in the energy sector.

fossil fuels and cleantech, and energy optimisation in process industry and manufacturing, will lead to further revision of VET qualifications and the development of new qualifications. As mentioned, it can be questioned whether today's educational system is fully geared to fully harvest the potentials from for example cleantech and disruptive changes in business models which do not follow the traditional sector logic.

The fact that Denmark has undergone a series of restructuring phases over the past thirty years and the gradual adjustment of the educational and labour market systems, notably by the comprehensive CVET supply, may partly explain why no overall green restructuring skills initiatives have been formulated.

The occupational profiles analysed for the study on cleantech already include a green dimension in the description of learning outcomes in the executive orders for each of the 12 entryways in upper secondary VET. At this stage it is not known if the executive orders are perceived as sufficiently broad to accommodate the identified occupational changes, or if an amendment of the executive orders will be necessary. An amendment could either be induced by adding one or more learning outcomes to the occupational profiles, or by adding new specialisations or electives.

3.1.4. Case studies

3.1.4.1. Structural change in the shipbuilding industry ([35])

In 1988, Denmark's share of the global shipbuilding market was 3.2% and the shipbuilding industry's share of the total Danish industrial turnover was 2.33%. By 2007, however, Denmark's global market share had fallen to just 1.45% and shipbuilding's share of total Danish turnover was just 0.76 % ([36]). Total employment in the industry declined by around 40% between 1988 and 2007, falling from 6,050 to 3,600 persons in 2007. These negative developments are the effect of restructuring driven by increased global competition since the 1980's. Lower labour costs in the Far East turned shipbuilding into a stagnant industry in Denmark, as well as in the rest of Europe.

The financial crisis might be the final end to the Danish shipbuilding industry as the global demand for new ships has decreased to an absolute minimum ([37]). In August 2009, the shipping company A.P. Moller-Maersk Group announced the closing of the Lindoe Shipyard in Southern Denmark due to increased competition and the effects of the financial crisis.

([35]) This case study is based on interviews with people involved in the identification of the skills need and in the development of the skills response from the Municipality of Odense and the Region of Southern Denmark. An interview with a representative from the Lindoe Offshore Renewable Center was conducted as well. All of them provided relevant and yet unpublished written information.

([36]) Data from the Danish trade association Danish Maritime's webpage.

([37]) Danish Maritime (2009): Nyt fra Danske Maritime, newsletter, July.

From the perspective of green structural change, the closing of the Lindoe Shipyard is a particular interesting case as public authorities and the energy sector have turned to offshore renewable energy as a means of creating new jobs for the Lindoe workforce.

The current plan is for the shipyard to be closed by February 2012, and at that time all remaining employees will be laid off. The closure will also impact Lindoe's many sub-suppliers. The Confederation of Danish Industry fears that 8,000 jobs may be lost as a result of the closure ([38]). Lindoe currently employs 2,545 persons – 454 monthly salaried and 2,091 blue collar workers ([39]). The group of employees paid hourly includes 1,578 skilled and 580 unskilled workers – see Table 1 for occupations among male workers (97% of total) ([40]). The group of salaried employees includes technicians, IT-supporters, works managers, managers, administrative officers and engineers – see Table 2 for occupations among salaried employees (in total).

Table 1: Occupations for male blue collar workers

	Painters	Electricians	Service	Ship-builders	Welders	Blacksmiths and fitters	Joiners & carpenters	Other
Skilled	33	26	201	410	302	410	73	10
Unskilled	175	-	-	56	204	-	-	78

Table 2: Occupations for salaried employees

Technicians	IT	Works managers	Managers	Engineers	Administrative	Other
70	35	71	70	87	30	91

Retraining needs

The Lindoe Forum ([41]) is a partnership between the Region of Southern Denmark and the two municipalities (Odense and Kerteminde) most affected by the closure of Lindoe. The forum was established shortly after the announced closure with a core mission to create new jobs for Lindoe's former workforce. The forum is currently working on a growth plan for the Lindoe area and a draft was presented on 26 January 2010. The plan includes an application for a subsidy from the European Globalisation Adjustment Fund. Based on an examination of existing and future employment opportunities in the region, the draft growth plan concludes that Lindoe's employees will be in a position to get new jobs in a range of existing and new potential growth industries with a minimum of retraining ([42]). These include:

([38]) Børsen (2009a): Lindø-lukning rammer op til 8000 mennesker, 11. August.

([39]) The Lindoe Forum (2010): Baggrundsnotat vedr. udkast til vækstplan for Lindø-området.

([40]) 3% female workers are not accounted for, but they are primarily occupied as welders and servicemen.

([41]) http://www.lindoeforum.dk.

([42]) The Lindoe Forum (2010): Udkast til Væksplan.

(a) building and construction,

(b) component and metal industries,

(c) offshore renewable energy,

(d) solar and thermal energy,

(e) maritime construction and reparation,

(f) decommissioning.

In addition, potential new jobs could be obtained in the food and welfare technology industries if substantial retraining needs are offered.

According to the Lindoe Forum, offshore renewable energy is one of the most promising sectors from a job creation perspective. First of all, the offshore renewable energy is experiencing rapid growth. It is expected that approximately 150 billion EUR will be invested in green offshore energy in Europe over the coming years with 215,000 new jobs as a potential outcome. Secondly, Lindoe has clear advantages due to its existing facilities and competencies which includes docks, production and storage facilities, cranes and lifting facilities as well as heavy transportation equipment.

The skills competencies of Lindoe's employees such as welding, surface treatment and outfitting, are also highly relevant. The core competencies were identified in a confidential report prepared by consultants A.T. Kearney on behalf of the A.P. Moller-Maersk Group ([43]). An assessment of competencies is presented in Table 3.

Table 3: Competencies of interest to the offshore renewable energy industry

Lindoe's key competencies		**Interest**
Salaried employees	Project development and design	Low
	Project management	Medium
Employees paid by the hour	Automatic production with robotic devices	High
	Surface treatment	High
	Welding and outfitting	Medium

Skills needs identification

Local municipal authorities have the formal responsibility for identifying skills needs in relation to Lindoe's employees as part of public employment services. Usually the authorities

([43]) Results are quoted in Oxford Research and LORC (2009): Feasibility Study – LORC.

do not identify skills on a collective basis, but given the scale of redundancies the Lindoe Forum plans to do a skills needs assessment focusing broadly on all of Lindoe's employees as part of their growth plan. At present, this identification is not completed, but it will most likely include retraining focused on the offshore renewable energy sector.

A range of major Danish companies in the energy sector, together with local, regional and national policy makers, established the Lindoe Offshore Renewable Centre (LORC) in partnership with the Lindoe Forum in January 2010. LORC is a new centre based in the old shipyard at Lindoe with a focus on research, innovation and development in the field of offshore renewable energy (wave and wind). One million DKK in initial capital was provided by the Danish Ministry of Economics and Business Affairs and the Region of Southern Denmark and placed in a new fund. A.P. Moller-Maersk Group made parts of the Lindoe Shipyard available to the new centre. It is expected that 100 million DKK is needed on a yearly basis to keep LORC in operation, and the same amount of funding should be provided by the energy industry and the public sector ([44]). The former Prime Minister of Denmark, Poul Nyrup Rasmussen, was appointed chairman of the board.

Some of the main activities of the centre are training, including a continuous identification of skills needs in the Danish offshore renewable energy sector ([45]). Information will be passed on to the public authorities as well as the vocational education and training system.

Current set-up

In the local area there are currently no retraining activities directly focused on employment in the offshore industry on offer. However, the vocational labour market training system (AMU) is quite flexible and, according to local authorities, when jobs start to materialise, retraining programmes will be implemented accordingly.

The Region of Southern Denmark has focused on the development of a regional offshore industry for several years. In the city of Esbjerg, in the south western part of the Region of Southern Denmark, there are several offshore training activities at offer and the Offshore Centre Denmark (OCD), a centre similar to LORC, is located in the city. The two centres – LORC and OCD – have decided to join forces in the newly established Alliance for Green Offshore Energy ([46]).

The skills response

The actual skills response in relation to offshore renewable energy is still under planning, but it will probably follow two different tracks: First of all, retraining programmes at the public training centres. Secondly, retraining programmes at LORC.

([44]) Børsen (2009b): Lindø energicenter på plads før jul, 8. October.

([45]) LORC's homepage (http://www.lorc.dk).

([46]) Erhvervsbladet (2009): Offshore alliance kæmper om EU-milliarder til nye jobs.

Assessment of the effectiveness and organisation of the response

It is still too early to fully assess the effectiveness of the response, as no retraining has yet occurred, and the actual volume in demand in the field of offshore renewable energy is still unknown. According to the LORC chairman, hundreds or maybe thousands of jobs can be created through the new initiative at Lindoe ([47]) but, while most observers agree that the effort can create jobs in the long run, it remains unclear in what numbers ([48]).

At an organisational level, it is possible to point out both strengths and weaknesses. The potential strengths are a high degree of coordination and cooperation in a public-private partnership among key stakeholders, a strong backing from lead players in the Danish energy sector, and the region's existing knowledge and experience base with the development of the offshore renewable energy sector. The potential weaknesses are that only initial financing has been obtained so far and that two similar centres in Esbjerg and Lindoe may turn out to be excessive in terms of actual demand. Furthermore, the Lindoe model to some extent builds competition as businesses involved in the LORC-project are also competitors in a fierce market.

3.1.4.2. Structural change in the machinery sector ([49])

The machinery sector, one of the largest traditional sectors in Denmark, lost approximately 12,000 jobs in the period 1995-2004 due to automation and outsourcing ([50]). Despite this, until 2008, the Danish machinery sector ([51]) experienced almost uninterrupted economic growth mainly due to the success of the wind turbine industry (which represents over a third of total turnover in the Danish machinery sector) ([52]). However, the effects of the financial crisis have put an end – at least temporarily – to this positive economic growth rate.

The closure of MAN Diesel's production of engines in the city of Frederikshavn is an example of restructuring which, in numerical terms, has had the most negative impact on employment in the machinery sector in recent years. During 2009, 540 persons that worked in the production of marine engines were laid off at MAN Diesels' production facilities in Frederikshavn ([53]). It is expected that an additional 200 local jobs will disappear as MAN Diesel's 38 local suppliers are forced to adjust to the new situation ([54]).

([47]) Børsen (2010): Lindø-center skal omsætte for 100 mio. 18. January.

([48]) Børsen (2009c): Nyt center på Lindø kræver store investeringer, 20. October 2009.

([49]) This case study is based on an interview with the person involved in the identification of the skill needs and in the development of the skills response from the Municipality of Frederikshavn. The person provided as yet unpublished written information.

([50]) Reg Lab (2006): Traditionelle Erhverv i Videnøkonomien, Copenhagen.

([51]) http://ec.europa.eu/enterprise/sectors/mechanical/machinery/index_en.htm.

([52]) Confederation of Danish Industry (2009): Konjunkturbarometer for maskinindustrien, Copenhagen.

([53]) Municipality of Frederikshavn (2009a): Skitse til Omstillingsplan for Frederikshavn, Frederikshavn.

([54]) Nordjyske.dk (2009a): 200 job i fare hos MAN-partnere, 6. August.

At the local level there have been layoffs in other industries, adding to the negative impacts of restructuring as the rate of unemployment in the municipality is likely to reach 15.2% (3,500 persons) in 2010 compared to 5.2% (1,200 persons) in 2008 ([55]). This far exceeds the national unemployment rate of 4.3% ([56]).

The 540 persons laid off so far include skilled workers (72%), low qualified workers (27%) and engineers and administrators (1%). The local municipality expects that 20% will either find a new job, move away from the area or retire early. The remaining 80% will be targeted in an extraordinary job creation effort by the municipality ([57]).

The restructuring of MAN Diesel in Frederikshavn, is primarily caused by the effects of the financial crisis. MAN Diesel specialises in marine engines so the company was badly affected by decreasing orders and cancellations of orders from the shipbuilding industry. At MAN Diesel, existing orders only covered 23% of productive capacity in 2010 and 3% in 2011 ([58]). Furthermore, an overcapacity in the global shipbuilding market combined with high inventories made it highly likely that fierce price competition would occur in the marine market over the next few years ([59]).

While the financial crisis has been a hard blow to MAN Diesel in Frederikshavn, MAN Diesel's problems should also be seen in the light of globalisation and growing competition from low cost countries. Since the 1980's, shipbuilding activities have increasingly been offshored to the Far East and the supply chain has steadily followed ([60]).

Retraining needs

In Frederikshavn, it is estimated that unemployment will increase to about 3,500 in 2010 in a town of 23,000 inhabitants ([61]). It is therefore urgent to stimulate job creation in existing or potential growth industries through active labour market policies. The municipality has prioritised two sectors with the potential to create new employment opportunities: maritime and energy efficiency sectors. In both cases, the municipality hopes that the implementation of new environmental regulations will turn into business opportunities ([62]). In future years the shipping industry will face new environmental regulations, in terms of energy optimisation and pollution emissions, in accordance with the International Maritime Organisation's green guidelines. New regulations will also be implemented in the construction sector. According to

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([55]) Municipality of Frederikshavn (2009a): Skitse til Omstillingsplan for Frederikshavn, Frederikshavn.

([56]) Danmarks Statistik (2009): Nyt fra Danmarks Statistik, no. 32, 28. January.

([57]) Municipality of Frederikshavn (2009a): Skitse til Omstillingsplan for Frederikshavn, Frederikshavn.

([58]) Municipality of Frederikshavn (2009a): Skitse til Omstillingsplan for Frederikshavn, Frederikshavn.

([59]) MAN Diesel (2009): MAN Diesel ceases engine production in Frederikshavn and realigns the site, press release, Frederikshavn.

([60]) Supply Chain Magasinet (2007): Man kan ikke pakke 1500 tones motor ind, 24. September 2009.

([61]) Municipality of Frederikshavn (2009a): Skitse til Omstillingsplan for Frederikshavn, Frederikshavn.

([62]) Municipality of Frederikshavn (2009b): Skitse til Vækstplan for Frederikshavns-området, Frederikshavn.

national regulations, the energy consumption in new housing units should be lowered by 25% in 2010 and by 50% in 2015.

Initiatives and developments at the local level will help to sustain the efforts. The maritime sector is growing in Frederikshavn, especially in the field of maritime services, and the municipality of Frederikshavn has launched a plan to make the city's energy supply 100% CO_2-neutral by 2015.

Skills needs identification

In September and October 2009, the municipal authorities conducted a series of counselling sessions and job search courses on site at MAN Diesel. These contributed to skills needs identification. A range of activities were also conducted relating to the maritime and energy sectors ([63]).

In the identification of skills needs in the maritime sector, the municipality of Frederikshavn has been able to draw upon assistance provided by the Region of Northern Jutland as well from the local business community. In a recent study, the Region of Northern Jutland did a mapping of the maritime sector in northern Jutland and through interviews with representatives from the approximately 220 regional businesses identified maritime sector skills profiles and skills needs ([64]). A conference was also held in November 2009, with participation from 90 representatives from the regional maritime sector. The agenda focused on how to switch from industrial production to services in the sector and how such a switch would likely change the demand for skills ([65]).

To discuss skills needs in the energy sector, a conference was held in October 2009, including three workshops with a focus on new business opportunities in the energy sector. A survey amongst 39 businesses working with energy and machinery was conducted to identify future skills needs.

Current set-up

It is currently unknown what the numerical demand for new employees will be in the priority maritime and energy sectors, but in both the existing provision of skills is apparently inadequate according to municipal authorities. Nevertheless, due to the flexible labour market training system in Denmark (AMU) ([66]), the time delay from when new demands occur to a new course being offered is short, and furthermore there is a legislative framework in place so that training offered can take account of individuals' actual competencies in the delivery of

([63]) Municipality of Frederikshavn (2009a): Skitse til Omstillingsplan for Frederikshavn, Frederikshavn.

([64]) Presentation of the mapping of the maritime sector in Northern Jutland by Business Director Jørgen Ove Jensen.

([65]) Nordjyske.dk (2009b): Maritim viden skal sikres i nyt center, 5. November 2009.

([66]) For a further presentation, see: http://pub.uvm.dk/2002/training.pdf.

the training. The municipal authorities have prepared new training modules in collaboration with the social partners covering both priority sectors, although they have not yet been implemented ([67]).

One major challenge for the municipal authorities is that the existing legislation, regarding the role of training as an instrument in active labour market policies, only offers six weeks of retraining to skilled workers in the first period of unemployment (ranging from 26 to 52 weeks depending on age). In a letter to the government, the municipality has proposed a more flexible regulatory framework, regarding training provision in restructuring, where the local employment offices can offer retraining beyond six weeks according to need ([68]).

The skills response

At the initial stage, all job seekers will be offered an individual assessment of competencies based on former employments and experiences. The assessment feeds into an individual retraining plan (GVU) with exclusive focus on retraining activities related to sectors where skills are in need, including the priority sectors.

The retraining programme consists of an introduction to the specific sector supplemented by individually chosen retraining modules. The participants will choose modules according to the specialisation they wish to attain. The different retraining modules relating to the maritime and energy sectors are grouped into five main areas ([69]):

(a) basic management of both maritime and land-based processing plants,

(b) process understanding and maritime systems,

(c) energy systems,

(d) energy calculation and optimisation,

(e) management and sales.

To implement the initiative, the municipality has applied for funds from the European Globalisation Adjustment Fund in partnership with the Region of Northern Jutland and other regional municipalities ([70]). The partners have applied for 58 million DKK (around eight million EUR).

Assessment of the effectiveness and organisation of this response

([67]) Municipality of Frederikshavn (2009c): Modulbeskrivelse, Frederikshavn.

([68]) Municipality of Frederikshavn (2009d): Uhensigtsmæssigheder i den nuværende lovgivning, letter to the government, 19. november 2009, Frederikshavn.

([69]) Municipality of Frederikshavn (2009c): Modulbeskrivelser, Frederikshavn.

([70]) Region Nordjylland (2009): Kompetenceudvikling for 90 mio. kr. skal styrke nordjysk vækst, Aalborg.

It is still too soon to assess the effectiveness of the response because the project is still under planning and the implementation will not begin until August 2010. At this stage the main challenge is that the total financing package is not yet in place to implement the retraining scheme at full scale. There are also no firm job vacancies identified, though expectations are that, if trained against the performance targets of the industry, it could generate job openings in Frederikshavn.

The municipal authorities have to await a grant from the European Globalisation Adjustment Fund before the project can be implemented. The municipality expect to get a positive reply because only two Danish applications have been submitted to the Fund to date ([71]).

Regarding retraining and job availability, the mayor of Frederikshavn expressed his concerns about retraining: 'Retraining for what? Retraining is good, and probably necessary, but it does not make sense to talk about retraining, as long as we cannot see any employment opportunities' ([72]). Only 25% of the unemployed in Frederikshavn find new jobs during the first 13 weeks of their unemployment ([73]) so local economic growth appears a prerequisite to job creation.

3.2. New and changing skills needs

This sub-section looks into new green occupations and greening of existing occupations, including skill needs for newly emerging green collar occupations and with new and changing skills requirements for existing occupations in the context of greening the economy.

Different sectors are highlighted by Government strategies as being of particular importance in driving the greening of the economy. This could indirectly have a state-push effect on changing skills demands (see above). Furthermore, the emergence of new green collar occupations and the new and changing requirements for existing occupations in Denmark will depend on Danish companies key competencies regarding green tech solutions.

'Monday Morning', Invest in Denmark and the Danish Ministry of Foreign Affairs identified Danish competencies in energy and cleantech solutions. Cleantech comprises known technologies such as solar cells, wind power, bio-based plastic, advanced lithium batteries, nano-technologies and nano-coating, and plug-in hybrid cars. Other industries are also impacted by cleantech such as agriculture, manufacturing, waste management, and building and construction. The table below shows the identified Danish key competencies in this regard.

([71]) Nordjyske.dk (2009c): Nye job til nordjyske ledige, 20. january 2009.

([72]) Erhvervsbladet.dk (2000): Frederikshavns store udfordring, 28. june 2000.

([73]) Nordjyske.dk (2009d): Dystre udsigter for arbejdsløse i Frederikshavn, 3. september 2009.

Table 4: Danish companies' key competencies in terms of energy and cleantech solutions

Renewable energy	Energy efficiency	Cleantech solutions	
Wind power	Building components and solutions	Ventilation Heat pumps	Waste treatment from industry and households
Biomass/Biogas	Pumps	Efficient boilers	Waste to energy conversion
Bio ethanol, 2. generation biodiesel	Energy efficient power plat	District heating and cooling	Water supply and waste water treatment
Solar energy	Co-generation (combined heat & power)	Systemic solutions for power plants	Ecological farming
Fuel cells		Storage of renewable energy	Water treatment and management
Water and wave power			Sustainable urban development

Sources: Background material in preparation of COP15 – http://da.cop15.dk/danmarks+indsats/danske+cleantech+l%C3%B8sninger ; and Monday Morning, Invest in Denmark, the Danish Ministry of foreign affairs (2008), Denmark – Key developer of Climate Solutions.- http://www.idk.dk/db/filarkiv/1043/MMclimatemasternew.pdf.

Table 5 below shows examples of some of the most significant Danish companies delivering green solutions. The qualitative and quantitative occupational consequences in each of these areas are not estimated by any official sources.

Table 5: Examples of companies delivering green solutions (solutions to reduction of greenhouse gas)

	Company examples	Solutions examples
Solutions to Energy	DONG, Vestas, Alfa Laval, BTM Consult, Energi Rådgiverne, Wave Star Energy, Svendborg Brakes	Energy consultancy, windmills, other renewable energies and components
Solutions to Buildings	Arkitema, COWI, Cenergy Energy Consultants, Danfoss, EA Energianalyse, Cosmer Biogas	Sustainable architecture, energy efficient pumps, insulation, low-energy windows, energy efficient lighting, planning
Solutions to Agriculture	Grontmij Carl Bro, Lundsby Industri, Landscentret for Lanbrugsrådgivning	Consultancy, biogas plants, separation plants, covered slurry stores
Solutions to waste management	Rambøll, PlanEnergi, LFG-Consult, Keep-Focus, Force Technology, Deponigas	Consultancy, gathering of methane, organic waste treatment, systems for energy surveillance

Solutions to shipping	BWSC, Danish Marine Systems, Grundfos, Iron Pump, ISM Consult, Pon Power, Man Diesel	Increased energy efficiency, friction reducing painting, wind power, air bubbles below the ship
Solutions to transport	Biogasol, IBUS Innovation, DAKA Bio-diesel, H2 Logic, DONG, Novozymes, Danisco, Passat Energi	Batteries, bio-fuels, fuel cells, enzymes

Source: Background report to the Business Climate Strategy, 2009.

Note: The relevant companies are here defined as companies delivering solutions to reduction of greenhouse gas. These companies are divided into sub-categories, i.e. whether they produce solutions for Energy; Agriculture; Transport; Waste; Shipping; or Buildings.

The trade committees for TVET (Technical Vocational Education and Training) and the trade committees for CVET are responsible for monitoring occupational changes with relevance to the supply and demand for upper secondary VET qualifications and CVET certificates. Since the reform of upper secondary VET in 2007, the trade committees must annually prepare a strategic development plan as the basis for a numerical and qualitative assessment of whether occupational changes should lead to amendments in the existing executive orders or to the development of entirely new qualifications within each of the 12 occupational VET entryways.

The sub-sections below look into key developments/likely developments regarding new green collar occupations (3.2.1) and greening of existing occupations (3.2.2).

3.2.1. New green collar occupations

This subsection deals with green collar occupations emerging as a result of policies to mitigate and adapt to the impacts of climate change.

As previously discussed, most sectors in Denmark have experienced greening of existing occupations over the past 30 years often driven by regulations and based on existing technologies. Recent policies to move more rapidly towards a low carbon economy are introducing further refinements to occupations and the emergence of novel 'cleantech' ([74]) technologies – a much broader notion than a green focus – is leading to technology convergence, often complemented by new business models and partnerships and driven by the market.

([74]) The basic concept of cleantech is to produce and use resources in an energy efficient manner so they do not negatively impact the local or global ecosystem.

In the environmental technologies and services sector, however, new green occupations have rapidly developed. For example, wind turbine operators (see case study) are now prevalent. New cross-sectoral occupations could also emerge, for example in cleantech companies as in energy inspection and energy efficiency services ([75]). Some emerging occupations in cleantech are new; could be termed 'hybrid', e.g. agricultural meteorologists, solar installers, bio energy technicians, energy assessors, green accountants, Manager in Renewable Energy (see case study), and inspectors on energy efficiency.

Overall, these developments suggest that a sectoral approach to analysing the greening of occupations is likely to be insufficient because it will not capture job creation opportunities from the occupational convergence between analytical skills service elements and technological skills elements – which, for example, characterises how Grundfos uses core competencies and technologies to introduce new knowledge intensive analytical services in a global market for energy efficiency. Similar cross-sectoral occupational convergence is seen in facility management and in a range of emerging occupations in cleantech ([76]).

As a follow-up to the recommendations of the Danish Globalisation Council, a unit was created to complement the tri-partite collaboration in carrying out a dynamic identification of changing skills and occupational demands resulting from growth of new industries, sector convergence and technological development (parallel to for example FrenquenzNet in Germany) ([77]). This unit conducted a study focused specifically on 79 cleantech companies ([78]). It included an in-depth analysis of 10 companies characterised by impressive growth and innovative abilities, and representative of the types of convergence of occupational profiles that have emerged as a result of new market opportunities from eco-friendly solutions.

Using a functional job function analysis, the study also analysed new and changing occupational demands at an upper-secondary VET profile for skilled workers. Key drivers and trends within cleantech over a 3-4 year perspective were examined with a view to understanding the typical delay from when new needs are first identified to the time a skilled employee with an upper secondary qualification enters the labour market. The case studies produced 12 competency categories relevant to 15 occupational profiles. The companies strongly suggested that existing upper secondary vocational education be revised as broadly as possible rather than creating totally new occupations for two reasons:

([75]) Brøndum og Fliess (2009) Cleantech – guldægget i dansk økonomi.

([76]) A study Danish Technological Institute carried out for the Danish Agency for Science and Innovation, and based on a very rich statistical dataset, concluded that the existing statistical industry data are insufficient to capture emerging disruptive industry dynamics with continuous reconfiguration of value chains - and in many instances resulting in sector convergence.

([77]) The call for tenders is managed by The Danish School of Education in collaboration with the consultancy firm KUBIX. Danish Technological Institute is responsible for identifying and disseminating studies and promising practices particularly to support the work of the social partners.

([78]) Brøndum & Fliess (2009) Erhvervs- og efteruddannelser i et cleantechperspektiv.

(a) first, it will take less time to renew existing programmes – not least because of the broad competency-based way the educational order for each VET qualification is described;

(b) second, for recruiting purposes it is more convenient for companies that new VET qualifications do not change titles frequently, as it typically takes time despite the tri-partite governance model to build sufficient trust in the validity of a new programme and its relevance to the industry.

The 12 competency fields are:

(a) core vocational knowledge (processes, technologies, materials, market and market dynamics);

(b) understanding of market and user behaviour (specification of solutions);

(c) impact of globalisation – competitive advantage, business models, partnerships;

(d) innovation (process, product, business models);

(e) ICT;

(f) knowledge about production technology – installation and maintenance;

(g) knowledge about material technologies, such as alternative materials, reuse of materials;

(h) environment, climate, sustainability;

(i) communication – including English and team collaboration;

(j) process and planning;

(k) automation;

(l) test and documentation.

The analysis of job function in cleantech companies determined that the existing VET qualifications represent a solid foundation for providing the competencies for emerging cleantech occupations. The study found no clear justification for the development of completely new programmes targeting cleantech. Instead it recommended that existing qualifications be adjusted – e.g. by adding specific courses – to match the skills needs related to cleantech.

Cleantech companies indicated a need for revision of existing VET competency goals in the following occupational profiles: auto mechanic; technical insulation; electro technician; supply technician; cooling technician; plastics technician; metal technician; process technician; wind technician; industry technician; industry operator; industry electrician; electrician; automation technician. Methodologically, however, the study does not take into account the range of short CVET courses that already have been developed and which can be included and count towards credit in an upper secondary VET qualification.

At this stage it is not known how the relevant trade committees will use the suggestions in the study to inform eventual amendments of the profiles identified in the cleantech study. The

latest revision of the main order on VET gives substantial opportunities to tailor the main programme according to the needs of the apprentice training company. Furthermore the latest revision also offers opportunities to start new VET programmes at a local basis if there is a sufficient demand from a number of enterprises.

3.2.2. Greening existing occupations

This subsection deals with greening of existing occupations as a result of policies to mitigate and adapt to the impacts of climate change.

Most sectors have undergone a gradual greening in the labour market over time, starting already in the 80's and 90's. For the period from 1997-2001 a total of DKK 500 billion (approximately EUR 67 billion) was allocated to stimulate employment growth of green occupations ([79]). The educational system has been gradual adjusted to align formal qualifications with 'green' requirements of the labour market. Various VET, CVET, and tertiary programmes have through the years therefore been adjusted to match the demand for skills and knowledge related to green technologies (see further Section 3.2.3). At that time however, developments were mainly driven by legislation, whereas recent development are much broader, with a real market pull, further accelerated by R&D and innovation investments in this field both for enterprise creation and for R&D and innovation purposes (Research 2015, 2009).

In the following sub-sections, the greening of occupations and skills needs are analysed in relation to selected sectors which in particular are affected by climate change and related energy targets.

Energy (general):

Since 1980, the Danish economy has grown by 78%, while energy consumption has remained more or less constant and CO_2 emissions have been reduced. This development reflects an increase in energy and CO_2 efficiency. In terms of production, Denmark is one of the most efficient users of energy compared with the other EU Member States and OECD countries. This also applies to CO_2 emissions in relation to production. Over the past five years there has been a slight increase in energy consumption in Denmark. This increase is expected to slow down, particularly due to the intense energy saving effort adopted in 2005 and followed up by the Energy Agreement of 2008 at an even greater level of ambition (see above).

The profile of energy consumption in Denmark has changed significantly as a consequence of energy policy measures to promote the use of renewable energy. Renewable energy contributes to enhancing the security of energy supply and is an important element in meeting

([79])http://www.fm.dk/Publikationer/1997/Samfundsoekonomisk%20vurdering%20af%20groenne%20initiativer.aspx?mode=full.

the Government's long-range vision to make Denmark entirely independent of fossil fuels. Furthermore, renewable energy sources are generally CO_2 neutral and therefore contribute to reducing GHG emissions.

The share of renewable energy in total energy consumption has increased significantly from 1994 to 2004, from 6.4 % in 1995 to 27.7 % in 2004 (see Table 6 below). The most important renewable energy source is wind power, second is biomass and bio-waste energy share.

The transition towards more renewable energy has resulted in significant growth in Danish exports of energy technologies, driven mainly by the Danish wind turbine industry. According to the Federation of Danish Industry, wind energy accounts for 2/3 of total Danish exports in energy technology.

Table 6: Real production of renewable energy (in GWh), 1996-2004

	1996	1998	2000	2001	2002	2003	2004
Wind power	1227	2820	4242	4299	4877	5561	6583
Water power	19	27	29	29	32	21	27
Biomass	295	387	387	550	875	1400	1834
Bio gas	113	190	208	214	233	276	264
Waste	602	666	947	1007	1017	1177	1157
Total renewable energy	2256	4090	5813	6099	7033	8435	9864
Total energy consumption	35.526	34.895	35.111	35.570	35.244	35.191	35.569
Share, renewable energy	6.4	11.7	16.6	17.1	20.0	23.7	27.7

Source: Energistyrelsens energistatistik 2004

The total number employed in the energy industry was around 28,000 in 2004, of which the main part was composed of persons with an upper secondary vocational qualification. Since 2003, the total number of people employed has increased and projections show that employment will further increase by 10-20,000 people between 2004 and 2015.

The global awareness of the climate challenge and growing demands for secure energy supply will increase demand for renewable energy worldwide. This could lead to a significant growth in the Danish exports of both energy technologies and services relating to optimisation of energy efficiency. This would drive job growth in the energy industry and energy services industries.

However, demand could be impacted by an ageing workforce – over 50 % of the current workforce in the energy supply sector is more than 50 years old today. Projected demand primarily concerns skills at an upper secondary vocational level. At the same time, the greening of relevant occupations (i.e. for industrial technicians, electricians, and building service technicians), is likely to drive further greening of other occupations (see case study on

Manager in Renewable Energy). A skills anticipation study carried out by Oxford Research for the Ministry of Education in 2009 ([80]) comprised 19 large energy companies. The findings of the study indicate that existing VET qualifications already include green skills elements similar to the demands projected for 2015.

Wind energy: Denmark has been a first-mover in the wind power industry for over ten years, and it is one of the world's leading manufacturers of wind energy. In 2004, Denmark accounted for a market share of 40.4% of total world wind turbine production. Even though production continued to increase, its share fell to 29.8% in 2007 due an enormous overall growth in the size of the global wind turbine industry. The total annual turnover of the wind power sector has risen by an average of 21.3% per annum over the last 10 years. In addition, the industry achieved exports of DKK 42 billion, the equivalent of 7.22% of total Danish exports in 2008 (The Windmill Industry, 2009). Employment has greatly increased, from fewer than 10,000 jobs in 1996 to about 21,000 in 2002 and 28,400 in 2009 (CEPOS ([81]), 2009). Denmark's leading position is a result of an active energy policy in the 1990s – a period during which the rest of the world did not focus as strongly on renewable energy.

With the renewed strong political focus on renewable energy in Denmark, the industry is expected to experience further economic growth likely leading to job creation regarding turbine installations, operations, and maintenance. This may also be the case regarding employment in manufacturing of turbines and components, though VESTAS has announced that they might offshore their production. In manufacturing the existing workforce mainly have an upper secondary qualification such as industrial technicians and electricians (see case study on wind turbine operators).

Since 2007, the University of Aalborg ([82]) has offered a master's programme targeting persons in the wind energy labour market with an engineering qualification. The Danish Technical University also offers a master's engineering programme, as well as a somewhat similar programme on sustainable energy ([83]).

A recent study carried out among cleantech companies suggests that a new converging occupational profile should be created targeting not only wind energy, but also solar energy enterprises and wave energy enterprises with the title of 'climate designer' ([84]).

([80])http://www.uvm.dk/~/media/Files/Udd/Erhvervs/PDF09/090421_Energibranchens_fremtidige_kompetenceb ehov.ashx.

([81]) Job figures from Danish Wind Industry Association, www.windpower.org

([82]) http://vbn.aau.dk/research/ny_uddannelse_i_vindenergi(13561565)/.

([83])http://www.ug.dk/uddannelser/universitetsuddannelser/tekniskvidenskabeligeuddannelser/civilingenioerudda nnelser/vindenergi.aspx.

([84]) http://www.google.com/search?hl=en&q=vindenergi+erhvervsuddannelse&btnG=Search&aq=f&oq=& aqi=.

Waste: Denmark was the first country in Europe to introduce a ban on landfilling of waste suitable for incineration. The national target for waste recycling will be transformed into clean energy sources (both waste materials and water). All cities have public incineration plants, and larger cities typically have several. Traditionally there were public landfill sites where citizens could deposit waste, particularly large products. Persons working at the landfills were low-skilled with no training and the work was in no way perceived as attractive. Growing demands for energy efficient and climate friendly solutions have changed the occupational profile for those working at waste treatment plants. Furthermore it has increased the attractiveness of those jobs ([85]). To accommodate changing skills needs at the plants, Danish Technological Institute carried out a major study on occupational profiles at the plants as input to the development of public labour market training courses and revision of existing courses.

At the plants all waste must be regrouped in different categories to maximise recycling. Waste from gardening is turned into weed-free soil which is then sold. Other forms of waste will after processing be used for energy efficient heating or electricity distributed through public power plants.

Workforce at the plants must possess some of the following core skills:

(a) know the chemical substance of different forms of waste so as to treat waste correctly;

(b) sort different forms of waste correctly;

(c) they must be able to communicate with users (inhabitants) in order to advise them about appropriate handling of different forms of waste;

(d) they must be able to explain the benefits of handling waste correctly;

(e) they must be able to handle hazardous waste correctly according to specifications to reduce risks for themselves or others;

(f) they must be able to advise citizens about correct handling of different forms of waste;

(g) they must be able to use ICT to access specifications regarding correct handling of different substances;

(h) they must be able to take appropriate steps in case of accidents from hazardous waste.

Construction: Over the past 30 years, the total building stock in Denmark has increased by nearly 40%. At the same time, construction in Denmark has been able to limit energy consumption with climate-friendly solutions that reduce CO_2 emissions. However, as with Europe in general, energy consumption in buildings still represents nearly 40% of total energy

([85])http://www.teknologisk.dk/_root/media/16060_629258_628597_Jobprofiler%20og%20kvalifikationskrav%20endelig%20udgave.pdf.

consumption in Denmark (The Danish Construction Association, 2009 ([86])). Consequently, buildings and construction constitute an area in which major energy gains expectedly can be achieved.

There is a strong demand for and focus on energy efficiency in the Danish building and construction sector, including new build and retrofit. Increased energy efficiency in buildings has been a political priority for many years ([87]) and is regarded as one of the key priority areas in the Danish Government's efforts to target energy and climate change challenges (see case study). The stimulus package for the construction sector (see above) includes a renewal of the existing public building stock to improve overall energy efficiency – turning them into green buildings.

Prior to this there has been a revision of VET competency objectives (learning outcome descriptions) for the construction industry and labour market courses to comply with these new trends. Adult vocational training already includes a certificate targeting persons that work with construction installations or systems that optimise and monitor energy efficiency ([88]).

Energy-efficient measures in the building sector may lead to new direct and indirect jobs. Besides the jobs created in building operations and construction, indirect jobs will most likely be created in manufacturing, administration, and consulting. The majority of these jobs are likely to be performed by persons already working in construction. Thus in general, energy-efficient measures will lead to a greening of existing occupations.

Architects and designers must consider the entire life cycle of the building and reduce raw material use, emissions, and water use, and improve energy efficiency, indoor air quality, and occupant health. Because green buildings are designed as single, integrated systems, architects and designers must understand the various components involved in green building: efficient heating, cooling, lighting, cooking, appliances, and insulation; passive solar, thermal mass, renewable energy sources; and low-impact building materials. Understanding the green building process and the national green standards and regulations requires additional knowledge, training, and certification.

The greening of the building and construction sector is likely to stimulate jobs in the manufacturing of green building components and systems (e.g. lighting, water filtration, insulation, and energy-efficient appliances).

([86])http://www.danskbyggeri.dk/files/Filbibliotek/Klima%20og%20energi/34887.klima%20og%20energipolitik_2009_final.pdf;
http://www.danskbyggeri.dk/files/Filbibliotek/Fokus/17505.factsheetdetdanskeenergiforbrug.pdf

([87]) See e.g. the building regulations at http://www.ebst.dk/br08.dk.

([88])http://www.ug.dk/sitecore/content/Forside/Uddannelser/arbejdsmarkedsuddannelseramu/tekniskeinstallationerogenergi/bygningers_el-installationer_og_antennemontage/energitjek_tekniske_installationer.aspx.

Transportation: Traffic in Denmark has increased by more than 50% in the last 20 years and is expected to continue to increase at the same rate in the foreseeable future. The transport sector currently accounts for approximately 25% of Denmark's CO_2 emissions, and this figure is expected to rise in the years to come. Thus, while many sectors have succeeded in stabilising or reducing their CO_2 emission levels, the transport sector has seen an increase of 31.6% from 1990 to 2007. Efficient measures are needed to reduce this trend which will require a major change in transportation habits and more energy efficient solutions. The reduction of GHG emissions from transport is one of the key areas in the Danish strategy regarding mitigating the effects of climate change. However, it is still uncertain what the consequences will be for the transport sector in general in terms of employment, occupational profiles, and skills needs.

Regarding private transport by cars, initiatives have already been taken to support the development of hybrid-electric and electric vehicles and increasing use of bio fuels. Moreover, traditional cars are becoming more fuel-efficient and lighter. A shift to hybrid and electric vehicles and alternative fuels will change the skills requirements of car mechanics, as reflected in a study carried out by the relevant trade committee on future demands to the car mechanic occupational profile (Danish Technological Institute 2009 – not yet published). The study is based on contributions from both employers and employees within the field. Changes in skills do not form part of the existing VET programmes for car mechanics, as the learning outcome in this regard focuses on error tracking, repair, and maintenance of gasoline and diesel cars. In addition, car mechanics should be able to calculate CO_2 emissions from different vehicles so that the service check automatically includes an assessment of a given vehicle's CO_2 emission level.

3.2.3. Identification of skill needs

As previously discussed, the identification of skills needs primarily occurs through the trade committees for upper secondary VET and CVET and is based on labour market information, studies conducted by their secretariats or external commissioned analysts. Thus, trade committees and respective councils monitor occupational changes that could call for development or adaptation of IVET qualifications and CVET certificates within the tri-partite governance framework.

There are no uniform methods used by the committees. Besides, skills anticipation studies, they use statistics to monitor transition rates to the labour market from upper secondary VET, as well as the use of and satisfaction with CVET courses through the quality monitoring mechanism for CVET available via the net VISKVALITET ([89]). The skills anticipation studies usually cover a 'family of occupations' within IVET and CVET. To a limited extent they also carry out cross-sectoral studies to analyse the impact of technological convergence –

([89]) http://www.viskvalitet.dk/uvm/web.pages.WebFrontpage.

for example cleantech – or regarding changes in particular work function that may also be cross-occupational. The committees often buy in external expertise for particular studies.

The Industry Trade Committee has recently published a catalogue on existing qualifications and certificates (including of a cross occupational and cross-sector character) to address climate topics, energy efficiency, and the environment. The Committee is also currently developing a range of certificates covering the same topics ([90]).

In a new national structure for CVET provision, 13 CVET competency centres have been formed to connect providers of CVET and basic adult education in a more transparent infrastructure. Those centres will also be responsible for anticipating and monitoring skills changes at the local level. Currently the Danish Technological Institute is preparing a guidebook of methods for anticipating skills needs.

The Danish VET system has through a series of reforms since 2000 given increased autonomy to the local level to adapt curricula to labour market needs through outcome and competency based goals without detailed proscriptive curriculum requirements, and through a uniform description of IVET qualifications and CVET labour market certifications, so that CVET certifications can also be integrated in IVET programmes and count towards credit in IVET. The main Act for VET and the descriptive framework for the executive orders were revised in 2007. After the revision the trade committees and the VET schools have substantial opportunities to adapt curriculum without amendments to the main Act or the executive orders if the revisions remain within the description of learning outcomes ([91]). With the reform of 2007, the Minister can also upon recommendations from the National Committee for VET (REU) form temporary committees if occupational changes in the labour market suggest that there could be a need for new upper secondary VET qualifications. The tri-partite governance model that is characteristic of the Danish VET system and the statistical system in place to monitor supply demand factors have resulted in a rather adaptive and responsive VET system.

3.2.4. Skills response

As mentioned, various VET, CVET, and tertiary programmes have through the years been adjusted to match the demand for skills and knowledge related to green technologies. Thus, in a range of executive orders for upper secondary VET there is already a green occupational component in the outcome and competency based goals for the specific VET qualification in IVET as well as in CVET. Examples are found energy production and recycling of energy sources, waste management, construction, facility management, transportation, and agriculture.

([90]) http://viewer.zmags.com/publication/01000326#/01000326/16.

([91])http://www.uvm.dk/Uddannelse/Erhvervsuddannelser/Love%20og%20regler/Bekendtgoerelser/Skabeloner%20til%20uddannelsesbekg.aspx.

Some relative new programmes have been implemented in the past years in VET, CVET, and also in tertiary vocational education. These relative new qualifications at the upper secondary VET level have been developed to comply with the increased focus on energy reduction and energy efficiency, and to exploit technologies that can be used to optimise and monitor energy consumption. It is characteristic of these initiatives, that they are usually driven by joint demand and supply side initiatives.

Examples at the upper secondary level are qualifications such as the building service technician, and wind turbine operator (see case) and cooling technician.

The building service technician has been developed to comply with the growing demands of ensuring healthy and energy efficient public and private buildings have appropriate management and control of buildings with advance usage of technology, and to inform building users about climate-friendly consumer behaviour. The occupation of building service technician is an example of how the greening effect has increased qualification requirements. In addition to technical skills, the person should also possess a number of generic competencies relating to management, planning, and communication. Previously, the inspection and servicing of both public and private buildings was carried out by retired craftsmen or a semi-skilled workforce. In waste management similar developments are noticeable. The profile of building service technician could represent an example of cross-sectoral occupational convergence between services occupations and technicians' profiles. Thus the occupation profile of a building service technician illustrates how the climate agenda also leads to a sectoral convergence of occupations including strong service and technical knowledge, skills, and competency components.

The new qualifications of wind turbine operator represents explicitly target the wind industry including sub-suppliers to the wind industry and it also represents an example of an entirely new occupation (see case study).

The cooling technician (a VET qualification in refrigeration technologies) represents an example of a greening of VET qualifications in response to green labour market changes. Prior to the development of VET qualification as cooling technician, the jobs were usually held by industry technicians and machine engineers. A vocational college in Jutland, specialised in refrigeration technologies, developed in close partnership with industry a new VET qualification as refrigeration technician as well as CVET certifications. The college is the only provider of this qualification nationally, and VET graduates from the college find employment all over the world. It takes four years to become a refrigeration technician. Like other VET qualifications in Denmark, the programme is organised on a dual principle. The college also provides courses tailored to individual companies, such as training in electronic regulation of refrigeration plants, or teaching legal regulations and courses for foreign technicians who wish to learn more about Danish approaches to operating refrigeration plants. Furthermore three universities have joined to develop an engineering master's degree in refrigeration, offered since September 2008 in response to a request made by a group of

companies affiliated the network KVCA ([92]). The programme has a strong entrepreneurial component with emphasis on product and service development.

Examples in tertiary vocational education are agricultural technician ([93]) and manager in renewable energy (see case study). Also, universities increasingly offer masters courses which address the climate and energy challenge – from monitoring and analysis of climate change and carbon cycling to the development of energy efficient solutions.

There are also in CVET a range of labour market certificates that have a green dimension in their learning outcomes. Relevant CVET certifications already available include for example management of biomass heating systems; climate and cooling technique monitoring and control; and fibreglass in wind turbine wing production. In engineering occupations the increased focus on energy efficiency (see for example the case study on marine technician) has already impacted curricula.

The Industry Trade Committee is currently developing a range of CVET labour market training courses directly aligned to climate friendly and energy efficient industry in areas such as hydraulic systems, assessment and optimisation, environmental mapping, air pollution and air cleaning, energy, environmentally friendly professional behaviour, and energy optimisation in production processes ([94]).

The identified skills adjustment responses mostly target specific educational programmes. An exception to this is the construction sector, where a major Government initiative was launched in November 2009 with involvement of all relevant stakeholders to look at the horizontal and vertical supply of skills for the entire value chain in order to determine whether any adjustments are needed within the subsectors of the ordinary education system – and in further education (see case study).

Skills responses seen in Denmark through the years have mainly concerned existing sectors and occupations. Consequently, the educational sector has a strong basis for meeting the renewed global and national focus on energy efficiency and renewable energy within the existing occupations, whereas it can be questioned if the right education programmes and CVET measures are in place to fully harvest the potential from cleantech and disruptive changes in business models which do not follow the traditional sector logic ([95]).

([92]) KøleVirksomhedsCenterAlsion, which represents 26 companies and approximately 15,000 employees.

([93]) http://www.ug.dk/Uddannelser/erhvervsakademiuddannelser/tekniskeogteknologiskeuddannelser/energiteknolog.aspx.

([94]) http://www.industriensuddannelser.dk/iuudvalg/iu-projekter/afsluttedeprojekter/4229.html.

([95]) Grundfos, the Danish producer of pumps, has just signed a major contract with the German Railway to audit its energy consumption patterns in all its activities and services with a view to making German Railways climate-efficient. This follows a strategic line in which Grundfos has become increasingly service-intensive in its fundamental business and value-added proposition.

3.2.5. Case studies on new green collar occupations

3.2.5.1. Manager in renewable energy ([96])

Local energy supply systems are increasingly based on renewable energy sources with the use of different technologies and energy sources (wind, solar, waves). The usage of renewable energy based on more energy resources involves a range of technological challenges from processing and integration to optimisation and distribution. To fully exploit natural energy sources with different properties and to achieve energy efficient and environmental friendly solutions in compliance with local circumstances, there is an emerging need for technicians who possess interdisciplinary knowledge about different energy sources and their technological basis and who are able to manage and provide the needed consultancy services in renewable energy implementation projects. This need has lead to the emerging of a new type of green collar occupation which to some extent has evolved from existing occupational profiles.

The emergence of this occupation is driven by demands to optimise use of energy sources in the energy supply in Denmark. The public energy supply of heating is already built on advanced recirculation principles, and energy supply was deregulated prior to the climate debate leading to more providers and increased competition among providers. Drivers of demand are the Government targets of lower dependency on fossil fuels and mitigation of greenhouse gas emissions, regional branding and job creation strategies, as well as private sector growth strategies.

The potential job creation could occur throughout the country given the organisation of energy distribution ([97]). The occupational profile is also relevant in consultancy services for example to optimise energy solutions in industry or in the public building stock. The occupational profile is not only relevant in a Danish context, but project managers of renewable energy projects could also carry out project abroad and be employed in other countries, for example to implement sustainable energy solutions through donor programmes in developing economies.

Skills gap

The skills gap concerns the ability to combine and integrate different energy sources. This requires broad knowledge about the characteristics of different types of energy sources, as well as specific knowledge about the technological basis for those sources regarding the transformation to energy solutions and transportation, distribution, storage, monitoring, and

([96]) This case study is based on interviews with people involved in the identification of the skills need and in the development of the programme who also provided relevant written information (report concerning the identification of the skill need and the proposal for a new educational programme as project manager of renewable energy).

([97]) http://www.ens.dk/da-dk/undergrundogforsyning/elogvarmeforsyning/sider/forside.aspx.

eventually optimisation. Moreover the profile also requires a mix of generic competencies such as project management, communication, cooperation, and language skills. Existing related occupations such as engineers and other qualified labour are primarily specialists within a specific energy or technology, and few have interdisciplinary knowledge and skills regarding convergence and exploitation of different energy sources.

Identification of skills needs

The initiative to investigate the skills gap was taken locally by a network of companies, a municipality, and an educational institution in Lolland ([98]) (a southern regional part of Zealand). The project partners recognised a potential skills gap through their joint efforts to establish Community Test Facilities and International Wind Power Academy on Lolland. Thus the initial interest in analysing the skills needs evolved from the concerns of a group of public and private partners in Lolland that represent a local renewable energy network.

The skills analysis initiative was organised as a project led by a steering group with representatives from Siemens, IWAL (International Wind Power Academy Lolland), DTU (Technical University of Denmark) and the vocational academy CELF. The project was backed up financially by the Ministry of Education and by the Region of Zealand, as the project complied with the regional energy strategy. The methods applied for identifying the skills gap nationally were two surveys among relevant companies in the energy sector and in consultancy services ([99]), municipalities and educational institutions in Denmark, followed by qualitative interviews with selected representatives from companies, educational institutions, and municipalities.

The quantitative survey demonstrated that 95% of all responding companies experienced an increasing need for project managers with competencies in renewable energy. At the same time the study revealed that the gap did not concern specialists, but rather hybrid competencies spanning different energy sources. Presented with a generic competency profile for a person qualified as Manager in Renewable Energy, 40% of respondents stated that they would definitely employ a person with such a profile today, and 25% stated that they most likely would employ such a person. In total, the respondents would employ 39 persons today (companies 23, municipalities 16), and 100 in three years (companies 57 and municipalities 43), thus reflecting an estimated increasing need for persons with this profile ([100]).

([98]) The island of Lolland is a region lagging behind, with lower qualification levels compared to the rest of Denmark and with unemployment levels at a higher level. Employment opportunities have decreased gradually as agriculture gradually restructured and local industry closed or relocated.

([99]) Companies included DONG; Haldor Topsøe, Floating Power Plant, Vestas, ABB, Siemens Wind Power, SEAS-NVE, Solenergicentret, PriceWaterHouseCoopers, Alectia Energi, Dansk Salgs Partner ApS, COWI, NIRAS, EA Energianalyse.

([100]) There are methodological limitations to this approach as companies tend to respond positively to suggested demands within their industry, and even tend to overstate demand because they do not need to make any firm employment commitments

Based on the quantitative analysis, in-depth qualitative interviews were conducted with selected companies (production companies, energy distributors, and consultancies), municipalities and educational institutions. The purpose of the interviews was to obtain in-depth and detailed knowledge of the skills and competency requirements and input to the curriculum content and organisation of the skills development initiative.

Existing provision of education/training for the occupation

The formal education system does to some extent offer education and training for this occupation – both VET qualifications and tertiary engineering qualifications. Thus, the identified occupational profile builds to some extent on skills and knowledge elements in existing VET qualifications already implemented prior to the identification of the profile manager in renewable energy. At the upper secondary level it concerns the profile industry electrician, and at the tertiary level energy technologist (energiteknolog) ([101]).

The originators of the initiative assessed the extent to which the formal education system already provides education and training opportunities of relevance to this occupation. According to this assessment, the existing education and training programmes did not match the skills requirements demanded, and it was concluded that there was a need for a programme that would supplement the existing qualifications.

The skills response

As response to the identified skills gap and assessment that the formal education system does not provide education and training for this type of occupation, CELF took the initiative to develop a new tailored tertiary qualification in cooperation with Siemens, IWAL, and the municipality of Lolland, informed by further follow-up interviews with the companies which were interviewed during the skills gaps identification process.

Thus the skills response was initiated at local/regional level but is likely to be relevant nationally. The intention of partners is to develop a national skills response – a new national formal qualification for the occupation as Manager in Renewable Energy. It represents a joint demand-supply-led initiative involving industry, local and regional public bodies and educational institutions, but with the main driving force behind the initiative coming from an educational institution, CELF. At the tertiary level new qualifications are not initiated by the trade committees.

The programme comprises five semesters equivalent to 150 ECTS (European Credit Transfer System). Entry requirements are the completion of a relevant upper secondary qualification (i.e. an industry qualification plus possible additional single subject requirements). The programme is based on both theoretical knowledge and practical training through projects.

([101])http://www.ug.dk/Uddannelser/erhvervsakademiuddannelser/tekniskeogteknologiskeuddannelser/energiteknolog.aspx.

Moreover, the programme includes work placement in a company in either Denmark or abroad (see more about content below).

Partnerships have been formed with companies and education institutions in the USA, Brazil, Germany, and England, as a basis for knowledge sharing, mutual learning programmes, and student/teacher mobility. The partners from abroad have shown great interest in the proposed programme (signed cooperation agreements have been attached to the proposal). The intention is for all students to study abroad for half a year – either through work placement in a company or by completing a study period in an educational institution in another country. Similar arrangements will be available for students from abroad. The programme will be offered exclusively in English. Identified potential employers (municipalities and companies) stressed in the skills assessment interviews that strong English language skills as well as a study period abroad would definitely improve employment prospects of future graduates from the programme.

Danish companies have agreed to provide the required training places and to continuously support the development of the programme.

At the time of writing, a proposal had been sent for a pre-approval (support) from the Confederation of Danish Industry and to public authorities for a pre-assessment of whether the proposed programme complies with labour market needs and does not conflict with existing programmes. The project partners expect that the Confederation of Danish Industry will confirm their support in the near future. Then the proposal will be subjected to a formal accreditation process before it can be approved by the Danish Ministry of Education.

If the proposal is approved, it will be offered as a formal national qualification from 2011. It will be subject to existing legislation and regulations for short-cycle tertiary education in Demark, including funding principles. All vocational colleges accredited to offer tertiary short-cycle qualifications (erhvervsakademier) can apply for the right to offer the qualification.

If, unexpectedly, the proposal does not fulfil the criteria for approval, the partners will attempt to reach an agreement with relevant industry partners to offer the programme within a further education scheme.

Assessment of the effectiveness and organisation of this response

This case represents a good practice example of how new tertiary educational programmes, which are not tri-partite governed like upper secondary VET and CVET labour market certificates, may develop bottom up in a close public-private partnership. Once a need is identified – and a range of means exist for this ([102]) – decentralised bodies such as one or

([102]) for instance: Madsen, Per Kongshøj (2008), Improving the capacity to anticipate EU-wide labour market and skills requirement, DENMARK, Contribution to the European Employment Observatory Review, Autumn 2008.

more educational institutions, most often in partnership with industry or other relevant partners, develop a proposal for a new educational programme accompanied by documentation that demonstrates potential demand. Following a formal accreditation by the relevant accreditation authority, the proposal is subjected to final approval procedures by the Ministry of Education.

As a good practice example, this case also represents good feedback mechanisms between the education and training system and business. The process following the identification of needs is, as in this case, primarily supply-side driven; however it is demand-side stimulated and involves continuous reciprocal demand-supply dialogue. Moreover, the formalised accreditation procedures at the national level aim to ensure that there is a sufficient demand at a national level to justify the development of a new tertiary programme. The demand side is of course also affected by the overall supply of qualified labour at a given time. Studies for example from the Danish Technological Institute have shown that in periods of stagnation, graduates from new programmes find a job right after graduation, but data on transition rates may hide that these graduates gain employment in jobs that do not correspond to their qualification level simply to get foothold in the labour market ([103]).

Content of the skills response

Content of the short cycle vocational HE programme (summarised):

Introduction:

- energy systems – now and in the future: Introduction to the energy sector – history and structure; drivers of development; the prospects of different types of energy sources (two ETCS);
- future energy systems: Introduction to challenges related to the increasing demand for energy nationally and internationally (three ETCS).

Renewable energy sources:

- wind energy and related technologies (three courses of 20 ETCS in total);
- biomass and related technologies (four courses of 15 ECTS in total);
- solar energy and related technologies (three courses of seven ETCS in total);
- wave energy and related technologies (four ETCS).

Transportation, steering and storage of energy

- basic electrical technology: electro-technique, combining electrical plants, etc.) (three courses of 13 ETCS in total);

([103]) Comparative study between USA and Denmark on transition patterns to the labour market for persons with vocational tertiary ICT qualification (USA department of Education, 2004).

- storage of energy: storing strategies, storing technologies, societal and environmental conditions (four courses of 20 ETCS in total);
- steering, regulation and control: steering possibilities and techniques, thermodynamic terms and principals, electrical technologies, energy supply – the interplay between production and consumption, societal and environmental conditions (four courses of 20 ETCS in total).

Information and communication

- communication technologies/ methods for collecting and storing data, steering and infrastructure (two courses of four ETCS in total).

Market mechanisms

- market dynamics, pricing mechanisms, international and national cooperation agreements and regulation etc. (two courses of five ETCS in total).

Mathematical modelling

- different models for assessment and communication about alternatives (five ETCS).

Work placement / study abroad

- work placement in Danish or foreign company (15-30 ETCS), study at a foreign vocational college (0-15 ETCS).

Project management

- project organisation (theories, methods, practical training), management and cooperation (two courses of two ETCS in total).

3.2.5.2. Wind turbine operator ([104])

Denmark has been a first-mover in the wind power industry for over ten years, and its leading wind turbine manufacturers have been able to maintain a very strong global position. This has been a consequence of a concerted policy to increase the share of wind power in Danish energy production. The policy has only been made possible through substantial subsidies supporting wind turbine owners. This indirect subsidy has in turn generated the demand for wind turbines from the manufacturers.

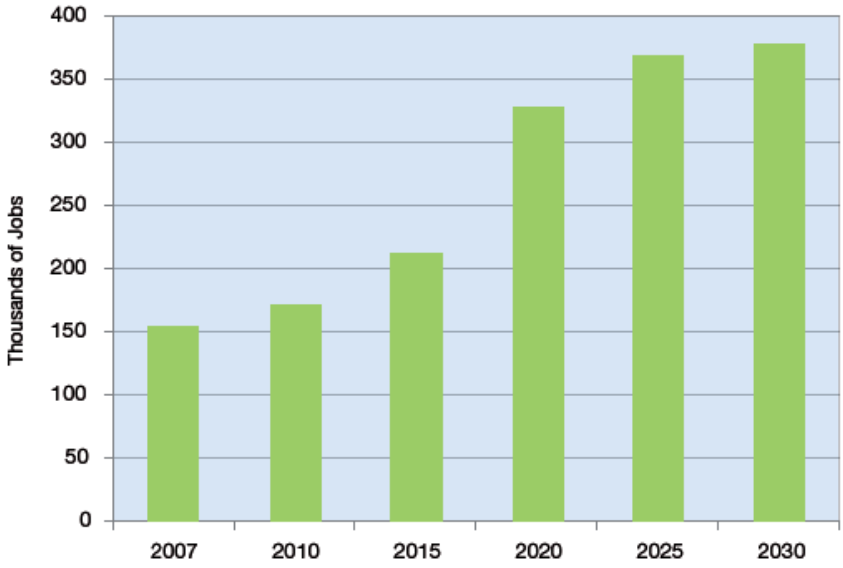
The wind energy sector has become increasingly important for the Danish economy. From being an industry with focus on the domestic market, the wind turbine industry is today a global industry with significant growth and a high export. The total annual turnover of the

([104]) This case study is based on available relevant documentation (see bibliography) as well as an interview with a Chief Consultant from the Industry's Trade Committee, who was involved in the identification of the skills gap and the development of the programme.

wind energy sector has risen by an average of 21.3% per annum over the last 10 years. In addition, the industry achieved export of DKK 42 billion, the equivalent of 7.22% of total Danish exports in 2008 (The Windmill Industry 2009). The global market size amounted to DKK 84 billion in 2008 compared to DKK 65 billion 2007. This amounts to a market size increase of 29% (The Windmill Industry 2009).

The market developments and the political support to wind power production have increased the labour force in the wind energy sector. In recent years the number of employees in the wind energy sector increased to 30,000 in Denmark in 2008. The number of employees in the sector was expected to fall to 26,000 in 2009 as a consequence of the global economic crisis (The Windmill Industry 2009). The most recent figures estimate that 28,400 employees worked in the industry in 2009 (CEPOS, 2009). In spite of the recent setback, future projections indicate that sector employment will surge. In EU alone it is projected that the wind energy sector will generate as many as 350,000 jobs by 2030 – see Figure 4 below.

Figure 4: Projections for employment in EU wind power



Source: EPIA and Greenpeace International

Wind energy has become a vital part of Danish efforts to lower its fossil fuel dependency. The focus on wind energy is supported by government subsidies which have played a significant role in the success of the Danish wind turbine industry. Annual subsidies were DKK 1.7-2.6 billion between 2001 and 2005 (Cepos 2009). Vestas from Denmark, and a number of sub-suppliers have grown substantially. Key competitor German Siemens is a long-time partner of DONG Energy in the construction of offshore wind energy parks (DONG ENERGY 2009).

Currently, Danish manufacturers have supplied around 40% of the cumulative generating capacity worldwide, with Vestas being the dominant company in the industry (WWF 2009).

Skills gap

The skills gap comprises knowledge, competencies, and skills regarding the wind turbine construction and maintenance process. The gap does not concern specific skills, but rather a demand for a skilled workforce trained to work specifically in the sector. A worker involved in wind turbine production must be able to carry out a range of tasks including:

(a) creating technical drawings of windmills and individual subsystems;

(b) assembly and disassembly of wind turbine parts;

(c) installation of wind turbine systems and technologies;

(d) adjusting engine and other technical installations on the wind turbine;

(e) use of measurement and diagnostic tools for identifying errors;

(f) specialisation in wing technology or engine technology.

Wind turbine production also requires generic competencies regarding project management, communication, cooperation, and language skills. Thus, what is needed is a specialist in all the aspects related to the production, assembly, and maintenance of wind turbines to produce high quality wind turbines and maintain a high level of operation.

The skills gap is reflected in the fact that many wind turbine companies are forced to train their own employees to ensure that they fit the job profile. Modern day wind turbine workers must be able to undertake several tasks as part of the production and maintenance process and must be capable of functioning in a global market where language and broad knowledge around wind turbine technology is essential.

Identification of skills needs

The identification of the skills gap was organised as a project led by a steering group with representatives from the Federation of Danish Industry and the employees' organisation 3F.

The skills gap was identified through workshops and dialogue between these organisations plus key employers in the wind energy sector and selected vocational colleges (Energibranchen 2008). This setup ensured that identified skills needs reflected the qualitative and quantitative needs of the industry. The educational profile was created mainly through the demands made by the wind energy sector.

Existing provision of education/training for the occupation

The supply of vocational education for the sector came originally from two sources – the formal upper secondary VET qualification of 'industrial operator' and to some extent that of industry electricians. Both programmes are not industry specific but have a broad technological and process basis. As markets for the wind turbine industry grew, technologies became more complex and the global competition increased. The industry decided there was a need to develop a qualification specifically to the needs the wind turbine industry. The wind turbine industry had argued for a more specialised education for their future workforce for a

number of years, as the existing offer no longer could meet the specialised demands of the sector.

The skills response

Growth in the wind energy sector in recent years has led to the demand for a vocational qualification aimed specifically at the wind energy sector in Denmark. Vestas and Siemens have lobbied for a specific wind turbine vocational programme for several years. Because of the volatility of the wind turbine sector, the future workforce must be able to undertake several work functions in the production process. There is thus a need for individuals with broad and interdisciplinary knowledge and skills tailored to the wind energy sector.

In response to the identified need, the steering group initiated the development of a new upper secondary vocational programme leading to a formal VET qualification as skilled wind turbine operator, in cooperation with relevant schools and vocational colleges. This initiative was taken at a time where the wind energy sector was growing at an impressive speed. Furthermore the political focus on the sector accelerated the process with regards to when and how the qualification should be introduced.

The specifics regarding the content of the requested programme were identified by surveying wind turbine companies, in particular Vestas and Siemens who dominate the industry and represent the large majority of employees in the industry. This ensured that the programme would comply with the performance demands from the sector. Individuals from the industry with specialised knowledge in specific areas were appointed to assist the steering group in the planning and development of the requirements and specifications of the qualification. This model of development is characteristic for how new VET programmes are developed. Particularly for new industries which have not formally be covered by vocational qualifications there will be a substantial direct dialogue with enterprises in the industry, whereas qualifications in more mature industries typically are developed or adapted within the framework of indirect representation through the trade committees.

The programme has been approved by the industrial trade committee and the Danish Ministry of Education and is today offered as a formal national upper secondary VET qualification by four vocational colleges throughout the country. All colleges and schools interested in offering the VET programme can be approved to do so if they fulfil the requirements by the industry trade committee. No students have yet completed the programme, but the first students completing the programme are set to enter the job market in 2011-12. The wind turbine sector has made no promises to the schools regarding how many apprentices they will be able to guarantee a job at the end of their education.

The jobs for future wind turbine operators are concentrated in Mid and South Jutland where most of the relevant companies reside. However, their competencies are not restricted to specific locations. A wind turbine operator is expected to be able to cross borders to repair broken wind turbines, participate in the construction of new wind farms, and to be able to

give guidance and advice to foreign workers at the construction site or at the local Vestas or Siemens plants (Interview).

The fact that the sector has become so successful in Denmark means that demand for skilled workers is growing. The wind turbine operator is the first step in the process of creating education specifically tailored to the wind energy sector. The wind turbine operator must be able to function in most areas within the wind energy sector. The emphasis in the programme is to create a wind energy worker. The wind turbine operator will be skilled in tasks such as installation of a wind turbine, crafting and handling of wind turbine materials, and planning of the process of creating and installing the wind turbine (Vindmølleoperatøruddannelsen 2008).

Assessment of the effectiveness and organisation of this response

The creation of the wind turbine operator education programme in 2009 meets the expectations made by the sector.

Whether the skills response adequately reflects the need of the industry – and whether programme can be determined a success – will depend on the willingness and ability of the wind turbine companies to offer apprenticeships to the new students and later employ these young people in job profiles that take full advantage of what they have learned during the programme.

Currently, companies are not hiring new employees due to the economic recession and they have proved reluctant to take in new apprentices. The programme's sole focus on the wind turbine industry leaves students with the problem of a lack of alternative job opportunities unless they are willing to go abroad once they have finished their education. The programme is so sector-specific that even small fluctuations in wind turbine sales and success could mean massive changes in job prospects for the wind turbine operator apprentices once graduated.

3.2.6. Case studies on greening existing occupations

3.2.6.1. Greening of existing occupations in construction ([105])

During the past 30 years the total building stock in Denmark has increased by nearly 40%. At the same time, construction in Denmark has been able to limit energy consumption with climate-friendly solutions that reduce the CO_2 emissions. However, energy consumption in buildings still represents nearly 40% of total energy consumption in Denmark, as in Europe in

([105]) This case is based available documentation (see bibliography) and on interviews with ministerial representatives and people represented in the working committee and relevant unofficial material provided by the authority in charge – The Danish Enterprise and Construction Authority.

general (The Danish Construction Association, 2009 ([106])). Consequently, buildings and construction constitute an area where major energy reductions are expected to be achieved.

Increased energy efficiency in buildings has been a political priority in Denmark for many years ([107]) and is regarded as one of the key areas of priority in the Danish Government's efforts to handle the energy and climate change challenges. Thus, as part of a series of climate change strategies, the Government has developed a strategy focusing on building renovation and installation of energy efficient solutions for new and existing buildings. The strategy includes stricter energy regulation in construction and a range of initiatives that stimulate the continuing development of new products and solutions for new and existing buildings.

Energy efficiency in buildings in Denmark is not just a state-led development. Energy reduction represents a major business opportunity. The world market for energy efficient products and solutions for buildings is growing, and Danish companies are in a very strong market position when it comes to energy efficiency technologies and services in buildings ([108]) ([109]).

This whole development implies a greening of occupations in the construction sector reflected in new green skills requirements at all levels – from engineers and architects to electricians and construction workers. Lately, this has been stressed in the Government's strategy for reduction of energy in buildings as well as in strategies developed by organisations in the construction sector ([110]).

The construction sector employed approximately 190,000 people in 2008, equivalent to 6.8% of the Danish workforce (Danish Statistics, 2009 ([111])). However, the world wide economic downturn has resulted in an estimated decline of 15% (a reduction of approximately 30,000 workers) according to the Danish Construction Association. Currently, the sector organisation supports the development of energy efficient renovation since it could create 5,000 new jobs.

([106])http://www.danskbyggeri.dk/files/Filbibliotek/Klima%20og%20energi/34887.klima%20og%20energipolitik_2009_final.pdf ; http://www.danskbyggeri.dk/files/Filbibliotek/Fokus/17505.factsheetdetdanskeenergiforbrug.pdf

([107]) E.g. the building regulations at http://www.ebst.dk/br08.dk

([108]) E.g. regarding lighting, energy-efficient windows, insulation, building materials, heating, ventilation, Passive-solar houses, zero-emission buildings).

([109]) See: Background report to the Danish Government's Green Business Strategy

Green companies in Denmark, March 2009: An empirical study carried out by The Danish Enterprise and Construction Authority's Division for Research and Analysis in cooperation with Statistics Denmark, commissioned by the Danish Ministry of the Environment.

Publications by Monday Morning, Invest in Denmark, the Danish Ministry of foreign affairs in preparation of COP15, see http://www.idk.dk/visPublikationsBeholder.asp?artikelID=21121.

([110]) The Danish Construction Association organizations; Knowledge center for energy reduction in buildings (June 2009).

([111]) http://www.statistikbanken.dk/statbank5a/default.asp?w=1024.

Table 7: People employed in the construction sector by occupational group, 2006-08

	2006	2007	2008
Low qualified workers	55.689	60.664	61.996
Skilled workers (with upper secondary VET qualification)	102.951	107.850	108.728
Technicians (with short cycle HE qualification)	9.760	10.213	10.316
Bachelors of engineering (with technical medium cycle HE qualification)	6.938	7.549	7.625
Workforce with other tertiary qualification	312	363	400
Civil engineers	1.136	1.296	1.375
N/A information	2.670	3.415	3.577

Source: Statistics Denmark, 2009 at http://www.statistikbanken.dk/statbank5a/default.asp?w=1024.

Skills gaps/weaknesses

The long-term focus on energy efficiency in buildings has resulted in changes in the job functions and skills requirements of construction sector occupations. Overall, increasing energy efficiency in buildings requires new knowledge about how to design and implement low energy construction and renovation projects in which each component forms an integral part, as well as up-to-date knowledge about the latest products and solutions. In addition, creating energy-efficient buildings requires increased interdisciplinary understanding and a broad cross-occupational insight into the construction process as a whole. New skills needs have emerged for specific new products and solutions and for the overall design and implementation approach related to energy efficiency building projects. In general, this development is reflected in an ongoing revision of upper secondary VET qualifications and CVET labour market certificates.

The Government's strategy for reduction of energy consumption in buildings (April 2009 ([112])) highlights that requirements regarding energy efficiency in new and existing buildings imply new green skills which should be followed up by relevant skills response initiatives. It stressed that further education is required at all levels – from engineers and architects to electricians and blue collar workers – and that existing educational programmes should be revised in accordance with the overall strategy for reduction of energy consumptions in the building stock to ensure that all future employees have solid basic skills regarding energy efficient construction. As mentioned, these demands will likely increase requirements for a cross-occupational understanding of the construction process and the maintenance and repair of the existing building stock. The strategy advocates that a new skills response initiative be organised in a process involving all stakeholders to ensure that each specific skills response matches the needs of the relevant occupational group.

([112]) http://www.ebst.dk/file/43439/reduktion-af-energiforbruget-i-bygninger.pdf.

Identification of skills needs

In response to Government's strategy regarding energy efficiency in buildings, an inter-ministerial committee has been set up to ensure a proper follow-up on the initiatives that stem from the national strategy. The committee has established a working group with members from relevant business organisations, education institutions, and public authorities, to thoroughly assess the skills requirements/needs for different occupations in the construction sector as compared to the existing provision, in order to identify new skills response initiatives needed for different occupational groups, such as engineers, architects, plumbers, electricians, bricklayers, and low-qualified workers. The outcome of the process will be an action plan that describes the existing supply and skills initiatives for the sector (value chain) and that presents new initiatives and recommendations.

This whole government-led process has recently been initiated (October 2009) and a mapping of the area is currently being conducted. Thus, the complete overview of skills needs and gaps has not yet been established and no skills responses have materialised yet ([113]).

Existing provision of education/training for the occupation

Formal educational programmes for occupations in the construction sector are offered within the VET system, the higher education system at all levels, and in the adult education and continuing training system.

In the VET and adult vocational training system, programmes and courses are adjusted and developed on a continual basis by the relevant trade committees, and energy efficiency has been at the core in the construction trade committee's work for some time, resulting in adjusted/changed learning outcomes descriptions and new CVET courses. In the higher education system, the greening of occupations has also been integrated into the short cycle vocational programmes as well as the medium- and long-cycle engineering programmes, for example by introducing new courses focusing on innovative low energy solutions.

The degree to which the total supply of education and training adequately covers and responds to the greening of the occupations in the sector will be analysed and evaluated a part of the inter-ministerial initiative with broad involvement of supply and demand side representatives.

The skills response

Various skills initiatives have been taken – and new ones are continually being rolled out – at various levels to adjust to the greening of occupations in the construction sector, i.e. changes of content and requirements in occupations as responses to innovation, new solutions and

([113]) The information provided in this case is based on interviews with ministerial representatives and people represented in the working committee and relevant unofficial material provided by the ministry in charge.

approaches, and regulation related to energy efficiency. Relevant examples of such responses are summarised below.

The results of the skills response development initiated by the inter-ministerial process will be finalised during spring 2010. The skills response is to be financed within the existing funding schemes of the educational system. Furthermore, the outcome is to be implemented in accordance with the existing legal framework and educational policy framework (thus the outcome will not have regulatory or financial consequences).

Assessment of the effectiveness and organisation of this response

The organisation of the continual adjustment of education and training programmes in Denmark is generally organised in a highly decentralised manner. In higher education, educational institutions are responsible for developing HE programmes, and national accreditation procedures ensure the relevance and the quality of these programmes. Upper secondary VET programmes and adult vocational training programmes are adjusted and developed by the relevant trade committees. The organisation of this process ensures that the skills supply corresponds to industry skills demand, new regulations, and changes in job functions for low-qualified and qualified workers in the sector. This method of organising the development of education and training, based on highly decentralised monitoring of the actual skills needs, national recognition of the qualifications offered, and close dialogue between the demand and supply side, has proven rather effective throughout the years.

However, developments such as demands for increased energy efficiency impact a range of occupations across traditional sector demarcations.

It is for this reason that the Committee for Future Proofing VET proposed an independent unit to identify and analyse such cross-occupational and cross-sectoral changes complementary to the anticipation and monitoring measures undertaken by the trade committees. The revision of the main order paved the way for the rights of the Minister of Education to form ad hoc committees to have an instrument to assess whether cross-sectoral and occupational changes should be translated into new VET programmes or revision of existing.

The organisation of the recent construction initiative, with the broad involvement of all relevant stakeholders from the supply side and demand side, holds a strong potential for determining whether the greening of occupations in the construction value chain is adequately addressed within the different subsectors of ordinary education and further education and training supply.

Examples of skills responses initiatives relating to energy efficiency (small scale, part of continual development in the area)

For civil engineers there are various examples of innovation activities regarding energy efficiency that have been integrated by the universities into the civil engineering programmes. One such example is innovation projects driven by an innovation network, LavEByg ([114]). This network focuses on developing integrated low energy and energy efficient applications and solutions for buildings. Its aim is to bridge the scientific approach at the universities with experience-based work in the field, and to facilitate the integration of innovative approaches and solutions into educational programmes and finally into the work practices of construction engineers. As an example, a new technology concerning the use of low temperature heating in low energy houses has been developed. This technology has been implemented into educational programmes of civil engineers at DTU.

Regarding further education of skilled and low-qualified workers, the relevant trade committees have for a quite some time regularly adjusted existing programmes and developed new courses focusing on energy efficient solutions in construction. An example is 'Energy test of electrical installations'. The learning outcomes are: an ability to carry out an energy test aimed at energy reduction in relation to electricity, water, heat and ventilation in buildings; ability to advise customers about energy reducing solutions and other types of green solutions; knowledge of how to ensure optimal integration of technical installations and components that produces heat, air conditioning and ventilation; and knowledge of relevant regulations.

In addition, specific demand-driven skills initiatives focusing on energy efficiency in buildings have been introduced by various actors. The list below presents examples of such initiatives:

(a) the Danish Construction Association, Tekniq (installations technology workers' organisation), Energy Service Denmark: New courses in buildings densitometry;

(b) Fredericia Municipality Business Council: Training course for workers in identification and calculation of energy reduction potentials;

(c) VIA University College: Establishment of a Climate and Energy Competency Centre;

(d) vocational college EUC Nord, in cooperation with The Danish Construction Association and The Knowledge Centre for energy efficiency in buildings ([115]): A course in energy efficient standard solutions for bricklayers and carpenters;

(e) trade committee, construction: New short national adult training programme in energy efficient renovation;

([114]) The network has existed since 2006. It is managed by DTU in cooperation with other research institutions, and members are various companies, public authorities, and branch organisations. The purpose of the creation of LavEbyg is to ensure that the large energy reduction potentials (60-80% reduction during the next 40 years) in new buildings and regarding existing buildings will be implemented.

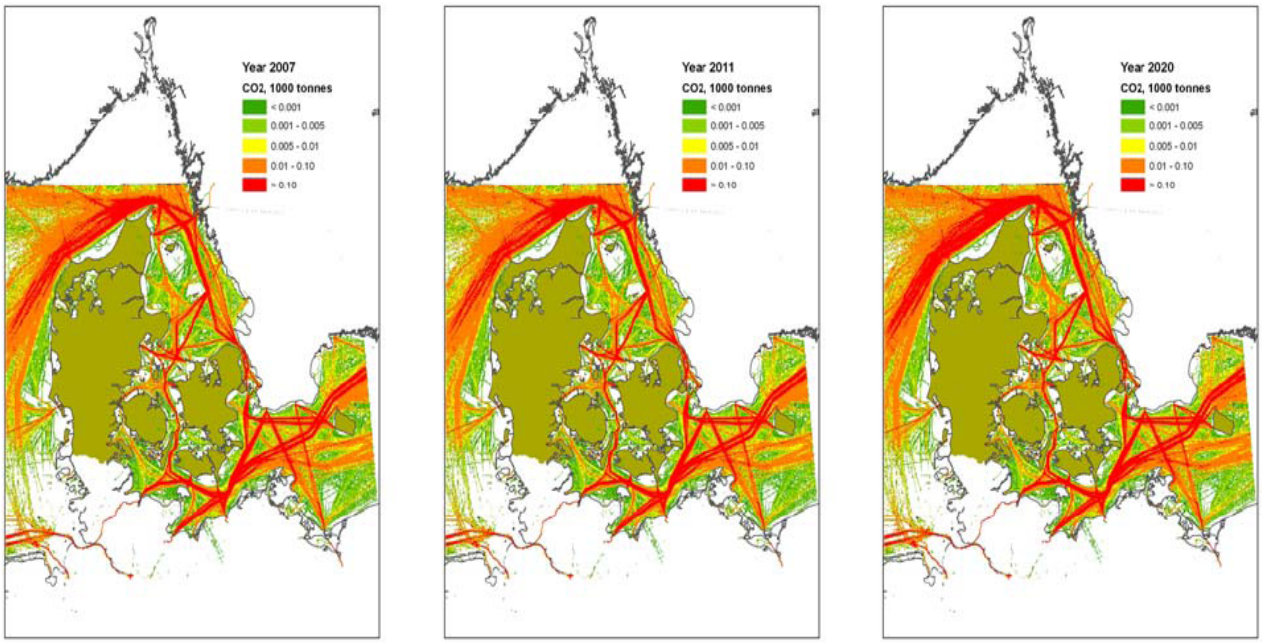
([115]) http://www.byggeriogenergi.dk/.

(f) the Danish Federation of Small and Medium-Sized Enterprises: Members' Course in energy efficient solutions;

(g) Business Centre Bornholm: Course in Energy and Sustainability.

3.2.6.2. Greening of existing occupations in the marine sector: Marine technician ([116])

90% of all goods in the world are transported by sea, and Denmark is home to the world's largest container freight company Maersk-Zealand of A.P Moeller Maersk. The amount of CO_2 emitted from Maersk ships alone was 48 million tons in 2008 (Maersk 2008). The shipping industry represented 4% of global CO_2 emission, mainly generated through the consumption of 12 million tons of bunker fuel (Maersk 2008).



The amount of CO_2 emitted by ships in and around Danish waters is illustrated below:

Apart from CO_2 emissions, shipping causes discharges of several other polluting substances including NO (Nitric Oxide) and SO2 (Sulphur dioxide). It is projected that these two substances are to be reduced drastically in the future due to the IMO-standards (International Maritime Organization). The amount of SO2 is set to be reduced by 91% while NO emissions are to be 'contained' in compliance with IMO-standards (Danish Ministry of the Environment 2009).

([116]) This case study is based on available documentation (see bibliography) and on interviews with representatives from MARTEC who are involved in the initiative.

Both on- and offshore industries are constantly looking for new ways to lower emissions and energy use. The shipping industry in Denmark has taken various initiatives aimed at reducing CO_2 – for example, Maersk CO_2-reduction initiatives in 2008 include:

(a) 8-10% fuel saving through a waste recovery system. This system has been fitted on 32 ships;

(b) the introduction of slower speeds on a large number of Maersk Line routes will reduce fuel consumption and CO_2 emission by up to 15%;

(c) installation of energy preserving technology (quest technology) in containers has reduced emissions by 260,000 tonnes per year;

(d) the Voyage Efficiency System (VES) used on all large ships to identify the most fuel efficient route (Maersk 2008).

The development of ever more energy efficient engines is important for the shipping industry's current and future efforts regarding minimising ships' emissions, and in the future the marine sector is likely to have a more intense focus on CO_2-friendly engines (Maskinmestrenes Forening 2009). Danish companies ([117]) hold a strong position when it comes to the development of green solutions for ships' engines.

One of the occupations affected by the efforts to reduce CO_2 is marine technicians. In the Nordic countries there are approximately 30,000 marine technicians. Marine technicians are responsible for running and maintaining larger technical installations at sea as well as on shore. This means that they are responsible for implementing and handling the machines and the technology introduced to reduce emissions. They also assist in the development of new measures to reduce emission levels from ships. The core competencies of marine technicians are maintenance and service of technical installations and structures, which includes aspects related to energy efficient and environment friendly technical solutions.

The unions of marine technicians in the Nordic countries 'Nordiska Maskinbefälsfederationen' are the leaders in the effort to develop the environmental role of the marine technicians.

Skills gaps/weaknesses

A marine technician plays a vital part in the development, operation, and maintenance of new technology offshore and onshore, and must continually gain new knowledge and acquire the necessary skills for operating and maintaining the technology and supporting other changes that occur in the sector. Skills response initiatives targeting this occupation have proven necessary to keep up with technological developments and new energy efficiency measures. This skills gap became evident to the significant stakeholders and industry players involved in the Danish initiative Green ship of the future. This initiative deals with the changes affecting

([117]) E.g. BWSC, Danish Marine Systems, Grundfos, Iron Pump, ISM Consult, Pon Power, Man Diesel.

and facing the marine sector (Green ship of the future 2009). The goal is to reach the following three targets:

(a) 30% reduction of CO_2;

(b) 90% reduction of CO_2;

(c) 90% reduction of NO.

Participants in the initiative are Maersk, Aalborg Industries, MAN Diesel, Odense steel shipyard, FORCE Technology, Danish Centre of Maritime Technology, and The Danish Maritime Authority (The Danish Maritime Authority 2008, The Danish Maritime Authority 2009). According to the initiative, planned changes in the sector are:

(a) engines with dual/multi certification to adapt engine pressure to an altered speed;

(b) waste heat recovery system;

(c) combustion gas circulation;

(d) optimisation of pump-and helping systems;

(e) optimisation of engine settings through automatic surveillance and information systems;

(f) scrubber-cleaning of combustion gas in existing ships;

(g) water-based methods to reduce NO emissions.

(The Danish Maritime Authority 2008)

The sector view was that the realisation of these initiatives would imply significant occupational changes of the marine technicians, and that existing educational programmes did not sufficiently provide the skills required for the tasks affected by these changes – this was the case both for the ordinary programmes and further education offers.

Identification of skills needs

Faced with the apparent skills gap in the area, a network of educational institutions (MARTEC and EUC North ([118])) and local companies in the Frederikshavn area (involved in a project called 'Energy City Frederikshavn') entered into strategic dialogue regarding skills needs and suggestions to ensure an adequate skills supply as well as ideas and guidelines for the educational response (Interview). MARTEC's cooperation with companies and organisations such as Aalborg Industries, Danfoss, and Arcon also provided input to the specific contents of the educational programme to be developed.

The identification of the skills needs was thus mainly supply-driven at the local level, but in cooperation with demand side representatives, notably companies representing the majority of

([118]) Which represent the main providers of programmes for the marine sector.

the local job market within the sector. The companies and institutions participated on a voluntary basis.

Existing provision of education/training for the occupation

Prior to the skills response initiatives taken by MARTEC (see below), there were no educational programmes or courses targeting or addressing in a more coherent manner the occupational and job profile changes emerging from the introduction of the green technological developments in the marine sector. No maritime programmes or courses had energy or environment as its main focus. Only a few smaller initiatives existed – for example the School of Marine and Technical Engineering in Aarhus offers a programme in environmental consultancy (Aarhus School of Marine and Technical Engineering 2009).

MARTEC is the first school to offer an educational programme focusing explicitly on issues relating to energy efficiency and the environment for the maritime sector.

The development of new skills responses was regarded as necessary to implement new environmental standards and initiatives.

The skills response

In response to changing requirements in the occupational field of marine technicians, the initiative was taken to establish a new educational programme in 'energy and environmental skills for marine technicians' at the vocational college MARTEC in Northern Jutland. At the same time a completely new school – EMS-MARTEC – was established at the premises of MARTEC, focusing specifically on energy and the environment in the maritime sector. This initiative was driven by MARTEC in cooperation with the college EUC North and various local and international companies. The school offers continuing training courses that provide trainees and working marine technicians with knowledge and skills necessary to conduct energy and environment related tasks.

The courses are structured in three broad categories:

(a) alternative energy and environmental impact;

(b) energy systems;

(c) energy optimisation.

The purpose of the first category is to familiarise students with the technical concepts behind alternative energy systems. It focuses specifically on windmills, biomass, geothermal energy, water pumping systems, wave energy, sun heating, fuel cells, thermal cells, biogas, ethanol, rape seed oil, and hydrogen and environmental certifications. The second component, energy systems, concentrates on energy consumption in general. It contains a technical focus on heating systems and energy efficient construction, calculation of energy spending, and energy regulations and standards. The third component focuses on energy optimisation. Competencies in this field are increasingly demanded by private companies in order to be

able to comply with regulations and cut down on energy spending. Students are taught about energy management, mapping, and measurement, and they learn about energy efficient components and equipment (Energi og miljøskolen).

Marine technicians are trained to become supervisors and mid-level managers, responsible for running and maintaining larger technical installations at sea as well as on shore. If properly trained they are therefore placed in positions where great potential exists to help ensure energy efficient and environment friendly technical solutions.

EMS-MARTEC receives public funding and support from private firms such as Aalborg Industries, and has a partnership with MAN Diesel (which designs, develops and produces engines for the maritime sector). MAN Diesel supports the EMS-MARTEC with vital information on the future industry developments. This partnership is supported by cooperation with The University of Aalborg. The University of Aalborg provides technical skills and a scientific approach. This should provide the marine technicians from MARTEC with the latest knowledge and information on new technological developments. This means that the school is able to implement forefront industry knowledge into its educational programme, thus making its students aware of the most up-to-date developments in the sector (Interview, Region Nordjylland 2009).

Assessment of the effectiveness and organisation of this response

It is too early to assess the effectiveness of the skills response as no students have yet to complete the programme. The first marine technicians specialised in energy and environmental issues are set to enter the market in the next 2-3 years. So far the educational courses regarding energy efficiency and environment have proved popular. This year, 25-30% of students at MARTEC have joined the energy and environment programme.

MARTEC has an ongoing dialogue with the companies and institutions mentioned earlier to secure placements and relevant study projects. This should also help the school ensure that the educational responses continually correspond to the needs in the labour market. In general, the school is cooperating with many companies and institutions possessing knowledge related to maritime affairs. To keep its position as a leading educational institution in the environmental area, MARTEC is working on establishing strategic relations with large companies. Thus, the primary concern in terms of the future of the school regards the lack of large corporate partners, such as Maersk mentioned earlier. It remains questionable whether local companies are in the frontline of environmental developments in the maritime sector as Maersk is.

4. Conclusions

The green agenda in Denmark is not new, being a policy priority for 30 years. In the 70's and 80's, however, developments regarding renewable energy and energy efficiency were mainly driven by regulations and an active use of fiscal policies to further a green behaviour among enterprises and consumers. Today, the green agenda is focused on an innovation and growth strategy as expressed in the Danish Government's R&D long term prioritised strategy 'Research 2015'. Private company innovation and business developments are significant drivers of this economic greening.

The strategic R&D and innovation focus has so far not been followed up by a new coherent skills action plan to link green education and training policies with job creation and strategic innovation investments. However, many skills initiatives have been developed over time within the long term focus on energy efficiency and the following changed skills requirements identified by the trade committees with their industry partners. There are also innovative regional examples of how inward business investments are combined with local training partnerships to ensure that the right mix of skills is available at the local level. The policy focus on energy efficiency and renewable energy has impacted the existing qualifications offered in all subsectors in the ordinary education system and in CVET. Several qualification profiles include a specific green component in the description of learning outcomes.

In Denmark, overall annual job losses have for several years totalled around 250,000 jobs, marginally lower than jobs created, both in periods of economic growth as well as downturns. In that sense, the current job losses that have resulted in major lay-offs particularly in manufacturing and process industries is not a new phenomenon. However, economists are concerned that once the crisis is over, Denmark could experience an almost jobless recovery due to the low productivity compared to the rest of the EU, and at the same time a workforce that has among the highest salary levels in the EU. Unionists are concerned that workers laid off now, particularly the low qualified, could end up in structural unemployment; the unions argue that the Danish government needs to be more proactive to ensure that Denmark's potential first mover advantage in alternative energy – particularly wind energy – is used in a systemic way to stimulate job creation through coordinated employment, skills upgrading, and innovation policies. The criticism was particularly fierce in the wake of the closure of the shipyard Lindøværftet in 2009, where the opposition and unionists estimated that the closure could cost up to 8000 jobs not only at the shipyard ([119]), but also in the range of sub-suppliers that depended upon the shipyard. Since then it has been decided that the shipyard will be turned into an innovation centre for renewable energy, but so far there are no indications that this innovation initiative will be accompanied by structural measures to ensure that the right skills are available to turn innovation advance into sustainable job creation. Recently, work council representatives from all the major industries in Denmark met to discuss how to

([119]) http://www.sf.dk/default.aspx?func=article.view&id=69488.

approach the government to stop the accelerated job destruction for particularly the low skilled during the current crisis.

An example of how innovation and job creation could go hand in hand comes from Grundfos, the Danish producer of pumps. Their recent contract with German railways – not to sell pumps but to carry out a total energy audit of all their activities with a view to energy optimisation – shows the disruptive and convergent character of business development potentials to exploit new markets for green energy.

Whereas Grundfos, from a sectoral perspective, is a manufacturing company, their business growth have in recent years occurred by exploiting their core competencies for new forms of service provision such as the contract for German railways. This would seem to show that a sectoral approach to skills anticipation is insufficient to capture innovation potentials and thus job growth potentials, which should be taken into account in European policies and studies on skills for new jobs. Development regarding cleantech is an example of technological convergence impacting a range of existing occupations, but also with potentials to create entirely new job opportunities not yet covered by formal qualifications, and with occupational profiles that span traditional sector demarcation lines.

4.1. Main 'greening' shifts in economies and labour markets

The overall restructuring tendency is that the greening of the economy will lead to further job destruction in process industries and manufacturing – which is also driven by other factors. The quantitative job potential is to be found in the energy sector and in cross-sectoral themes. The emerging of new occupational profiles in e.g. cleantech will most likely, and hopefully, lead to new jobs that could offset the job destruction elsewhere.

The Danish country study shows there are at present at least three forms of greening shifts observable.

One is concerned with greening of existing occupations. Rather than a shift per se, the greening of existing occupations represents a continuation of a long term development, driven by policy initiatives going back to the late 70s. In many instances the greening of occupations has already impacted the description of learning outcomes of existing qualifications, particularly VET, CVET and tertiary VET, and qualifications are continually being adjusted to match the greening requirements of occupations. In addition, there are examples of entirely new qualifications developed in response to the greening of existing occupations. The greening of existing occupations takes place within sectors, and the organisation of the education system is well in place to anticipate and respond to these changes.

A second concerns the creation of entirely new occupational profiles not yet covered by education supply in Denmark. This change is associated with technological convergence resulting in new business opportunities from cleantech.

The third shift has the character of disruptive innovation. The technological competency base is being used to create new business services that are globally relevant linked to auditing and development of energy efficiency measures within all functions and activities of a client company. The Danish company Grundfos is an example of such first mover activity.

4.2. Skills implications and development

4.2.1. Anticipation and identification of skill needs

Several approaches for the anticipation and identification of skills needs can be observed:

(a) one concerns an industry or sector approach;

(b) another concerns a functional approach with analysis of a family of occupations and how greening impacts particular job functions within that family of occupations;

(c) a third approach concerns technological convergence – in this case convergence resulting in cleantech solutions. The approach specifically avoids a sector approach but looks at how technological convergence impacts job functions whether they exist at present or are emerging, with a view to identifying which programmes should be adapted and to identify whether there are areas where new programmes could be needed;

(d) a value chain approach (as initiated by the Government) for the value chain of building and construction.

4.2.2. Response policies and programmes

There is no direct policy response to the impact of greening. This could partially be explained by the gradual restructuring of industry that has occurred since the late 70's, plus the fact that the annual job destruction and job creation is among the highest in the OECD at 250,000 annually. Furthermore, over time the local level has gained increasing autonomy to adapt programmes to local needs. Within VET and CVET the main mechanisms are the monitoring and analyses the trade committees undertake, informed by a range of statistic sources. Since the reform of 2007, a unit for anticipation of skills needs was created with funding from the government. Its main aim is to complement the work of the trade committees for IVET, particularly regarding developments that occur across industries and sectors.

4.2.3. Effective delivery mechanisms

Historically, the organisation of the education system has proven highly efficient to respond to structural and restructuring changes in the labour market. In particular, the labour market programmes (adult continuing training programmes for unskilled and skilled workers) have played a major structural and restructuring role due to the tripartite governance mechanisms,

the short duration and the adaptive character of the programmes, which reduce the time from a person's training to the undertaking of new job functions in the labour market.

The organisation of the education system is also well placed to anticipate and respond to the greening of existing occupations within sectors. It can be questioned, however, whether the organisation of the educational system is geared to respond efficiently to these changes. It is highly uncertain whether the existing supply and CVET measures are sufficient to fully harvest the potentials from for example cleantech and disruptive changes in business models which do not follow the traditional sector logic.

Several systemic features of the educational system help ensure that existing delivery mechanisms are well placed to respond to change:

(a) the tripartite governance structures in VET and the high level of decentralised involvement in monitoring and responding to change in general;

(b) the ordinary education system and the further education and training system can be characterised as parallel systems described through learning outcomes;

(c) certifications offered in the CVET system count towards credit in the ordinary system, and the adult apprentice system was recently made a permanent feature of the further education and training system. The Act on Recognition of Informal and Non-formal Learning was approved for the further education and training system in 2007, particularly with a view to making visible the competencies of the low qualified.

5. Recommendations

5.1. Policy recommendations

Within the open method of coordination initiatives should be taken to ensure coherence between R&D and innovation policies and investments in green education and training, to ensure an optimal framework for sustainable job creation.

Methods for early anticipation of skills are aimed to induce responsiveness into the education and training systems, taking into account the time lapse from identifying new skills sets to a new graduate with the appropriate skills first entering the labour market. Sectoral approaches to skills anticipation may however show only parts of the picture, because they do not fully capture the industry dynamics which may be driven by technological convergence or repositioning of value chains (Shapiro, 2006, Zysman 2008). The example of Grundfos and the cleantech study illustrate the limitations of a sectoral approach if the analysis is to be used to identify changing skills demands. There is therefore a need for cooperation at a European level to further analyse which type of methods are best suited to capture skills changes that occur as a result of convergence, disruptive changes in business models, or repositioning of value chains.

5.2. Recommendations for education and training

None.

5.3. Recommendations for further research and data collection

Further research should be initiated to understand how technological convergence and disruptive business innovation (sector convergence) or repositioning of value chains can be identified and analysed with a view to identifying emerging skills needs that cannot be clustered according to sector and occupational qualifications.

Such measures would need to be coordinated with the innovation unit from DG Enterprise and DG Employment to ensure coherence in approaches. Furthermore, such measures should be tested with a view to consolidating different methods for skills anticipation to increase the value of such activities.

Acronyms and definitions

3F	Union for Unskilled Workers
AMU	Vocational Labour Market Training System
cleantech	Clean Technologies
CVET	Continuous Vocational Education and Training
Dansk Metal	Danish Metalworkers' Union
DG	Directorate General
DI	Danish Industries
DKK	Danish Krone
DTU	Technical University of Denmark
ECTS	European Credit Transfer System
EMU	Danish Educational Portal
EU	European Union
EUR	Euro
GHG	Greenhouse Gas
GVU	Individual Retraining Plan
IDA	Danish Society of Engineers
IMO	International Maritime Organisation
IVET	Initial Vocational Education and Training
IWAL	International Wind Power Academy Lolland
LO	Danish Confederation of Trade unions
LORC	Lindoe Offshore Renewable Centre
OCD	Offshore Centre Denmark
OECD	Organisation for Economic Cooperation and Development

R&D	Research and Development
RD&D	Research, Development and Demonstration
REU	National Committee for VET
TVET	Technical Vocational Education and Training
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VET	Vocational Education and Training

Public authorities, organisations and others

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Interviews:

Interviews with various contacts in Government Departments in The Ministry of Climate and Energy, The Danish Enterprise and Construction Authority and The Ministry of Education.

Interview with representatives from Organisations (metalworkers' Union, Confederation of Danish Industries)

Case studies:

New green occupation (1): Manager in renewable energy

Interviews:

This case study is based on interviews with people involved in the identification of the skills need and in the development of the skills response who also provided relevant written information (report concerning the identification of the skill need and the proposal for a new educational programme as project manager of renewable energy).

New green occupation (2): Wind turbine operator

Interviews:

This case study is based on the documentation listed below as well as an interview with a Chief Consultant from the Industry's Trade Committee, who was involved in the identification of the skills gap and the development of the programme.

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Greening of existing occupations (1): Occupations in construction

Interviews:

This case is based on interviews with ministerial representatives and people represented in the working committee and relevant unofficial material provided by the authority in charge – The Danish Enterprise and Construction Authority

Documents:

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Greening of existing occupations (2): Marine technician

Interviews:

This case study is based on interviews with two representatives from MARTEC who are involved in the initiative as well as the articles and documentation below:

Documents:

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Green structural change (1): Shipbuilding industry

Interviews:

This case study is based on interviews with people involved in the identification of the skills need and in the development of the skills response from the Municipality of Odense and the Region of Southern Denmark. An interview with a representative from the Lindoe Offshore Renewable Center was conducted as well. All of them provided relevant and yet unpublished written information.In addition, the documents below:

Documents:

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Oxford Research and LORC (2009): *Feasibility Study* – LORC.

Green structural change (2) Machinery sector

Interviews:

This case study is based on an interview with the person involved in the identification of the skills need and in the development of the skills response from the Municipality of Frederikshavn. The person provided relevant and yet unpublished written information.

Documents:

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