Investing in the Future of Jobs and Skills

Scenarios, implications and options in anticipation of future skills and knowledge needs

Sector Report
Electricity, Gas, Water and Waste

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Preface

This report presents the final results of the *study Comprehensive analysis of emerging competences and economic activities in the European Union in the electricity, gas, water and waste sector*. The report is part of a series of sixteen future-oriented sector studies on innovation, skills and jobs under the same heading, commissioned by the European Commission (DG Employment, Social Affairs and Equal Opportunities). Eleven of these studies were executed by a core consortium led by TNO (Netherlands Organization for Applied Scientific Research) and consisting of TNO Innovation Policy group (Leiden, the Netherlands), TNO Labour (Hoofddorp, the Netherlands), TNO Innovation and Environment (Delft, the Netherlands, SEOR Erasmus University (Rotterdam, the Netherlands) and ZSI (Centre for Social Innovation, Vienna, Austria). The core consortium was in charge of the overall management of the study, the further elaboration and application of the overall approach and methodology, as well as data collection and analysis (see annex 1 for team composition).

The study was carried out during the period January 2008-April 2009. Stakeholders in the sector, including the European sectoral partners and representatives of various other organisations, have been involved in various ways and forms throughout the study. This included a sectoral kick-off meeting at the start of the study and three multisectoral stakeholder meetings in Brussels during which intermediate results of the studies were presented and discussed. Valuable workshop discussions in the frame of the project were held and inputs received from a number of experts. Apart from multiple inspiring consortium ('internal') workshops, two main 'external' workshops were held.

A draft final version of this report was validated and complemented during a second external, final workshop in Brussels on 23 and 24 October 2008. The final workshop brought together an apt mixture of different European and national sector experts representing the industry, European social partners, other various representative organizations, academia as well as the European Commission (see Annex 2 for a full list of participants). The workshop, which formed an explicit and integral part of the methodological approach, yielded a number of helpful comments and insights which have been used in further finalising the study. We express our sincere gratitude to all workshop participants and to all those that contributed to this study.

Although the content of this paper remains the responsibility of the authors, valuable discussions were held and inputs received from a number of experts. We would like to thank them and in particular the participants of the workshop held in October 2008 in Brussels who discussed an earlier version of this report. We thank especially Erik Macak, Bob Windmill, Nicolas Rega, Frank Baumeister, Roberto Pedersini, Michael Beck, Steve Davies, Antonino Gregorio, Angel Carbonero, Rafael Montero, Kevin Gatt, Leonardo Ciampi and Marco De Giuli for their and useful supportive comments in revising this paper.

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Delft, 1 May 2009

Dr Frans A. van der Zee (overall project leader)

1 General introduction

This report presents the final results of the study Comprehensive sectoral analysis of emerging competences and economic activities in the European Union focusing on the electricity, gas, water and waste sector. The report is part of a series of sixteen future-oriented sector studies on innovation, skills and jobs under the same heading, commissioned by the European Commission (DG Employment, Social Affairs and Equal Opportunities). The study was executed by a consortium led by TNO (Netherlands Organization for Applied Scientific Research) and consisting of TNO, SEOR – a consultancy of Erasmus University (Rotterdam, the Netherlands) and ZSI (Centre for Social Innovation, Vienna, Austria). The study was carried out during the period January 2008-April 2009.
While the main focus of the study is on the future of skills and jobs by 2020, the study is both backward- and forward-looking in nature. It analyses recent relevant sector developments and trends and, at the same time, depicts the current state of play in the sector with an emphasis on innovation, skills and jobs. Current trends and developments form the stepping stone and fundament for the second and third future-oriented part of the study which is scenario-based, forward-looking and exploratory in nature.

Background and context
The study should be placed against the background of the EU's renewed Lisbon strategy in which securing and improving EU competitiveness and redeploying the European economy to new activities with more value-added and new and better jobs are key. In the process of change and restructuring to adapt to new realities, there is a need for a more strategic management of human resources, encouraging a more dynamic and future-oriented interaction between labour supply and demand. Without there is the risk that bigger shortages, gaps and mismatches of skills will result not only in structural unemployment but also hamper longer-term competitiveness. Skills and jobs are of vital importance for the future of the European economy and have recently gained increasing attention, both at national and EU level. As stressed by the European Council in March 2008, investing in people and modernising labour markets is one of the four priority areas of the Lisbon Strategy for Growth and Jobs. The New Skills for New Jobs initiative launched in December 2008 (European Commission, 2008a) elaborates on how this could best be done. The initiative aims to enhance human capital and promote employability by upgrading skills, as well as to ensure a better match between the supply of skills and labour market demand. More transparent information on labour market trends and skills requirements, but also the removal of obstacles to the free movement of workers in the EU, including administrative barriers would help achieve this goal, and improve occupational, sector and geographical mobility. The initiative also stresses the need to improve the Union's capacity for skills assessment (by improved monitoring and forecasting), anticipation (by better orientating skills development) and matching with existing vacancies. The current financial and economic crisis makes these challenges even more pressing. Further strengthening the economic resilience and flexibility of the European economy and its Member States calls, along with other measures, for support of employment and further facilitation of labour market transitions (European Commission, 2008a:10).

Approach and methodology

The study takes a longer term future perspective, and looks ahead to 2020, but also back, and takes a highly aggregated European perspective. While it is fully acknowledged that more detailed Member State and regional analyses are important and vitally important for anticipating future skills and knowledge needs, the European perspective has been central in this analysis. Key to the study and a common point of departure was the use of a pre-defined methodological framework on innovation, skills and jobs (Rodrigues, 2007). During the course of this study this framework has been further developed, operationalised and applied to the sector. The approach combined desk research and expert knowledge available in a broad and dedicated research team with the knowledge and expertise of 'external' sector experts. The purpose of this common uniform methodology is to deliver results that enable comparisons across and between sectors and hence enable the preparation of possible future actions to investigate the topic of new future jobs and skills for Europe, by encouraging a more effective interaction between innovation, skills development and jobs creation. The methodology is structured along various steps, each step providing inputs and insights for next steps to come. Overall, the methodology covers the following steps:

Step 1. Identification of economic activities to be considered (i.e. sector selection)
Step 2. Main economic and employment trends and structures by sector
Step 3. Main drivers of change
Step 4. Main scenarios
Step 5. Main implications for employment – changes by job function
Step 6. Main implications for skills – emerging needs by job function
Step 7. Main strategic choices to meet future skills and knowledge needs
Step 8. Main implications for education and training
Step 9. Main recommendations
Step 10. Final workshop.

Further and next steps

The results of this study – along with 15 other sector studies using the same approach and being released at the same time - will serve as a guide in launching further EU-led but also other actions, by industry, sectoral partners, education and training institutes and others. One important aim of the study is to promote the strategic management of human resources and to foster stronger synergies between innovation, skills and jobs in the sector in the medium and longer run, taking into account the global context and encouraging adaptations to national and regional specificities. A very important element in further enabling and facilitating these goals is sound and continuous monitoring together with a uniform and consistent way of analysing future skills and knowledge needs for the various decision-making levels involved. The approach taken in this study aims to provide a broader framework that does exactly this. Further dissemination and explanation of the methodology at the Member State, regional and local level are therefore vital in the follow-up of this EU level study, as is its actual take-up. The results of the study include implications, conclusions and recommendations to anticipate future skills and knowledge needs. It does not in any way, however, assess or evaluate current or planned policies. Conclusions and recommendations may therefore coincide but may also oppose current policies and/or policy plans at the EU, national or regional level. The implications, conclusions and recommendations logically follow from scenarios – credible plausible sector futures – meant to better structure and anticipate possible future developments.

Looking ahead in times of crisis

Even though the year 2020 may currently seem far off for most of us, the future will announce itself earlier than we think. In times of financial and economic crisis there is a logical tendency to focus on the now and tomorrow; withstanding and surviving the crisis are prime. Nevertheless, at the same time the medium and longer term ask for adequate attention. In this current age of continuing and pervasive globalisation, strong technological change and innovation affecting production and consumption around the globe, timely preparations to be able meet future skills and job needs are called for more than ever before. This is even more true in the face of an ageing European society and ditto workforce.

Contents in three parts

The report consists of three main parts. Part I analyses recent relevant sector developments and trends and depicts the current state of play in the sector, with an emphasis on innovation, skills and jobs. The findings of Part I of the report combine original data analysis using Eurostat structural business statistics and labour force survey data with results from an extensive literature review of relevant already existing studies. While giving a clear and concise overview of the most important trends and developments, the prime function of Part I is to provide the fundaments and building blocks for Part II of the study. The findings of Part I are based on the present and the recent past. The second part of the report is future-oriented and looks at sectoral developments and more specifically developments in skills and jobs in and towards 2020. The core of part II consists of plausible future scenarios and their implications for jobs, skills and knowledge. These implications have been analysed for various job functions. In a final part III, a range of main strategic options (‘choices’) to meet the future skills and knowledge needs is reviewed, including implications for education and training. The study concludes with a number of recommendations for the sector (individual firms, sector organizations, sectoral partners), education and training institutes and intermediary organisations, and last but not least, policy-makers at various levels, ranging from the EU to the local level.

Part I

Trends, Developments and State-of-Play

Part I. Trends, Developments and State-of-Play

Guide to the reader

Part I presents the results of steps 1, 2 and 3 of the common methodology applied to the electricity, gas, water and waste sectors. Step 1 delineates and defines the sector. Step 2 presents the main economic and employment trends and developments in the sector (mapping) and the results of a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis. Step 3 analyses the main drivers of change of relevance for the sector based on a meta-driver approach and expert opinion. Part I of the report consists of 8 chapters. Chapter 2 identifies and statistically defines the sector. Chapter 3 provides an overview of the structural characteristics of the sector, including developments and trends in employment, production and value added. It contains information on work organisation (part-time/full-time, gender, age), and industrial relations, but also on emergent trends by function. It also addresses existing partnerships for innovation, skills and jobs, one of the possible policy instruments to better prepare for and adapt to the future, facilitate mutual learning and boost innovative capacity both at the sector and firm level. While not part of the methodology as such, partnerships form an interesting example of how the development of skills and jobs can be linked to innovation. Chapter 4 discusses the value chain (network) and its evolution over time, including issues of restructuring and relocation. Chapter 5 focuses on innovation, R&D and technological change, while chapter 6 analyses the impact of globalisation and trade on and for the sector. Chapter 7 highlights the importance of regulation especially in relation to employment. Chapter 8 provides the results of a SWOT analysis of the sector. Chapter 9 concludes with an overview of the most important drivers for the sector.

2 Defining the sector

In this report the past and current trends are analysed for the sector electricity (generation, transmission and distribution), gas (production, distribution and trade), waste (collection, treatment, disposal, recycling) and water (collection, treatment, supply, sewerage) based on NACE 1.1 code 40, 41 and 90. Although the specific characteristics of these subsectors would necessitate detailed analysis to reckon with all relevant ins and outs, the goal of this report is to characterise trends at a higher level. This is possible as only trends are discussed that possibly influence employment and skills. When the term 'the sectors' is used in this chapter, we refer to electricity, gas, waste and water together. Where applicable we mention the subsectors explicitly. Finally, we should note that more quantitative information is available for water, gas and electricity, compared with waste. The reason is that the data sources have more information for the former sectors. In the NACE 1.1 system electricity, gas and water are coded as 40 and 41. Waste, however, is coded as 90 (environmental services). In, principle, this NACE code 90 should be taken out and shifted to NACE 40 and 41 to have a complete sector. Unfortunately, this is not entirely possible. Due to differences in data availability, there is more information on sector 40 and 41 from the Structural Business Statistics from Eurostat. This source provides data for industry, trade and services and data on employment form of work organisation, firm size and detailed data on employment (NACE 3 digit). The Structural Business Statistics does not provide data for agriculture and non-commercial service (NACE 80 and up). Only for value added, trade and occupations comparable data for waste is available. Summation, furthermore, is not always possible. The original data on occupations are weighted with employment for electricity, gas and water to make country groupings possible, but with value added for waste, the next best after employment, since employment data were lacking.

3 Structural characteristics of the sector: past and present[1]

3.1 Employment, production and value-added trends in the EU

Due to the structure of the data sources, electricity and water on the one hand and waste on the other have to be considered separately.

Employment

The availability of detailed employment figures for the waste sector is limited. However, the waste sector has experienced high growth rates over the last decade which were especially policy driven. In general it is useful to distinguish between the two main sub-sectors: specialized waste management (collection, incineration, landfill, composting, etc.) which employs about 50000 people in the EU and experiences annual growth rates of around 11% and the waste recycling sector (for paper, glass, metals, etc.) with 500 000 to 1 000 000 in the EU-25 (European Commission, 2004b)

[1] As production and consumption takes place locally, developments outside the European Union are not always very important. Therefore, we concentrate on the EU-developments and do not present extensive figures for BRIC-countries, Japan and the United States.

More detailed employment figures are available for the utilities sector. It should be noted, however, that increases in contracting out probably influences these figures. Especially in subsectors that feel the influence of efficiency regulation (privatisation, competition, incentive regulation) a trend is visible to larger shares of contracted out workers. No data are available to include these workers.

In electricity, gas and water 1.7 million people are working (Table 3.1). Compared with other sectors, a large share of them works in the new Member States. However, this share is decreasing over time. Employment is decreasing in general with 0.9% in the EU. The decrease is larger in the new Member States. Losing momentum countries represent about 50% of EU employment and are dominated by new Member States. Growth is visible in three of these states and the only EU 15 winning country is France.

Table 3.1 Employment electricity, gas and water, 2000-2006

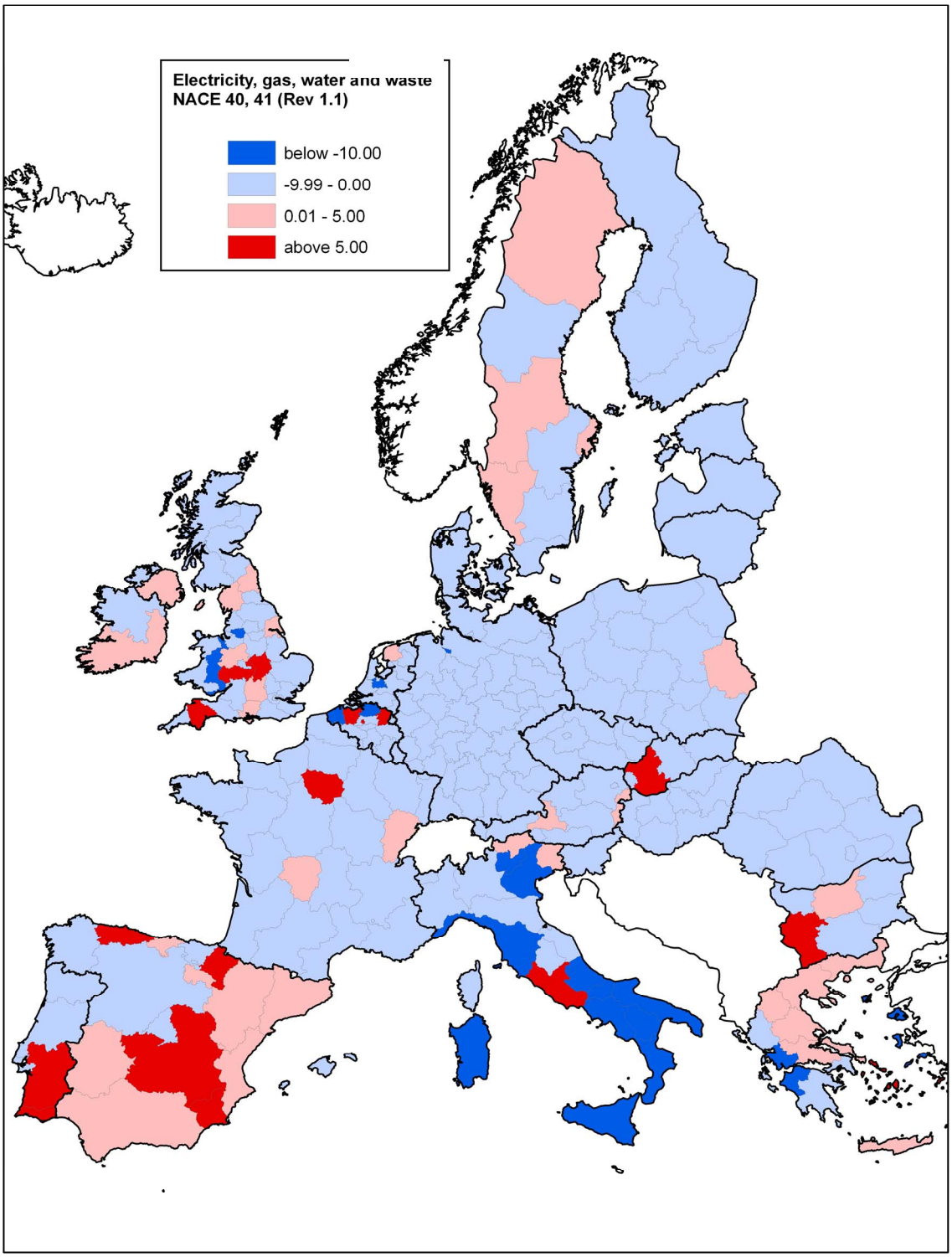
	Level 2006	Annual growth	Share in EU	Change in share
EU	1699	-0.9	100	0
EU 15	1000	-0.6	59	5
NMS	698	-1.3	41	-5
Winning	360	1.4	21	3
Losing momentum	836	-1.6	49	-2
Upcoming	130	2.0	8	1
Retreating	373	-2.2	22	-2
Definition	Level (*1000)	Average annual growth (%)	Share in EU employment sector (%)	Change in share in EU employment sector (%)
	2006	2000-2006	2006	2000-2006

	Concentration[2] >100	Concentration <100
Growth	**Winning:** France, Czech Republic, Estonia, Slovakia	**Upcoming:** Denmark, Ireland, Spain, Sweden
Decline	**Losing momentum:** Germany, Bulgaria, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia	**Retreating:** Belgium, Italy, Luxembourg, Netherlands, Austria, Portugal, Finland, United Kingdom

Source: Eurostat/TNO

[2] See further Box 2.

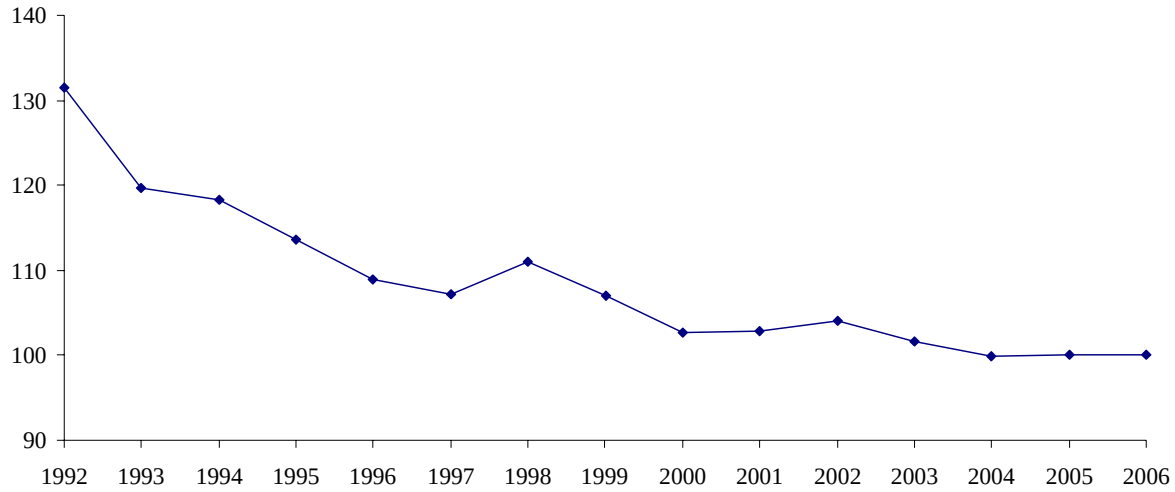
Figure 3.1 Changes in employment in electricity, gas and water by NUTS 2 region, 2000-2006 (in annual percentage change)



Source: TNO based on Eurostat

Figure 3.2 shows the average change in employment on a longer time scale. In this figure we take the unweighted average of employment with 2006 set at 100. Although this figure should be interpreted with care as the available observations increase over time (in 1992 we have data for five countries and in 2006 for 18), it shows that employment decreases over a much longer time horizon. The larges decreases took already place in the nineties.

Figure 3.2 Average change in employment EU, electricity, gas and water (2006=100)



Source: OECD

Box 1. Concentration index: what it is and what it measures

The concentration index assesses the relative contribution of a specific sector to the national economy compared to a greater entity, such as the EU, thereby correcting for the size of the country. In more general terms, the concentration index is a measure of comparative advantage, with changes over time revealing changes in the production structure of a country. An increase of the concentration index for a sector signifies relatively fast growth of that particular sector in the country concerned compared to the same sector in the EU.

How does the concentration index work in practice? We'll give a few examples: if sector x represents a 5% share of the German economy and a 5% share of the EU economy, the concentration index of sector x equals a 100. If sector x represents 5% of the German economy, but 10% of the EU economy, the concentration index of sector x is 50. If the same sector x represents 10% of the German economy and 5% of the EU economy, the concentration index of sector x is 200.

The concentration index concept can be applied using different indicators (variables). In our study we measure the concentration index using employment, value added and trade, in order to make a distinction between the relative performance of countries EU-wide. We distinguish between four country groupings, each signifying a different sector performance over time. If a sector in a country has a strong position (hence showing a concentration index higher than 100) and has experienced a clear index growth over the last years, the sector is defined as *winning* in that country. If the sector has a strong position, but experienced a decline of the concentration index, we say the sector is *losing momentum*. If the sector has a weak position, but gained in the past, we say that the sector in that country is *upcoming*. If the sector has a weak position and experienced a decline of the index, we say that the sector is *retreating*.

The EU employs about 1.3 million electricity and gas workers (Table 3.2). The new Member States show a remarkable large share compared with other sectors. This share, however, has decreased during the last seven years with 6%. In general, employment decreased in electricity and gas with -1.4% annually between 2000 and 2006. This decline was somewhat steeper in the new Member States (-1.8% annually) than in the EU 15 (-1.1% annually).

The sector electricity and gas is dominated by losing momentum countries as they have a share of 65% in the EU. This share has been stable during the last seven years. Losing momentum countries are Austria, France and Germany and seven new Member States. The majority of the old Member States shows a decline in employment as also seven countries of the EU 15 are retreating. The decline in employment is not less than 4.7% per year. Only four countries are winning, with a rise in employment of 3.2% per year. These countries are dominated by three new Member States. However, also Denmark, Ireland and the United Kingdom show (marginal) positive growth rates.

Given these developments, it is not surprising that employment as a vertical share of total employment is decreasing also (Table 3.4). Although the share is still much higher in the new Member States (1.20%) versus 0.45% in the EU 15, the decrease is twice as high between 2000 and 2006. Figure 3.3 gives an overview of the employment shares of electricity, gas and water in the European regions.

Table 3.2 Employment electricity and gas, 2000-2006

	Level 2006	Annual growth	Share in EU	Change in share
EU	1297	-1.4	100	0
EU 15	799	-1.1	62	6
NMS	499	-1.8	38	-6
Winning	137	3.2	11	3
Losing momentum	838	-1.5	65	0
Upcoming	132	0.6	10	1
Retreating	189	-4.7	15	-3
Definition	Level (*1000)	Average annual growth (%)	Share in EU employment sector (%)	Change in share in EU employment sector (%)
	2006	2000-2006	2006	2000-2006

	Concentration >100	Concentration <100
Growth	**Winning:**	**Upcoming:**
	Sweden, Czech Republic, Estonia, Slovakia	Denmark, Ireland, United Kingdom
Decline	**Losing momentum:**	**Retreating:**
	Germany, France, Austria, Bulgaria, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia	Belgium, Italy, Luxembourg, Netherlands, Spain, Portugal, Finland

Source: Eurostat/TNO

The production and distribution of water is much smaller than electricity and gas (Table 3.3). In the EU they engage a little more than 400 thousand jobs. Growth in the EU 15 is much higher than in the new Member States. Although the share of these countries decreases, it is still major with 50% in 2006 of total EU employment. Furthermore, differences between new

Member States are huge as even six countries are winning, while four are declining. Upcoming and retreating countries, however, are completely dominated by the EU 15.

In the Netherlands, for instance, 19,600 people worked in electricity and gas, while 24,800 people worked in waste collection, treatment and recycling (CBS, 2008). In the UK 141,000 people worked in the waste sector in 2005, compared with 100,000 in electricity and gas in 2003 (Skills for Business 2004a and 2006). Although these sources cannot be compared directly, in both cases more people work in waste.

Table 3.3 Employment water, 2000-2006

	Level 2006	Annual growth	Share in EU	Change in share
EU	402	0.9	100	0
EU 15	202	1.5	50	6
NMS	200	0.2	50	-6
Winning	126	1.8	31	-2
Losing momentum	87	-3.1	22	-4
Upcoming	113	5.2	28	8
Retreating	76	-2.2	19	-2
Definition	Level (*1000) 2006	Average annual growth (%) 2000-2006	Share in EU employment sector (%) 2006	Change in share in EU employment sector (%) 2000-2006

	Concentration >100	Concentration <100
Growth	**Winning:**	**Upcoming:**
	Portugal, Czech Republic, Estonia, Latvia, Lithuania, Poland, Slovakia	Belgium, France, Italy, Denmark, Spain, Austria, Finland, Sweden
Decline	**Losing momentum:**	**Retreating:**
	Bulgaria, Hungary, Romania, Slovenia	Germany, Luxembourg, Netherlands, United Kingdom

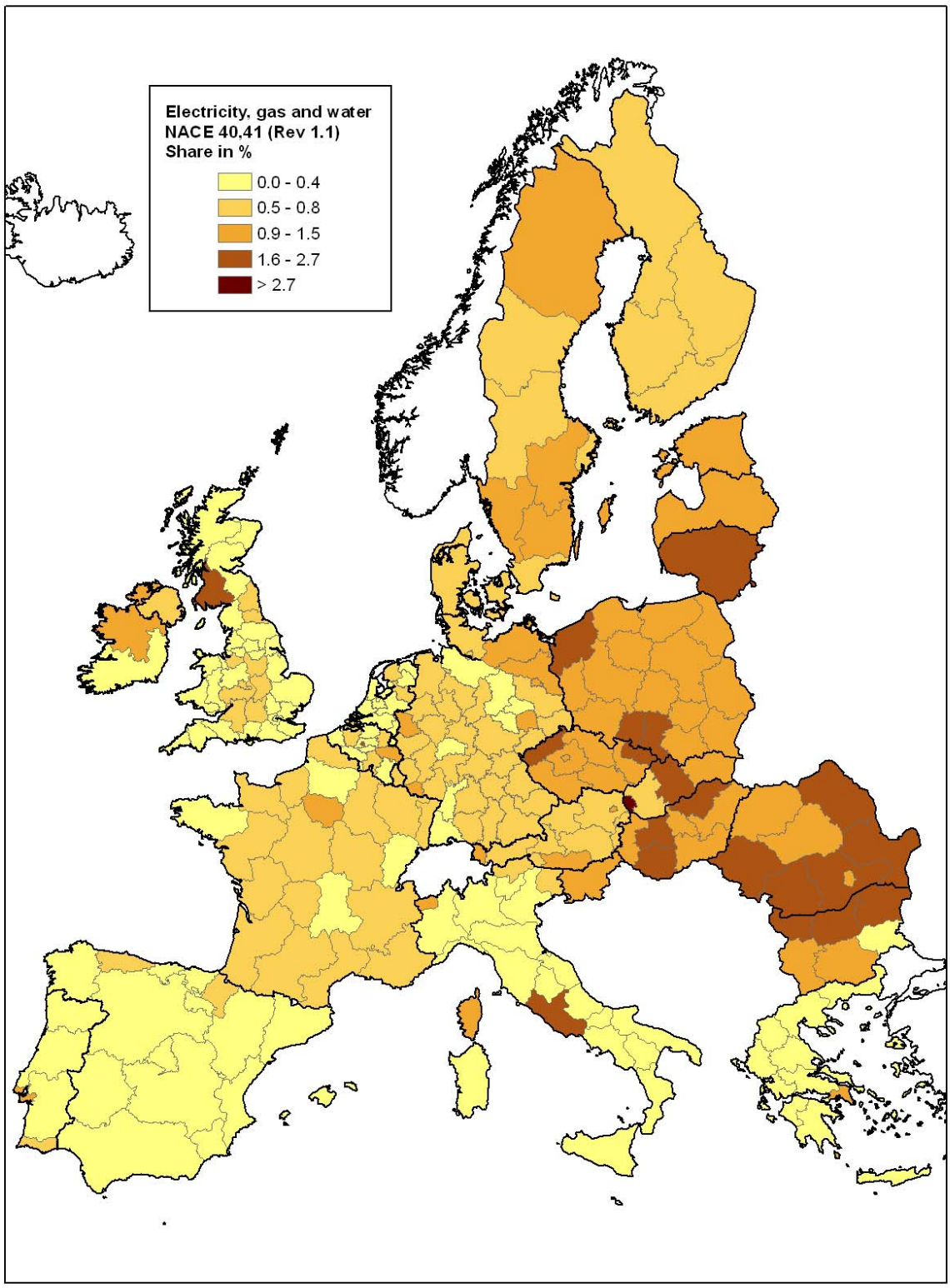
Source: Eurostat/TNO

Table 3.4 Employment electricity, gas and water in vertical shares, 2000-2006

	Share 2006	Change
EU	0.77	-0.08
EU 15	0.56	-0.06
NMS	1.68	-0.13
Definition	Share sector in total employment 2006	Total change in share 2000-2006

Source: Eurostat/TNO

Figure 3.3 Vertical shares: employment in electricity, gas and water as share of total employment by NUTS 2 region, 2006



Source: TNO based on Eurostat

Value added

Electricity and gas are the dominating sector in terms of value added. It totals 177 billion euro, nearly three times as much as waste and six times as much as water (Tables 3.5, 3.6 and 3.7). The growth in value added, however, is much higher for waste and water as value added of electricity and gas shows only a growth of 0.3% per year, while this is 2.0% for water and 2.4% for waste. For all sectors growth is much higher in the new Member States, with markets being much more saturated in the EU 15.

In all three sectors value added is dominated by the EU 15. Comparing this with employment shares shows that value added per worker is much higher in these countries. Differences between sectors are very large with respect to country groupings. The only clear similarity is that for electricity, gas and water only some EU 15 countries are in the categories upcoming and retreating. However, other EU 15 countries are also in the categories winning and losing momentum.

Table 3.5 Value added electricity and gas, 1995-2006

	Value added		Share in country		Share in EU	
	Level	Change	Level	Change	Level	Change
EU	177	0.3	1.7	-0.2	100	0
EU 15	158	0.1	1.6	-0.2	90	-1
NMS	19	1.7	3.6	-0.3	10	1
Winning	112	1.7	2.0	0.1	63	8
Losing momentum	26	-1.1	2.3	-0.8	14	-2
Upcoming	3	3.4	1.4	0.1	2	0
Retreating	35	-2.4	1.2	-0.6	21	-6
Definition	Value added Billion euro 2006	Annual average growth 1995-2000	Share in national GDP 2006	Total change in share 1995-2006	Share in value added sector EU 2006	Total change in share 1995-2006

	Concentration >100	Concentration <100
Growth	**Winning:**	**Upcoming:**
	France, Germany, Italy, Portugal, Lithuania, Poland, Slovenia	Greece
Decline	**Losing momentum:**	**Retreating:**
	Belgium, Denmark, Finland, Sweden, Czech Republic, Estonia, Hungary, Slovakia	Netherlands, Ireland, Spain, United Kingdom

Source: Eurostat/TNO

As the EU share of winning and upcoming countries increases in all three sectors the main trend is a growing majority of countries with positive growth rates. Value added is growing fast for winning and upcoming countries, both for water and waste. Growth figures exceed 4% in these countries. Except for waste, however, other countries show significant decreases in value added.

Table 3.6 Value added water, 1995-2006

	Value added		Share in country		Share in EU	
	Level	Change	Level	Change	Level	Change
EU	28	2.0	0.3	0.0	100	0
EU 15	24	1.6	0.3	0.0	88	-2
NMS	4	5.2	0.6	0.1	12	2
Winning	13	5.8	0.4	0.1	43	12
Losing momentum	7	-1.9	0.3	-0.1	25	-9
Upcoming	4	4.2	0.2	0.0	13	2
Retreating	5	-0.6	0.2	-0.1	19	-5
Definition	Value added Billion euro 2006	Annual average growth 1995-2000	Share in national GDP 2006	Total change in share 1995-2006	Share in value added sector EU 2006	Total change in share 1995-2006

	Concentration >100	Concentration <100
Growth	**Winning:**	**Upcoming:**
	Germany, Portugal, Spain, Czech Republic, Poland	Belgium, Italy, Austria
Decline	**Losing momentum:**	**Retreating:**
	Sweden, United Kingdom, Estonia, Hungary, Lithuania, Slovenia, Slovakia	France, Netherlands, Denmark, Finland, Greece, Ireland

Source: Eurostat/TNO

Table 3.7 Value added waste, 1995-2006

	Value added		Share in country		Share in EU	
	Level	Change	Level	Change	Level	Change
EU	65	2.4	0.6	0.0	100	0
EU 15	61	2.2	0.6	0.0	94	-2
NMS	4	5.9	0.7	0.2	6	2
Winning	6	5.7	0.7	0.2	9	2
Losing momentum	31	0.6	0.7	-0.1	48	-9
Upcoming	26	4.7	0.5	0.1	39	7
Retreating	2	-0.2	0.5	-0.2	4	-1
Definition	Value added Billion euro 2006	Annual average growth 1995-2000	Share in national GDP 2006	Total change in share 1995-2006	Share in value added sector EU 2006	Total change in share 1995-2006

	Concentration >100	Concentration <100
Growth	**Winning:**	**Upcoming:**
	Netherlands, Poland, Slovakia	Belgium, France, Italy, Greece, Ireland, Portugal, Spain, Sweden, Slovenia
Decline	**Losing momentum:**	**Retreating:**
	Germany, Austria, United Kingdom, Czech Republic	Denmark, Finland, Estonia, Hungary, Lithuania

Source: Eurostat/TNO

Trade balance

Export for the EU 15 countries is much higher than for the new Member States (Table 3.8). However, as a share of value added the differences are much smaller. Especially in the EU 15 exports have been growing at remarkably high rates of over 15% annually. Even in the EU 15, however, exports are only 11% of total value added. Still, export and shares develop positively in all country groupings.

The EU 15 represents by far the largest share of EU imports (Table 3.9). As well, growth in imports has been much higher in the EU 15 than in the new Member States. Growth is lower, however, than for exports. The new Member States did not perform poorly with 4% average growth per year, however the EU 15 showed over 12% growth.

The EU has on aggregate a small negative trade balance; imports exceed exports (Table 3.10). This observation is true for the EU 15, but not for the new Member States. For both groups the trade balance improved between 1995 and 2006. Behind the fairly modest aggregate figures considerable differences per Member States are revealed. For example the winning countries saw their aggregate trade balances improve by almost 3 billion euro, whereas the retreating countries faced a decline of nearly 2.5 billion euro.

Table 3.8 Exports electricity, gas and water, 1995-2006

	Level	Change	Share	Change
EU	24900	16.1	12	8
EU 15	22548	16.7	12	8
NMS	2352	11.8	10	5
Winning	16894	30.4	30	22
Losing momentum	5196	4.9	10	1
Upcoming	1254	19.1	2	1
Retreating	1555	8.5	4	2
Definition	Export in million euro 2006	Annual change % 1995-2006	Exports divided by value added (%) 2006	Total change % 1995-2006

	Concentration >100	Concentration <100
Growth	**Winning:**	**Upcoming:**
	Belgium, Germany, Austria, Slovakia	Italy, Netherlands, United Kingdom
Decline	**Losing momentum:**	**Retreating:**
	France, Czech Republic, Estonia, Lithuania, Poland	Luxembourg, Denmark, Finland, Greece, Ireland, Portugal, Spain, Sweden, Hungary

Source: Eurostat/TNO.

Table 3.9 Imports electricity, gas and water, 1995-2006

	Level	Change
EU	25648	12.1
EU 15	24529	12.7
NMS	1119	4.1
Winning	18754	22.4
Losing momentum	461	-3.8
Upcoming	1141	20.2
Retreating	5292	1.7
Definition	Imports in million euro, 2006	Annual change (%), 1995-2006

	Concentration >100	Concentration <100
Growth	**Winning:**	**Upcoming:**
	Belgium, Germany, Austria	France, Ireland, Estonia, Poland
Decline	**Losing momentum:**	**Retreating:**
	Luxembourg, Slovakia	Italy, Netherlands, Denmark, Finland, Greece, Portugal, Spain, Sweden, United Kingdom, Czech Republic, Hungary, Lithuania

Source: Eurostat/TNO.

Table 3.10 Trade balance electricity, gas and water, 1995-2006

	Trade balance	Change
EU	-748	1933
EU 15	-1981	934
NMS	1233	999
Winning	5128	3121
Losing momentum	50	-10
Upcoming	-1897	1248
Retreating	-4030	-2427
Definition	Exports - imports in million euro, 2006	Total absolute change, 1995-2006

Growth	**Winning:**	**Upcoming:**
	Belgium, Germany, Austria, Slovakia	Italy, Netherlands, United Kingdom
Decline	**Losing momentum:**	**Retreating:**
	France, Czech Republic, Estonia, Lithuania, Poland	Luxembourg, Denmark, Finland, Greece, Ireland, Portugal, Spain, Sweden, Hungary

Source: Eurostat/TNO.

The revealed comparative advantage shows the relative contribution of sectors to the trade balance of Member States. This is done by dividing exports relative to the imports of the sector by the exports relative to the imports for the country as a whole. This means that if the country exports more than it imports, the sector can only have revealed comparative

advantage if the share of exports to imports exceeds that of the country as a whole. Positive scores can vary between 0 and 100 and indicate that the sector has a strong contribution to comparative advantage than other sectors (measured as the influence on the trade balance).

Table 3.11 Revealed comparative advantage electricity, gas and water, 1995-2006

		Level	Change
EU		-4	39
EU 15		-9	38
NMS		64	63
Winning		85	156
Losing momentum		63	-35
Upcoming		-32	60
Retreating		-95	-102
Definition		Exports/ imports sector divided by exports/ imports total economy	Total absolute change 1995-2006
Growth	**Winning:**	**Upcoming:**	
	Denmark, Spain, Czech Republic, Lithuania, Slovakia	Belgium, Germany, Italy, Netherlands, Luxembourg, Finland, Sweden.	
Decline	**Losing momentum:**	**Retreating:**	
	France, Austria, Estonia, Poland, Slovenia	Greece, Ireland, Portugal, Hungary	

Source: Eurostat/TNO.

For the EU as a whole, revealed comparative advantage was negative in 2006 (Table 3.11). This is not surprising since the trade balance was negative. If we measure revealed comparative advantage over the 1995-2006 period, the EU has apparently improved. More notably, however, is that the new Member States have increased their revealed comparative advantage over the old Member States.

Conclusions

Four major conclusions can be drawn from this analysis:

- Employment is generally decreasing in electricity and gas, but increasing in water. However, major differences between countries are present.
- Value added is generally increasing in all sectors. The main trend is a growing majority of countries with positive growth rates.
- Differences between sectors are often very large. Country groupings, with some exceptions, do not overlap for employment and value added.
- Exports and imports are still relatively low, but increasing fast in almost all countries. The trade balance is negative for the EU 15, positive for the new Member States and improving for the EU.

3.2 Employment structure and work organisation

Firm size

The majority of firms (91%) in the EU employs less than 50 persons (Table 3.12). Almost 6% of firms has between 50 and 249 employees, whereas, almost 3% has over 250 employees. In the new Member States the share of larger firms is much higher than in the EU 15. Measured as the share of workers, the picture is quite different. In the EU 10% of workers worked in firms with less than 50 employees and 13% in firms between 50 and 250 employees (Manshanden et al., 2008). In the new Member States, especially the share of workers in this last category is, with 20%, much higher.

Table 3.12 Firms electricity, gas and water by employment size, 2005

	Share of firms with employees		
	<50	50-249	>250
EU	91	6	3
EU 15	96	3	1
NMS	76	16	8
Winning	91	6	3
Losing momentum	84	11	5
Upcoming	97	2	1
Retreating	92	5	3

Note: Country groupings are based on employment (Table 3.1). Source: Eurostat/TNO.

Education

Employment in electricity, gas and water is dominated by mid educated workers (Table 3.13). This is even higher in the new Member States, where only 4% of employment consists of low educated workers. In both new and old Member States a decrease is visible in low educated workers, while in most cases the share of mid and high educated workers increased. The share of high educated workers is even 4% higher than for the whole economy in the EU 15, but 12% lower in the new Member States.

Gender, full-time employment and age

The sector is characterised by a normal share of full-time employees and males, who are on average older than in most other sectors (Eurostat, 2006). Table 3.13 gives figures for the electricity, gas and water industry, while Eurostat (2006) shows that waste follows the same pattern. Around 73% of workers are male in the EU 15 countries, but this share is decreasing in the last years. Several sources mention that ageing is a problem in the sector (e.g. Kitchens and Myers, 2007). This is visible in the decreasing share of workers younger than 40 and in the increasing share of workers above 50 years. This could lead in future years to problems when an increasing share of very experienced workers are leaving the sector.

Table 3.13 Employment by share of women, age and education: electricity, gas and water, 2000-2006

	EU		EU 15		NMS	
	Level	Change	Level	Change	Level	Change
Women	27	4	22	2	35	4
Age < 40	38	-3	40	-2	35	-4
Age 40 – 50	33	-1	33	-1	33	0
Age > 50	29	4	27	3	32	4
Low education	11	-4	17	-5	4	-4
Mid education	63	3	52	1	77	5
High education	26	2	31	4	19	-1
Full-time	95	n.a.	93	n.a.	99	n.a.
Definition	Level % 2006	Total change % 2000-2006	Level % 2006	Total change % 2000-2006	Level % 2006	Total change % 2000-2006

Source: Alphametrics/Eurostat/TNO.

3.3 Employment- main trends by job function

One of the most interesting indicators for parts 2 and 3 of this study is the trends and developments that can be identified at the (micro) level of job functions. More than aggregate employment and more than figures about gender and age distribution can changes in job functions tell us something about ongoing change and restructuring in the sector. Changes in (the need for) competences and changes in the distribution of job functions are closely linked to each other, both at the level of the sector and at the level of the firm. Competences are combined in occupation profiles, and can be distinguished in core competences, specialization competences or complementary competences (Rodrigues, 2007:34). Another distinction is between theoretical, technical and social competences (i.e. knowledge, skills and competences in ECVET) (ibidem). Identifying the changes in job functions by sector is a first step towards a better understanding of the changing competence needs in the sector. Competences for the purpose of this study are assumed to be located in a general grid defined by the main occupation functions: general management, marketing, financial and administrative management, R&D, logistics, production management, production, quality and maintenance (Rodrigues, 2007:35).

As a first step towards identifying trends in competences, the observed changes in the distribution of job functions over time will be analysed. In the second part (the scenario-based future-oriented part), a further elaboration of these changes on the need for new and existing competences will be provided. The analysis starts with an analysis of the state-of-play, i.e. the situation as per 2006. Subsequently, changes in job functions over time are discussed, in general (overall) and for different categories of workers classified to educational level.

Employment by occupation: state-of-play and main changes

Occupations are dominated in the EU by engineers, office clerks and secretaries, extraction and building trades and electronic equipment mechanics (Table 3.14). Compared with the new Member States, the EU 15 has especially more managers, engineers, other professionals and office clerks and secretaries. Electricity, gas and water producers in the EU 15 have a white collar style (perhaps also due to stronger consumers departments and a client oriented approach), whereas in the EU this sector has a somewhat more operational style. If the country grouping is considered, it is clear that among winning countries, the share of

engineers is high (25% of employment). Another striking observation is that the countries in retreat have the highest shares of managers and office clerks and secretaries.

Table 3.14 Occupation shares gas, electricity and water, 2006

	EU 15	NMS	EU	Winning	Losing momentum	Upcoming	Retreating
Managers	7	5	6	5	6	6	10
Computing professionals	3	2	2	2	2	3	3
Engineers	20	16	18	25	16	18	18
Business professionals	5	3	4	4	4	5	6
Other professionals	10	7	9	12	8	11	8
Office clerks and secretaries	17	9	14	8	12	14	20
Service workers	1	1	1	2	1	2	1
Extraction and building trades	9	11	10	6	12	11	8
Blacksmiths and machine workers	4	9	6	5	8	4	4
Electronic equipment mechanicals	10	13	11	13	11	9	8
Other craft and trades workers	0	1	0	0	1	0	0
Chemical process plant operators	6	11	8	8	9	9	5
Other plant and machine operators	3	6	5	6	5	2	3
Labourers	4	6	5	3	5	6	6

Note: Country groupings are based on employment (Table 3.1).

Table 3.15 Changes in occupation shares gas, electricity and water, 2000-2006

	EU 15	NMS	EU	Winning	Losing momentum	Upcoming	Retreating
Managers	1	0	0	0	1	0	2
Computing professionals	1	0	0	0	1	-2	1
Engineers	3	4	4	4	5	-1	5
Business professionals	1	1	1	1	2	1	1
Other professionals	1	-11	-4	0	-17	3	1
Office clerks and secretaries	-1	-2	-1	-3	-3	5	-3
Service workers	0	-1	0	1	0	0	-1
Extraction and building trades	-1	1	0	-1	1	-3	0
Blacksmiths and machine workers	0	1	0	0	2	0	0
Electronic equipment mechanicals	-3	5	0	-2	5	1	-7
Other craft and trades workers	0	0	0	0	0	0	0
Chemical process plant operators	-1	4	1	0	4	1	-1
Other plant and machine operators	0	0	0	0	1	0	0
Labourers	0	-2	-1	-1	-2	-5	2

Note: Country groupings are based on employment (Table 3.1).

At the EU, EU 15 and NMS level, most occupation shares are rather stable (Table 3.15). Only other professionals show a large decrease, maybe due to better data in later years assigning a

higher percentage to specific occupations. Interestingly, losing momentum and retreating countries show an increase in the share of managers and engineers (Table 3.15). Other professionals are decreasing fast in losing momentum countries in favour of engineers and mechanicals, while retreating countries show a large decline in mechanicals. Upcoming countries show an increase in office clerks and secretaries, but in all other country groupings they show a decrease.

The employment structure in the waste sector is nearly the same in the new Member States and the EU 15 (Table 3.16). Occupations are dominated by technicians, drivers & mobile plant operators and other elementary occupations. Winning and losing momentum countries have a much higher manager share than upcoming or retreating countries. In this last category the share of clerks is very low, but here are a lot skilled agricultural and fishery workers.

Table 3.16 Occupation shares waste, 2006

	EU 15	NMS	EU	Winning	Losing momentum	Upcoming	Retreating
Managers	5	6	5	9	8	3	4
Technicians	13	10	13	16	14	13	12
Clerks	8	6	8	11	10	8	4
Skilled agricultural and fishery workers	1	1	1	1	0	1	11
Craft and related trade workers	6	8	6	7	6	7	8
Drivers & mobile plant operators	21	18	20	20	23	22	19
Other plant and machine operators	5	6	6	6	8	4	3
Domestic helpers, cleaners, launderers	3	5	3	2	4	3	2
Other elementary occupations	37	38	37	27	27	38	34

Note: Country groupings are based on value added (Table 3.6).

Table 3.17 Occupation share changes waste, 2000-2006

	EU 15	NMS	EU	Winning	Losing momentum	Upcoming	Retreating
Managers	-1	1	0	-2	0	-1	-2
Technicians	3	1	2	-1	3	2	-3
Clerks	-1	0	-1	6	0	-2	-2
Skilled agricultural and fishery workers	0	0	0	0	0	0	0
Craft and related trade workers	0	-3	0	-7	0	1	0
Drivers & mobile plant operators	-1	3	-1	-11	0	0	5
Other plant and machine operators	-1	1	-1	3	-1	0	3
Domestic helpers, cleaners, launderers	-1	0	-1	-1	0	-1	1
Other elementary occupations	1	0	1	13	-2	0	-1

Note: Country groupings are based on value added (Table 3.6).

The changes in occupational structure between 2000 and 2006 are very small at EU, EU 15 and NMS level (Table 3.17). This is also the case for the country groupings. Apparently, the sector is rather stable with respect to occupational structure. Exceptions are winning countries, where there are some big shifts in some occupation, but this might be a matter of registration, because the shifts have more or less the same magnitude.

3.4 Productivity and labour costs

Some data are available on productivity and labour cost for electricity, gas and water (Table 3.18 and 3.19). The wage adjusted labour productivity of electricity and gas was 3.4, indicating that the apparent labour productivity was more than three times as high as the average personnel costs. This is much higher than the non-financial business average (1.48). For drinking water the EU average was 2.3 still higher than the non-financial business average.

Apparently, no major difference is present between the wage adjusted labour productivity in the EU 15 and the new Member States for electricity and gas. Although labour productivity is much lower in the new Member States, average personnel cost is on average comparable lower. However, major differences exist between Member States as the country with the highest productivity (Slovakia) has a 2.8 higher wage adjusted labour productivity and the country with the lowest level (France).

The wage adjusted labour productivity is lower in the new Member States for drinking water. Some countries (Latvia, Poland and Estonia), however, have a productivity around the EU 15 average. Note again that differences between countries are very large. The United Kingdom has a 3.2 times as high productivity as France.

Productivity can change dramatically in the sector, highly influencing skills needs. Labour productivity in some countries even doubled. An example is the UK electricity industry. While the level of employment decreased in the last years, the level of performance expected from staff increased considerably. Employees had to accept a wider range of duties, more responsibility and accountability and an environment characterised by change and uncertainty. With respect to skills, many things changed. Compared with ten years ago greater emphasis is given to (Skills for Business, 2004a, p. 6):

- commercial (business, financial, sales and marketing) and customer service skills;
- multi-skilling;
- ‘softer’ skills such as leadership, team working and interpersonal skills to facilitate new patterns of working;
- project and contract management skills to facilitate reorganisations;
- IT skills as new IT systems are introduced;
- higher engineering skills to facilitate innovations;
- skills to facilitate environmental awareness, e-commerce, energy trading, metering and security awareness.

In five years the share of commercial and administrative workers doubled (from 23% in 1999 to 45% in 2003), while the share of managers (from 8% to 3%) and technical employees (from 69% to 52%) decreased significantly (Skills for Business, 2004a, p. 21). Note, however, that increases in contracting out could influence this figure and that it is unclear how the study dealt with this influence.

Table 3.18 Productivity and labour cost electricity and gas, 2004

	Labour productivity	Average personnel costs	Wage adjusted labour productivity
EU	137	40	3.4
EU 15	208	60	3.4
NMS	39	12	3.3
France	133	67	2.0
Germany	146	63	2.3
Austria	163	67	2.4
Belgium	273	95	2.9
Netherlands	164	55	3.0
Italy	155	50	3.1
Luxembourg	229	69	3.3
Sweden	213	60	3.6
United Kingdom	192	52	3.7
Denmark	204	51	4.0
Portugal	242	55	4.4
Finland	218	48	4.6
Norway	271	58	4.7
Spain	308	57	5.4
Romania	11	5	2.1
Slovenia	61	25	2.4
Lithuania	23	8	2.7
Latvia	21	8	2.8
Hungary	53	18	3.0
Bulgaria	20	7	3.1
Estonia	31	9	3.3
Poland	41	12	3.5
Czech Republic	62	14	4.6
Slovakia	64	11	5.6
Definition	Thousand euro per worker	Thousand euro per worker	Labour productivity divided by average personnel cost

Source: Eurostat (2007)

Table 3.19 Productivity and labour cost drinking water, 2004

	Labour productivity	Average personnel costs	Wage adjusted labour productivity
EU	65	28	2.3
EU 15	96	40	2.4
NMS	16	8	1.9
France	66	50	1.3
Belgium	90	57	1.6
Italy	67	43	1.6
Spain	66	37	1.8
Sweden	100	54	1.9
Portugal	38	19	2.0
Denmark	57	25	2.2
Luxembourg	162	64	2.5
Germany	116	42	2.8
Austria	126	43	2.9
Netherlands	160	54	2.9
Finland	140	39	3.6
United Kingdom	151	36	4.2
Romania	4	3	1.3
Hungary	13	10	1.3
Bulgaria	5	4	1.5
Slovenia	28	18	1.6
Lithuania	10	6	1.7
Czech Republic	17	10	1.7
Slovakia	13	7	1.9
Latvia	11	5	2.3
Poland	20	9	2.3
Estonia	27	8	3.4
Definition	Thousand euro per worker	Thousand eur per worker	Labour productivity divided by average personnel cost

Source: Eurostat (2007)

3.5 Industrial relations

Labour unions play an important role in the sectors. This becomes very clear at moments where discussions are started or policies are implemented with respect to new regulations. Especially, privatisation and liberalisation (discussed in section7), invoke discussions with regulators, ministries, politicians and private companies. This is not only impacted by the affects on employment levels and changes in functions, but also by the affects on income levels. This has to do, of course, with the employers-employee relation changing in many cases from government-civil servant to a private business model.

An example is the resistance against lower paid work and less job security when waste collection is contracted out to the private market or when liberalisation of the electricity market is discussed. Another example is the resistance of the European Trade Union Confederation to liberalisation policies of the EU (ETUC, 2007a and 2007b). Main objection of the ETUC is that these policies do not move the sector in the direction of improving the quality of work and jobs and that they have large social consequences not accounted for. Competition requires a level-playing, else low quality, low prices and bad and low-paid jobs

are the result. Many unions, like the ETUC, are involved also in discussing important items like protecting consumers, fighting climate change, guaranteeing security of supply and improving the quality of services.

As the sectors are very important in all day life, providing fundamental services, (threats with) strikes or other production influencing actions are very effective. In general workers have the right to strike in these sectors in European countries. However, some countries have restrictions as electricity, gas, waste and water are defined as essential services. In France, for example, strikes are permitted as long as normal service is guaranteed to all users, while in Germany strikes should be proportional. In other countries employers have the right to decide which workers are not allowed to strike (Greece) or can the government take over (United Kingdom). In general, all countries have taken measures to guarantee supply when strikes occur (Fairbrother et al., 2002).

3.6 Partnerships for innovations, skills and jobs

One of the central tenets of the renewed Lisbon Strategy is the partnership concept; by building a European partnership for growth and employment, the reforms needed to boost growth and employment will be facilitated and speeded up (European Commission, 2005). Partnership in this view "mobilises support" (mobilisation) and "gets the different players at work together" (collective effort), as well as "makes sure that the(se) objectives and reforms are taken on board by all the various players" thus spreading ownership (ibidem, page 14). In the implementation of the European Cohesion Policy, the partnership principle is fundamental as well. The EU recognises the importance of involving local and regional actors, in particular in areas where greater proximity is essential such as innovation, the knowledge economy and new information and communication technologies, employment, human capital, entrepreneurship, support for SMEs and access to capital financing. Beyond that public-private partnerships and the improvement of governance in the fields of entrepreneurial innovation, cluster management, innovation financing are promoted at all EU levels – from the local to the regional, the national as well as the European level and across economic sectors. Partnerships for innovation, skills and jobs, in connection with the industrial high level groups, as well as lead markets and cluster initiatives are being promoted at both European and national level.

Existing partnerships for innovation, skills and jobs generally show a number of characteristics, which include:

- *Involvement of all relevant actors,* ranging from companies, research organisations, education and training institutes to public administration and others.
- *Cross-sectoral approach:* even though partnerships may be assigned to a specific sector, they often work across different business sectors.
- *Cross-thematic approach, i.e.* linking innovation, skills and jobs.
- *Inclusion of general human needs into the partnership strategy:* human needs, such as housing, health or mobility can be part of the formulated partnership vision or strategy
- *Long term commitment of actors (members).*
- *Joint problem solving,* i.e. working on problems that cannot be met by one member alone
- *European dimension,* i.e. being established at the European level.

Partnerships for innovation, skills and jobs can create a leverage effect for innovation, especially if broader *general human needs* are taken into consideration.[3] For instance, partnerships in the tourism sector aiming at developing 'leisure' should combine knowledge in tourism with, e.g., culture, sports and environment. A partnership aiming at developing the quality of habitat consequently should combine knowledge on at least construction, furniture, electronics and urban management. Partnerships for innovation, skills and jobs integrating general human needs on European level are still very rare.[4] It is likely to find more inclusive partnerships on the national and regional level.

Whereas the potential benefits of partnerships are clear, finding strong examples that fit the above characteristics at EU level are still difficult to find. There are, however, good examples in various sectors at the national and the regional level. Some of these stand out in terms of partnership approach, innovation capacity, approach for skills development, or their job maintaining and job creating capacity. Examples include the City Fringe Partnership for developing regional job opportunities in the printing sector and the ERRAC and EURNEX network in the rail sector where a European approach is combined with a strong effort to integrate latest research results in an virtual European training curriculum.

Partnerships, networks and clusters on innovation, jobs and skills often face similar barriers and obstacles, whatever sector is at stake. These include:

- *Restricted scope:* Partnerships often are set up in order to solve problems which can not be met by one partner on its own. The problems, thereby, are either defined bottom-up or articulated by the politics in a top-down process. In the latter case, the scope of partnership is limited to their given geographical scope and/or their thematic focus (If partnerships are established top-down as instrument to address specific problems they are usually restricted to the policy represented by the awarding authority, e.g. a particular Ministry). Similarly, partnerships and networks established at the European level, such as e.g. networks of excellence, technology platforms, etc. have a specific thematic focus (in this case innovation in research and development).
- *Short-term nature:* Partnerships which are built up by means of public funding are often project driven, feature a short term nature and, generally, are not sustainable due to their dependence of a single fund.
- *Weak direct links between skills, jobs and innovation processes:* Skills upgrading and job opportunities are a result of innovation processes. Therefore, partnerships which focus on innovation do seldom focus on skills and jobs with the same strong interest.
- *Sectoral restrictions:* In general partnerships working on international or European level seem to be more likely to occur in strongly internationalised economic sectors with a common universal challenge (e.g. pollution or sustainable development). Then they are mostly limited to the problems they want to address.

Partnerships in the electricity, gas, water and waste sector

Smartgrids (www.smartgrids.eu) is a European Technology Platform established under the sixth European Research Framework Programme. The platform tries to increase efficiency, safety and reliability of European electricity transmission and distribution systems and removing obstacles to the large-scale integration of distributed and renewable energy sources by means of an integrated strategic research agenda and the mobilisation of private and public

[3] An argument put forward by professor Rodrigues at the workshop "Innovation policies for a knowledge intensive economy – assessing the European experience" in 2005 in Brussels.

[4] Outside the scope of the current series of studies, there is at least there is one good example, the European Construction technology platform (see http://www.ectp.org/default.asp).

investment in research. The platform consists of broad range of enterprises related with the sector (manufacturing, utilities and grid owner, consulting and engineering offices, IT companies), research institutions, associations, public administration which can be seen in this context also as financial bodies. The platform should be open to all active stakeholders in this field.

The main joint objectives are:

- To develop a shared vision for the future which encourages the engagement of multiple, independent parties;
- To identify research needs and build support for an increased public and private research effort on electricity networks;
- To align ongoing RTD projects and new European, national and regional programmes on electricity transmission and distribution systems;
- To draw conclusions and recommendations for follow-up actions and implementation of the strategic research agenda and deployment plan.

To pursue this object four working groups has been established. The Networks assets working group defined research related with the renewal of electricity infrastructure networks. Four subthemes are defined: network asset management, architectures and tools for operation of infrastructure, advanced operation of high voltage system in respect of efficiency and reliability and regulatory topics.

The network operations working group addresses "...the Network Operations within the SmartGrids from the perspective of all involved and affected stakeholders and to elaborate and propose solutions to the identified problems, taking into account obstacles to realization and any other challenges emerging either from the network operations or externally. Indeed, a successful transition of the electric power supply from the infrastructure based monopoly towards the customer oriented service depends in the first line on the adequate Network Operations." In the Demand & Metering working group a focus group was implemented to define the vision of all stakeholders and define research areas. The Generation & Storage working group is not built up yet.

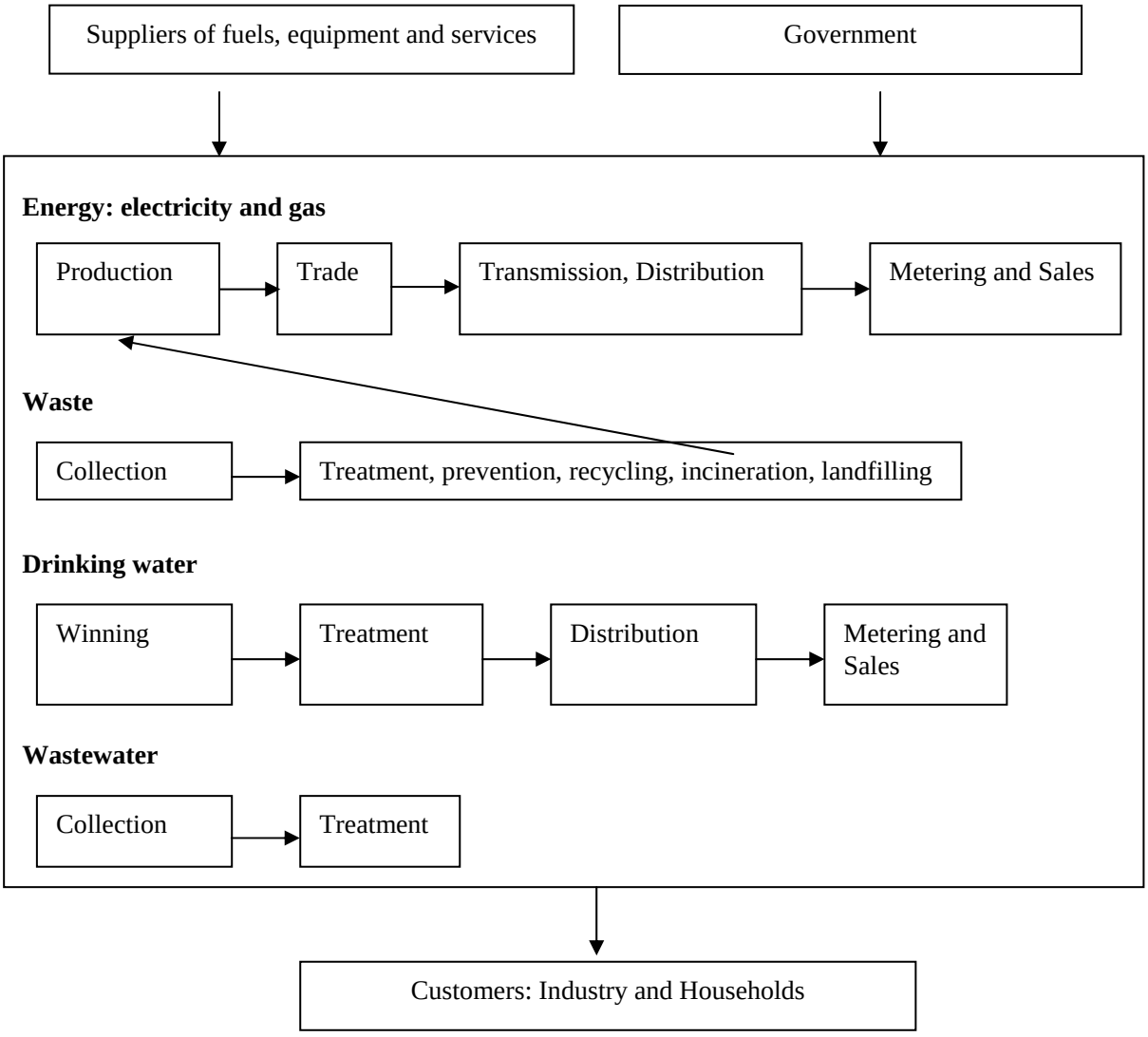
The main focus of the platform is to generate and foster sustainable technological innovations for the sector. Due to this fact and due to the project structure in some of the working sectors the partnership is limited. The focus of Smartgrid is technological innovation in the sector to modernise utilities and infrastructure. Skills adaption and development on new demands and job creation are not in the focus of the platform.

4 Value chains, networks and actors

4.1 Analyses of the value chain

The value chain is graphically represented in the figure below.

Figure: 4.1:The value chain structure electricity, gas, water and waste



The sectors are used by all other sectors as all sectors need water, waste facilities, electricity and or gas to be able to produce their products (i.e. enabling character). This means that the sectors are essential in the sense that skill shortages might influence the whole economy. Therefore, all four sectors are in general highly regulated by governments (see section7). If the sector produces its outputs properly the influence on other sectors is in most cases very limited and can be neglected. For the waste sector, for instance, research has shown that major differences in waste policies has very limited influence on employment in other sectors (e.g. Vernon and George, 2001). On the other side are the energy intensive sectors where the level of energy prices can significantly influence the level and composition of production. Finally,

the increase in policies to promote renewable energy, nuclear electricity, 'clean' new coal fired power plants and energy savings might influence employment in sectors like construction and agriculture as it requires the production of new installations, windmills, solar appliances, biomass installations and biomass itself (Dijkgraaf et al., 2006). Building and renovation of houses and offices aimed at energy reduction requires some extra labour with specific skills. In general, however, the effect of energy reduction on labour will be small as the extra work is small compared with total available labour (London Renewables, 2004).

The sectors are locally oriented by nature. Most activities take place within one country. Although gas and electricity are very often large importers of fuels, substitution possibilities between abroad and home are very small due to availability of resources. Still, electricity is increasingly traded at an international market. While interconnection capacity is still very limited for most countries, often less than 10% of capacity, some countries have higher capacities. Furthermore, coupling of national exchanges has taken place between Belgium, France and the Netherlands. Even there, however, trade is limited by interconnection capacity. This is especially the case at peak hours. Significant trade also takes place in the waste market. This is especially the case for recycling, while incineration and landfilling are dominated by national players. This is also the result of the proximity and self-sufficiency principles applicable to shipment of waste at international level (Basel convention) and transposed into EU-legislation, which gives national countries the possibility to close borders under certain circumstances. In the water industry nearly all activities take place within the borders of each country.

4.2 Restructuring and change

Restructuring of the sector is dominantly the result of changes in regulation and is dealt with in section7. Relocation does not play a major role in the sector. Nearly all production is local per definition and does not change over time in terms of changes between countries. Exceptions are dealt with in section 6.2.

5 Sector dynamics and the role of technological change, R&D and innovation

The last fifteen years are characterised by significant sector dynamics due to technological change, R&D and innovation. The general trends for most sectors are:

- ICT is much more used, especially in the billing process for gas, electricity and water. Mason et al. (2002) shows that the electricity, gas and water sector has one of the highest shares of ICT-workers compared with 38 other sectors. Only sectors like computer services, radio & TV and telecom have a higher share. While the average share was 10.5% in the UK, for electricity, gas and water the share is 21%.

- EU-directives and national regulation led to large investments in capital to decrease environmental pressure of conventional production technologies. Important measures are the decrease in emissions from landfills, incineration plants and electricity production units and measures to implement stricter limits for drinking water and sewerage. Dijkgraaf and Vollebergh (2008), for instance, show that in ten years time, the investment needed for a waste-incineration plant doubled (leaving variable costs untouched) as a result of stricter regulation of dioxines, NOx, particles, HF and SO_2. Costs per ton of waste processed increased from 31 euro to 79 euro.

Specific trends for electricity are:

- Investments in increasing efficiency of existing electricity technologies (coal, gas). The average energy efficiency (electricity and heat) of conventional electricity production in the EU improved over the period 1990-2004 by 6.4 percentage points to 47.8%. This increase was the result of replacing old plants by more efficient plants, improvements in existing technologies and a switch from coal to gas. Increases in efficiency differ very much per country with at the high-end countries like Luxembourg, Romania, Germany and the Netherlands and at the low-end Sweden, Bulgaria, Estonia and Czech Republic (EEA, 2008).

- Investments in new electricity technologies (combined heat power plants, light water reactor, waste to electricity, nuclear, 'clean' coal fired electricity plants, wind, solar, biomass, recycling). As a result more technologies came available at lower costs. For instance, costs of wind energy in Denmark (the forerunner in the world wind market) decreased from 50 eurocent per kWh in 1991 to 25 eurocent in 1999 (Agnolucci, 2007), while current costs are around 5-8 eurocent per kWh (with large differences between countries due to available wind).

- Energy production has developed from dominance by fossil fuels to increased use of renable and clean energy. This development is stimulated by the large increase in efficiency and decrease in costs of these options (see section 7.3).

A specific trend for waste is that treatment has developed from simple disposal (landfilling) to more use of incineration, recycling and prevention (see section 7.2).

As a result of these developments capital intensity increased in dominant parts of the sector. Kwoka and Madjarov (2007) show, for instance, that electricity currently has much more assets per unit of revenue compared with nearly all other sectors. Only mining and railroads are near the level of electric utilities. For gas utilities capital intensity is somewhat lower, but still much higher than manufacturing. Also water and main parts of the waste sector, not included in Kwoka and Madjarov (2007), are highly capital intensive. Eurostat (2006, p. 242) shows that capital intensity is twice the industry average. As Yasar and Paul (2008) shows that capital and skilled labour are complements, the increase in capital intensity has led to larger demands for skilled labour.

6 Trade, globalization and international competition

6.1 International competition

Competition is very often restricted to regional or national markets. Only waste prevention and recycling companies currently work at a full international market. However, as a result of EU liberalisation policies the market for electricity is moving the last years from a national to an international market (Dijkgraaf and Janssen, 2007). Dominant trends are the increase in interconnection capacity making trade between countries possible and the growing use of exchanges making trade more transparent. Although markets are currently still dominated by national developments, investments in new capacity are highly influenced by this

internationalisation. Given the high capital intensity and the resulting long economic life, investors realise that future prices will no longer be determined in national but in international markets (Slingerland et al., 2006).

Internationalisation also stimulates concentration in the last years as mergers and acquisitions take place frequently. This is not only the case for subsectors with international competition, but also for subsectors where competition takes place at a national scale. Examples are:

- Electricity and gas: Intense concentration took place in recent years in the electricity industry. Between 1996 and 2001 mergers and acquisitions rose from 3.5 billion euro to 42 billion euro. These mergers did result in the presence of companies in different countries. Companies like EDF and Electrabel, for instance, are present in nine countries as electricity company and in four countries as gas company (Domanico, 2007). Mergers involve also the rise of multi-utilities, combining activities in waste, water, electricity and gas (Turmes, 2002).

- Waste: The French company Veolia, who bought waste companies in Belgium, the UK, Germany and Italy in the last two years. In the same period the Spanish company FCC bought companies in Austria and the UK. In total 16 major mergers and acquisition took place with a value of 13 billion euros (Hall, 2007). Remarkable development was the complete withdrawal of two large American companies. This was due to problems with competition authorities, a view that the companies were too stretched, had built up too much debt and, in WMI's case, was facing shareholder lawsuits (Davies, 2003).

- Water and sewerage: Only in France, Spain and the UK major private companies are present. As they could not grow in their own country, while the market was saturated, they invested in international growth. This succeeded especially in eastern Europe. Leading were the French companies Veolia and Suez, as they acquired concessions in the Czech Republic, Hungary, Poland and Romania. Also UK companies acquired concessions in these and other countries, but sold nearly all of them again before 2007 (Hall and Lobina, 2007).

6.2 Trade issues of relevance and importance to the sector

The sector is characterised by different trade barriers. Main barriers are:

- Electricity and gas: due to the necessary infrastructure distribution companies are regional monopolies (Filippini, 1998). Production companies (often integrated with distribution) were very often monopolists several years ago, but compete increasingly with each other due to liberalisation policies of the EU and national governments (Green et al.. 2006). International competition is hindered by a lack of interconnection capacity (see section 6.2).

- Waste: due to scale effects collection of household waste is a local monopoly (Dijkgraaf, 2004) where market competition is currently difficult to implement especially in small towns and cities, although some experimental efforts are being conducted to generate more competition in this area. In the current situation municipalities generally do not allow that different waste companies are active in the same region for the same service. Municipalities however can decide to have different contractors for different services (collection, treatment) or waste categories

(recyclables, not recyclables) and can also outsource the collection to a company (competition for the market). In practice municipalities generally choose between providing the service by themselves, a cooperation with neighbouring municipalities, a public firm of which they are shareholders or by contracting the service out to an external firm (public or private). The actual use of these different forms differs very much within and between countries (see section 6.3). Waste disposal is very often organised within countries as a result of the EU proximity and self-sufficiency principle, limiting the level of competition to national companies. Exceptions, however, exist as national governments can allow exports and imports. There are no trade barriers for recycling and prevention as the EU regulates these activities at a European scale, while often activities are competing at a world market (Van Beukering and Bouman, 2001).

- Water and sewerage: due to the necessary infrastructure, high transportation costs and legal problems with responsibility services are regional monopolies (Klein, 1996 and Dijkgraaf et al., 1997). This means that competition on the market does not exist for dominant parts of water and sewerage. Only large clients (companies) have the possibility to choose between producers or to produce the services themselves.

Given the trade barriers, the sector is highly regulated with respect to efficiency (see section 7.1.).

Access to raw materials and import prices are a very important factor for electricity and gas. World developments resulted the last years in sharp increases in the oil price, which also resulted in increases in the gas prices as oil and gas prices are coupled by markets. This influences the composition of investments in plants as rising prices makes coal fired plants and renewable energy more attractive. As investments in renewable and clean energy and security of electricity supply are very important for the whole economy, the EU and national governments regulate this (see section 7.3).

6.3 Externalisation strategies-outsourcing and offshoring

In general offshoring is not often used in the sector as very often service delivery is local by definition and transport costs are very high for long distances. Only for services like call-centres is offshoring an opportunity. In the pas years this is used occasionally. An example is the UK firm powergen that offshored their call centre to India. However, they hang-up in 2006 as offshoring had a negative effect on customer service. Although costs are between 37% and 55% lower, many companies complain about service levels. Having no offshored service centre is now even used as promotion by rivals (Brignall, 2006).

For waste recycling, however, offshoring is used at a high intensity for some streams. This is the case, for instance, in the decommissioning of ship wrecks. These wrecks are almost always decommissioned in developed countries. The impact on environment and health can be large, stimulating international organisations to regulate this business (Andersen, 2001). Also for secondary materials world trade is increasing the last years (Beukering, 2001). When manual decommissioning is necessary, trade to developed countries is more interesting given lower labour costs and decreasing transport costs.

Outsourcing is used in the sector in two directions. First, it is possible to outsource the entire service to the private sector. Second, public utilities might outsource part of the service to the

private sector. For waste collection outsourcing the entire service is currently the main instrument to promote efficiency as competition on the market is not possible. However, the level of outsourcing waste collection differs very much between EU countries, while it nearly never exceeds 50% of the municipalities (Table 6.1).

Occasionally, outsourcing is used in the same way in the water industry (France). Outsourcing water, sewage treatment, electricity and gas, however, is much more complicated than outsourcing waste collection. The reason for this difference is that waste collection is a relatively simple production process, while outsourcing the operation of the other sub-sectors involves very complex contracts due to the high capital-intensity and the necessary use of networks. Although this type of outsourcing might influence efficiency in the sector, it does not influence the distribution of employment between the sector and other sectors.

Table 6.1 Use of private sector in household waste collection

	Share private sector (% municipalities)
EU 15	
Austria	50%
Belgium	Frequently
Denmark	80%
Finland	Small
France	50%
Germany	Small
Greece	Small
Ireland	40%
Italy	46%
Luxembourg	Small
Netherlands	38%
Portugal	Small
Spain	56%
Sweden	60%
UK	50%
NMS	
Bulgaria	30%
Cyprus	na
Czech Republic	na
Estonia	Frequently
Hungary	Small
Latvia	Small
Lithuania	na
Malta	na
Poland	Frequently
Romania	na
Slovakia	Small
Slovenia	Small

Source: Dijkgraaf and Gradus (2008) and Davies (2000).

Although outsourcing is complex, it is used to produce some of the intermediate products and, of course, to build and maintain plants. This type of outsourcing increased the last years as regulation to promote efficiency gave companies more incentives to rationalise operations (see section 7.1). Outsourcing may also be used as a response to potential skill and staffing shortfalls, especially in utilities where many skilled workers are retiring given the aging workforce. Still, level and growth are far below the level for other industries (Kitchens and

Myers, 2007). Furthermore, the level of outsourcing differs very much between countries and subsectors. Comparing water utilities in Finland and Lithuania, for instance, utilities outsource around 70% of goods, services and works in Finland (Hukka and Vinnari, 2007), while in Lithuania outsourcing is currently non-existent (Pietilla and Spokas, 2004).

Box 2. Defining and measuring relocation and outsourcing

One of the biggest challenges when analysing and discussing offshoring and outsourcing is the definitional issue of what precisely is meant and - closely related – how to measure the phenomenon. Outsourcing covers activities previously carried out in-house sourced to third parties whether abroad or in the home country. Offshoring in its strictest sense relates to activities being discontinued in the home country and transferred to a location abroad managed within the same entity or by an affiliated legal entity (OECD, 2007). Frequently, the political debate mixes the above three and also discusses job losses due to restructuring unrelated to offshoring under the same label. Furthermore, the political debate is fuelled by estimates which are the main source of evidence in the absence of hard statistics. Two broad sources on job relocation have as a result emerged: private consulting estimates and press monitoring estimates (Van der Zee et al., 2007). While consulting estimates have severe limitations (ibidem), the estimates collected by press monitorings such as the ERM are more reliable. The most valid data, however, systematic official statistics on the employment impact of relocation, are not collected anywhere in the world today. As a result, academics who nevertheless want to use official statistical data resort to proxies of indicators of relocation activity, such as trade data, FDI flows and input–output tables (Van der Zee et al., 2007). However, these indicators only measure the indirect effects of relocation and are affected by a number of other factors making hard conclusions difficult to draw.

7 Regulation

The influence of regulation is large in the sector due to two reasons. First, the products are essential for all other sectors in the economy as they need to use waste facilities, water, electricity and or gas (see section 4.3). Government regulation is therefore often used, aimed at guaranteeing availability and quality. Second, the environmental impact of the sector is large. Both EU and national regulation is initiated to decrease this impact.

Although many EU and national regulation packages are relevant for the sector, four packages are relevant in our context as they might influence the level and composition of employment:

- First, regulation is initiated aimed at promoting efficiency in waste disposal, water, electricity and gas. This leads to concentration, rationalisation, competition and or privatisation with sometimes major impacts on employment.

- Second, waste management policies are initiated aimed at prevention and recycling. This could lead to major impacts on employment as prevention and recycling differ with respect to labour intensity and required skills compared with waste disposal.

- Third, energy policies are initiated aimed at renewable or less dirty energy. This could lead to impacts on employment as the employment requirements differ with conventional sources of energy.

- Fourth, regulation is aimed at increasing quality and safety for all sectors.

In the remainder of this section we discuss these four developments.

7.1 Efficiency

The impact of regulation aimed at efficiency can have major influence on the composition and level of employment. An example from the UK electricity industry makes this clear. This example is interesting as the UK is a forerunner in the EU. While Member States have the obligation to open market as a result of EU regulation, the market in the UK was already opened in 1998. The electricity industry was traditionally characterised by public ownership, a lack of competition and inadequate regulation. This led to inefficiency, a lack of control on investments and quality and insecurity of supply. Stimulated by EU-regulation, national governments started to liberalise markets. In the UK the national public monopolist CEGB was split into four production and twelve distribution private companies in 1990. Competition was introduced as the companies had to sell their electricity in the wholesale market, new entrants were allowed to enter the market and from 1999 on consumers were free to choose between companies. Although many details are important in valuing the pros and cons of this operation (see e.g. Newbery, 1999), it clearly influenced employment. Between 1990 and 2004 the number of workers in the UK electricity industry declined from 150,000 to 69,000, a decline of 54% (Skills for Business, 2004a, p.5).

This pattern of decreasing employment is dominant in parts of the sector with a history characterised by lack of competition and government ownership, which are liberalised by introducing competition. The literature shows that not only competition on the market can be effective as illustrated by the example above, but that lighter types of competition like price regulation (Hawdon et al., 2007) and benchmarking (De Witte and Dijkgraaf, 2007) can also have major effects on efficiency.

Countries and subsectors within the sector differ of course with respect to the mentioned trends. Dominant trends in the last 15 years are:

- Electricity: liberalisation and in some case privatisation for generation and rationalisation (benchmarking, incentive regulation) for distribution networks;

- Gas: liberalisation and in some case privatisation for production and rationalisation (benchmarking, incentive regulation) for distribution networks;

- Waste: an increasing role for private companies for collection, rationalisation (benchmarking) for collection, liberalisation for waste disposal and a free market for prevention and recycling, e.g. market liberty to advertise or advice about waste prevention and waste management..

- Water and sewerage: in general dominated by public provision in a traditional non-competitive framework (Hall and Lobina, 2007), but some examples of rationalisation (benchmarking in the Netherlands, Denmark, Norway, Spain), privatisation (UK, France, Spain, Germany, Hungary, Czech Republic) and outsourcing (France).

While the dominant trends are visible in all countries, for electricity and gas liberalisation and privatisation processes differ between countries and are characterised by continuous developments and changes. Table 7.1 gives an overview of some relevant characteristics for the electricity market. The column 'Market opening' summarizes what the share of customers is that can choose freely between electricity companies. Column 'Concentration' summarizes the market share of the three largest companies. Column 'Strength of regulation' shows on a 0 to 5 scale how strong electricity is regulated by the government. The Table shows clearly that large difference exist between countries. Compare for instance Ireland and the UK where the UK has much more market opening and less concentration. The Table shows also that market opening is much less in the new Member States (resulting in lower efficiency, see Apfelbeck, 2005), while concentration and strength of regulation is more comparable. The last years concentration increases as mergers and acquisitions take place on a regular base (see section 6.2).

Table 7.1 Overview electricity market, 2006

	Market opening (% customers)	Concentration (C3, % market share)	Strength of regulation (max. 5)
EU 15	88	74	3.8
Austria	100	67	4.5
Belgium	90	90	5.0
Denmark	100	67	3.0
Finland	100	30	4.0
France	70	88	4.0
Germany	100	50	0.0
Greece	62	100	3.0
Ireland	56	88	5.0
Italy	79	35	4.5
Luxembourg	57	100	3.5
Netherlands	100	88	3.0
Portugal	100	99	5.0
Spain	100	85	3.0
Sweden	100	70	4.0
UK	100	60	5.0
NMS	54	76	3.8
Bulgaria	80	na	na
Cyprus	35	100	4.0
Czech Republic	47	46	5.0
Estonia	10	100	3.0
Hungary	67	56	3.0
Latvia	76	99	5.0
Lithuania	na	100	4.0
Malta	0	100	2.0
Poland	52	32	4.0
Romania	84	50	na
Slovakia	66	84	4.0
Slovenia	75	71	4.0

Source: Green et al. (2006).

The situation of the gas market is in main lines comparable with electricity, although the opening of the electricity market precedes that of the gas market (Pepermans and Proost, 2000 and Davies et al., 2007).

The literature finds in general that concentration does not promote efficiency, the privatisation is less important than competition and that rationalisation (e.g. benchmarking) and competition has clear positive effects on efficiency (Megginson and Netter, 2001 and De Witte and Dijkgraaf, 2007).

7.2 Waste regulation

The EU has determined a priority of waste management options for all Member States (cf. EU Waste Framework Directive[5]):

- waste should be prevented as much as possible;
- if this is not possible at acceptable cost, recycling should be used;
- if recycling is no option, the resulting waste stream should be recovered for example through incinerated with energy recovery;
- if all these methods are no options, waste can be disposed of (landfilled).

Table 7.2 Overview waste market

	Recycling % total waste	Incineration % total waste	Landfilling % total waste	Landfill tax euro per ton	Landfill ban
EU 15	37	22	42	36	
Austria	58	22	20	65	Yes
Belgium	57	33	10	28-62	Yes
Denmark	42	54	4	74	Yes
Finland	30	10	60	30	Na
France	29	33	38	8	Not effective
Germany	59	24	17	No	Yes (2005)
Greece	8	0	92	No	No
Ireland	23	0	77	15	No
Italy	32	11	57	17	No
Luxembourg	na	na	na	23	na
Netherlands	64	34	2	86	Yes
Portugal	5	22	73	No	No
Spain	39	6	55	7	No
Sweden	44	47	9	40	Yes
UK	23	8	69	24	No
NMS	10	3	87	0	
Bulgaria	1	0	99	No	No
Cyprus	na	na	na	No	No
Czech Republic	6	14	80	No	No
Estonia	37	0	63	No	No
Hungary	3	7	91	No	No
Latvia	14	3	83	No	No
Lithuania	na	na	na	No	No
Malta	15	0	85	No	No
Poland	5	1	94	No	No

[5] See http://ec.europa.eu/environment/waste/index.htm

	Recycling % total waste	Incineration % total waste	Landfilling % total waste	Landfill tax euro per ton	Landfill ban
Romania	2	0	98	No	No
Slovakia	5	6	88	No	No
Slovenia	12	1	87	No	No
Year	2002-2004	2002-2004	2002-2004	2004	2004

Sources: Dijkgraaf (2004), EU (2007), Vehlow et al. (2007), data from European Topic Centre on Resource and Waste Management and several specific national sources.

This choice means that employment has increased in the prevention and recycling industry and decreased in landfilling. In the UK, for instance, employment in recycling increases yearly with 7%, while employment in waste disposal decreases with 5%. In total a small increase of 1-2% is seen (Skills for Business, 2006). Furthermore, this change might influence skills needed in the waste sector. According to Skills for Business (2006, p. 23) substitution towards recycling affects all occupations, but particularly machine operators and drivers. Increases in incineration and other dedicated treatment plants ask also for special labour skills.

Countries, however, differ very much in the actual policies chosen to stimulate the EU priority. While especially Austria, Belgium, Denmark, Germany, the Netherlands and Sweden chose for a landfill tax and/or ban some other countries did not yet implement policies. Not surprisingly, countries with these types of instruments have also the highest percentage of waste recycled and incinerated (see Table 7.2). The old Member States (EU 15) have a much higher percentage of recycling and incineration than the new Member States (NMS).

7.3 Renewable and clean energy

The debate on climate change and the non-renewable character of coal, oil and gas results in an increasing stimulus for electricity from renewable sources like solar, wind and biomass. Table 7.3 gives an overview of renewable sources as share of total electricity produced in 1997, 2006 and the goal for 2010. The general picture is that the share of renewable electricity decreases somewhat in countries that have already a large share, mainly due to a large stock of such sources (mainly as a result of available hydro electricity), and increases considerably in countries with a small share. This increase is reached by stimulating electricity from solar, wind and biomass sources, for instance by the introduction of the European CO_2 emission trading system (Slingerland et al., 2006). Explicit choices of national governments are also very important. Denmark, for instance, is a clear example of a case where consistent choices to stimulate wind energy resulted in a significant increase in the industry (Klaasen et al., 2005 and Morthorst, 2006). Of all wind turbine capacity in 2002, installed by foreign companies, the Danish industry had a market share of 69% (EWEA, 2004). For the American and German this share is only 15% and 12% respectively. It should be noted that this type of policy stimulated especially R&D skills in Denmark as installation is primarily done with local engineers.

Manufacturing and installation is in large part done by other sectors, but operating and maintenance is part of the electricity sector. This is sometimes intensive, especially for biomass sources as it requires collecting, transporting and processing biomass fuels. Maybe

more important, Foxon et al. (2005, p. 2133) shows that the penetration of renewable energy is hindered by a lack of skills necessary to move from demonstration projects to more substantial, pre-commercial deployment. On the other side is currently unclear what the EU policy will be in the further future, both with respect to environmental issues and security of supply. This hinders investments in new capacity as investors are not sure which options are preferred and which penalties and/or subsidies will be introduced (Slingerland et al., 2006).

Regulation is also very important for other 'clean' types of electricity like new technologies for 'clean' coal fired electricity plants (CCS) or nuclear electricity. There is, of course, a heavy debate on these options as they are often much less clean than renewables. Main question, however, is whether reductions in energy use combined with more investments in renewables are enough to meet climate change goals. It is possible that the policy answer will be no, resulting in regulation stimulating investments in nuclear electricity and 'clean' coal fired plants. Currently, Member States already differ in their opinion and policy.

Table 7.3 Overview renewable electricity (% total electricity generated)

	1997	2006	Goal 2010
EU 15	18	20	26
Austria	70	63	78
Belgium	1	3	6
Denmark	9	27	29
Finland	25	26	32
France	15	12	21
Germany	5	12	13
Greece	9	14	20
Ireland	4	10	13
Italy	16	15	25
Luxembourg	2	4	6
Netherlands	4	6	9
Portugal	39	30	39
Spain	20	18	29
Sweden	49	48	60
UK	2	5	10
NMS	12	11	17
Bulgaria	7	9	11
Cyprus	0	0	6
Czech Republic	4	6	8
Estonia	0	2	5
Hungary	1	4	4
Latvia	42	39	49
Lithuania	3	3	7
Malta	0	0	5
Poland	2	3	8
Romania	31	29	33
Slovakia	18	17	31
Slovenia	30	24	34

Sources: EU (2004) and EurObserv'ER (2007).

7.4 Quality and safety

The sector is characterised by increasing regulation of quality and safety. While the sector itself already invests large sums in quality and safety, the value for society is very high, stimulating governments to increase it even further. This is further stimulated by the necessary attention as a result of possible attacks. Also the risk profile necessitates to invest in safety. In the UK, for instance, around 4,000 accidents happen in the waste sector, implying an accident probability per worker four times the national average. The most frequent causes for accidents are due to heavy weights, slips, trips and falls (e.g. from vehicles) and moving vehicles, whereas risks due to the latter are the highest (Skills for Business, 2006).

Utilities like electricity and gas have also a relative high incidence of accidents. These development required in the last years more training of employees and also specific skills.

8 SWOT

SWOT analysis is a tool in management and strategy formulation, used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project, business venture or – as in this case – a sector, the latter being defined within a well-described geographical entity. The aim of a SWOT analysis is to identify the key internal and external factors that are important to achieving a particular objective or set of objectives. Strengths and weaknesses are internal factors that create or destroy value. For a company these can include assets, skills or resources that a company has at its disposal, compared to competitors. Opportunities and threats are external factors that create or destroy value. They emerge from either the company dynamics of the industry/market or from demographic, economic, political, technical, social, legal or cultural factors (STEEP or DESTEP, see also chapter 9). When applied to the sector level, SWOT has a similar meaning, albeit on a higher, more aggregated level.

The SWOT analysis presented in Table 8.1 is the result of an intensive workshop discussion which was subsequently validated and amended in two external workshops, including the final workshop in Brussels (step 10 in the methodological framework).

Table 8.1: Analysis of Strengths, Weaknesses, Opportunities and Threats- electricity, gas, water and waste sector

	Weaknesses
o growing demand o new opportunities as result of new technologies (e.g. cradle-to-cradle, renewables, CCS) o sound financial position	o often monopolistic behaviour o complicated regulatory environment o large inefficiencies o capital intensity o "culture of incumbents" o geographically fragmented market o low attractiveness
o **Opportunities**	o **Threats**
o stable, transparent, predictable regulation o large possibilities to decrease costs o demonopolisation o waste: cradle-to-cradle ? o eco-efficiency o CCS (Carbon capture and storage), 'clean' coal fired electricity plants o necessary investments in grid and production capacity o R&D o quicker procedures for new capacity o investments in renewables o investments in nuclear electricity	o lack of resources o electricity: high oil prices/shortages o water: in some countries shortages o GHG emission policies o competition from ICT for ICT-workers o competition from other sectors for technicians/engineers o loss of control as result of liberalisation/privatisation o investments in infrastructure takes long time o insecurity of supply o bad regulation o financial crisis might make it more difficult to invest

9 Drivers

9.1 Identifying sectoral drivers: methodology and approach

The methodological framework as defined by Rodrigues (2007) serves as the starting point for the identification of drivers. Rodrigues identifies three main driver categories: economic, technological and organizational drivers, with the economic dimension representing the main trends in demand and supply, the technological dimension covering the main trends in process and product innovation (including services) and the organizational dimension representing main trends in job functions (conceptual, executive). The Rodrigues' approach in principle enables the identification of drivers, and especially so at the meso (sector) and micro (firm or company) level. The search and identification procedure of drivers itself is less well defined, however. Implicitly it is assumed that expert opinion and desk study are sufficient tools to come up with a relevant and plausible set of drivers at the sector level.

During the first stage of the project, a methodological tool (approach) has been developed to facilitate and help the identification and further delimitation of drivers, to arrive at a set of key drivers. Apart from expert opinion mobilised and managed as discussion panel (in a similar manner as a SWOT analysis is usually organised), this approach strongly builds on the findings of existing foresight and other future studies. By consistently linking the search for drivers with the findings in existing foresight and other future studies, a more coherent and all-embracive methodology to finding sector-specific drivers can be deployed.[6] This so-called 'meta-driver' approach of identifying main sectoral drivers starts from a more generic list of meta-drivers derived from a literature survey, and subsequently in a step-wise manner delimits the drivers to a set of most relevant and credible drivers. It does so by combining adequate expert (sector) knowledge in a panel setting. By subsequently asking the expert panel to score the different drivers on a range of characteristics, including relevance, uncertainty, and expected impact (similar to a SWOT procedure), a corroborated and conclusive list of sector-specific drivers can be derived. The meta-driver approach hence enables filtering out in a systematic and consistent way meso and possibly micro (sector-specific) as well as the macro (economy-wide) trends and developments judged relevant and important to the sector, directly and indirectly.

The meta-driver approach includes the following five steps:

Step 1. Drawing up of a list of relevant generic or meta-drivers based on literature review and expert knowledge (check-list: rows)

Step 2. Designing a list of key questions in order to identify the sector relevance and other properties of meta-drivers at sector level (check-list: columns)

Step 3. Filling in the check-list matrix: which meta-drivers do matter most for the sector?

Step 4. Which drivers do matter most for jobs and skills?

[6] Common ways to rank trends and drivers are the DESTEP (Demographic-Economic-Social-Technological-Ecological-Political) and STEEP (Social-Technological-Economic-Ecological-Political) categorisations. For our purpose, slightly altered DESTEP definitions are used to reflect the embracing dimension of analysis.

Step 5. Does the tailor-made list herewith cover all relevant sectoral drivers, i.e. are there any sector-specific drivers missing (check on completeness)

Arguments in favour of the use of the 'meta-driver' approach are:

- The ability and opportunity to use the rich potential of a multitude of already available studies on drivers, determinants of change and key trends
- Circumventing the risk of a too narrow focus on the sector per se while acknowledging sector-specificity, and avoiding the risk of analyzing sectors as if they were isolated (cf the difference between 'general equilibrium' and 'partial equilibrium' approaches)
- Guaranteeing overall consistency, coherence and completeness, as well as warranting a same point of departure important across lots/sectors – i.e. a way of integral assessment, making sure that all important factors are systematically taken on board.

An alternative and second way to arrive at a list of main sector-specific drivers of change is to start with a SWOT and subsequently translating the Opportunities and Threats part into sector-specific drivers. The SWOT is used as a tool to verify and check the resulting list of drivers. By combining the results of both the "from meta-drivers to sector-drivers" and the "from SWOT to sector-drivers" exercises a complete and consistent list of sector-specific drivers can be derived.

9.2 Identification of sectoral drivers

In the next table all meta-drivers are analysed for relevance.

The most important drivers are:

- Institutional: Trade and market liberalisation
- Institutional: EU integration
- Institutional: Environmental regulation
- Natural resources: Availability (and price developments) of oil and energy
- Natural resources: Availability and price of other natural resources

Table 9.1 Assessment of main drivers on the meta-driver approach

Category	Driver	Is this driver relevant for the sector? Y / N	How relevant is this driver for the sector? Scale 0-10	How uncertain is this driver for the sector? Scale 0-10	Are substantial impacts expected on the volume of employment? Y/N	Are substantial impact expected on employment composition? Y/N	Are substantial impacts expected on new skills? Y/N	Short, medium or long run impact?[7] S	M	L	Are substantial differences expected between (groups of) countries? Y / N	Are substantial differences expected between subsectors? Y / N
Ageing / demographics	Ageing - Adapt to the market demands of an ageing and more diversified society	N										
	Ageing – declining labour force	N										
	Population growth (birth and migration)	N										
Econo-mic	Income per capita and household	N										
	Income distribution	N										

[7] Short = 0-3 years; medium = 3-7 years; long = > 7 years. All three categories may apply

Globalisation	Outsourcing & offshoring	Y	5	2	Y	Y	Y	Y	Y	Y	Y	Y
	Increasing global competition	N										
	Emerging economies driving global growth (new market demand, especially BRIC[8] countries)	N										
	Global / regional production networks (dispersed production locations, transport)	N										
	Counter-trend regionalism / protectionism	N										
Cultural values	Increasing market segmentation (tailor made production, mass customization)	N										
	Lifestyle changes	N										
	Increasing demand for environmentally friendly / organic products	Y	6	0	Y	Y	Y	Y	Y	Y	Y	Y[9]

[8] BRIC countries: Brazil, Russia, India, China
[9] Especially electricity.

Technology, R&D and product and process innovation	Advances in IT impacting on organizational structures & new business models	Y	6	5	Y	Y	Y	Y	Y	Y	Y	N
	Internet changing production and consumption patterns (e-business; etc.)	N										
	New types of work organisation (teams-based, sociotechnique, etc.)	Y	6	10	Y	Y	Y	Y	Y	Y	Y	Y
	New/additional value-added services	N										
	Other (biomass, wind, solar, 'clean' coal fired electricity plants, nuclear, prevention, recycling)	Y	6	3	Y	Y	Y	Y	Y	Y	Y	Y
Natural resources	Availability (and price developments) of oil and energy	Y	10	2	N	N	Y	Y	Y	Y	Y	Y[10]
	Availability and price of other natural resources	Y	10	5	N	N	Y	Y	Y	Y	Y[11]	Y[12]

[10] Electricity.
[11] Countries with water shortages (e.g. Spain, Portugal, UK).
[12] Drinking water.

Institutional / Political	Trade and market liberalisation (national level)	Y	10	5	Y	Y	Y	Y	Y	Y	Y	Y
	EU integration – deepening (single European market etc.)	Y	10	5	Y	N	N	Y	Y	Y	N	Y
	EU integration – broadening (bigger domestic market)	N										
	Quality of institutions (judiciary, transparency, lack of corruption, viable business climate, structural rigidities)	N										
	Labour market regulation	N										
	Environmental regulation	Y	10	4	Y	Y	Y	Y	Y	Y	Y	Y
	Security and safety regulation	Y	8	5	Y	N	N	Y	Y	Y	Y	Y

Part II.

Future Scenarios and Implications for Jobs, Skills and Knowledge

Part II. Future Scenarios and Implications for Jobs, Skills and Knowledge - Guide to the reader

Part II presents the scenarios and their implications for jobs, skills and knowledge. It reflects steps 4, 5 and 6 of the common methodology. The contents of part II are as follows: Chapter 10 describes the structure and highlights the content of the four main scenarios (step 4). For each of these scenarios plausible yet different assumptions have been made as to how the main drivers of change will develop and add up to different states of the future. In subsequent steps the implications of the scenarios for jobs and skills are analysed. In order to facilitate a translation of these implications to the job function level, first a workable job function structure is proposed. This structure is based on the functions as they appear in Eurostat's Labour Force Survey and further elaborated. Chapter 10 discusses the main implications of the scenarios in terms of future employment volumes by job function (step 5). Chapter 11 assesses the implications of scenarios for future skills and knowledge needs by job function. It translates the implications of the scenarios for skills and knowledge by function (step 6).

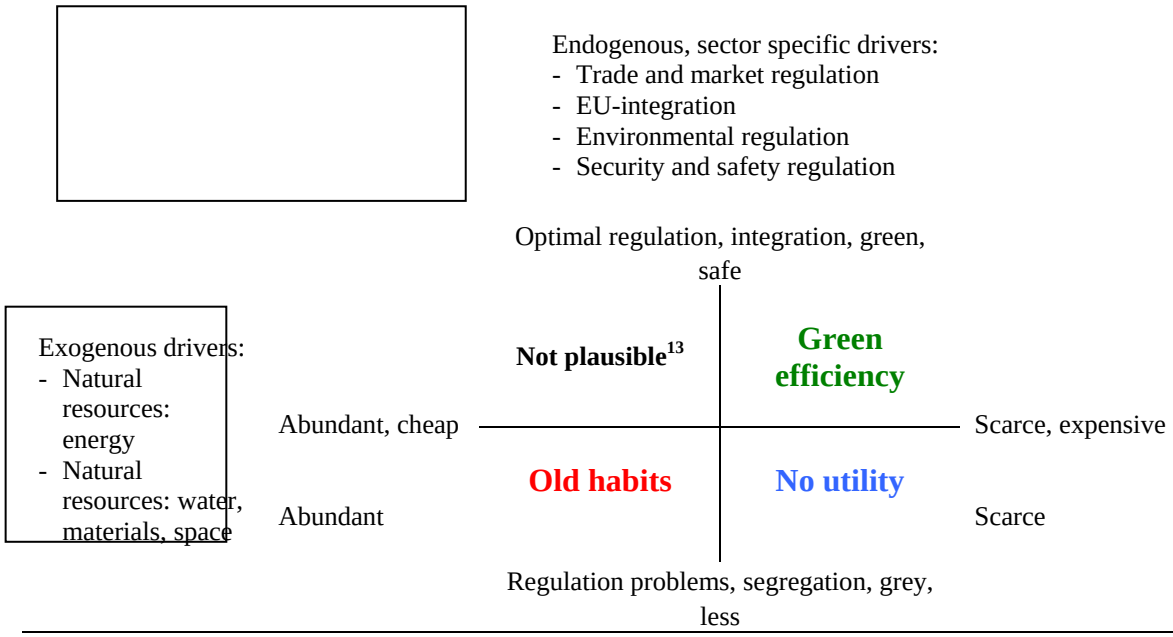
10 Scenarios

10.1 Overview

This section presents the main scenarios for the utilities sector. The scenarios take a medium-long range time perspective, taking 2020 as the focal year. The scenarios are construed to 'scan' the future, and are for the purpose of this study used to assess the impact of future developments on jobs, skills and knowledge. It is important to understand what scenarios can deliver and what not. Scenarios depict plausible futures and might reveal possible paths of development towards these futures. They are neither predictions or forecasts, nor wishful pictures of the future. Grounded in existing data and trends, scenarios are derived in a logical and deductive way, with different and sometimes opposing presumptions about how key drivers might develop, resulting in inferences about plausible, i.e. credible and imaginable, futures.

The goal of the scenarios presented here is to analyse whether different futures will have different implications for job volumes and skill needs by function. If this is the case, it is clear that the answers to arising volume gaps and skill needs should reckon with these differences, and hence will imply different (sets) of possible answers – i.e. strategic choices – for each scenario. It should be emphasized that by definition it is unknown which scenario will become reality. In fact, there is only a tiny little chance that indeed one of the scenarios will become the 'real' future. Chances are much higher that the future will be a mix (of elements) of the described scenarios. Scenario analysis, however, enables us to get a better view on the wide range of volume effects and skills needed in the future, and therefore also of possible solutions.

Figure 10.1 Four scenarios



[13] This scenario is not included in the analysis as the demand for regulation is primarily caused by high pressure exogenous drivers.

The scenarios used in this study are based on a clustering of relevant and significant drivers and a clear distinction between exogenous and endogenous drivers (see Figure 10.1). The main difference between the two driver categories taken is the scope and ability to directly influence drivers at the sector level, by national or European policy-making. The drivers included in the following scenarios are the drivers identified in Part 1. Only drivers of the highest significance are taken into consideration, i.e. with a relevance between 8 and 10. Two sets of endogenous factors are not included in these scenarios. These concern the course of action taken at the industry/company level itself (by definition excluded) and the measures directed towards the educational and training system, respectively. These last factors are discussed in the last part of this study.

Figure 10.1 summarizes the scenarios and highlights the various drivers that together make up the distinguishing elements for the identification of the scenarios, with the x-axis reflecting the relevant exogenous drivers and the y-axis reflecting the relevant endogenous drivers.

10.2 The drivers – building blocks for scenarios

Exogenous drivers for the scenarios are:

- Natural resources: energy: On the left hand side we have the old situation with cheap and abundant availability of energy resources. The utility sector produces just the quantity of fuel and electricity needed by consumers. On the right hand side energy becomes scarce and expensive. Maybe that technological improvement will reverse this again, but that is not probably at the time scale of this study (which ends in 2020).

- Natural resources: water, materials, space: The same difference as for energy is present, but now affecting drinking water and waste utilities. Drinking water problems arise in some countries due to less rainfall (climate change). Some materials become scarce implying that the inefficient waste sector should react to make more use of the materials left in the waste. In some countries landfilling becomes a problem due to scarcity of space.

Endogenous drivers for the scenarios are:

- Trade and market regulation: At the top of the scheme we assume that regulation is optimal in the sense that the institutional setting is organised thus that efficiency is optimized. In some parts competition is more heavily used (electricity, gas, recycling, incineration), while in others (landfilling, collection of waste, water) incentives are organised (e.g. benchmarking, tariff regulation, contracting out) to increase efficiency. At the bottom of the scheme we assume that regulation is not optimal.

- EU-integration: At the bottom of the scheme we have the ‘old’ situation with national policies and no international competition. At the top of the scheme more EU-integration takes place. Electricity, gas, incineration and waste recycling become international markets at the regional or even EU-level. Still, for some

parts of utilities (drinking water, waste collection, landfilling) a national policy persists.

- Environmental regulation: At the bottom of the scheme we have no major environmental regulation. Some measures are taken, but not substantial. At the top of the scheme, however, policy reacts to scarcities and high prices. Green policies are initiated with two main goals:
    - decrease energy, water and materials use by stimulating green demands (less demand trough green choices and substituting demands to less intensive products);
    - decrease environmental effects of energy, water and waste treatment by stimulating new technologies (e.g. wind, solar, cradle-to-cradle).
- Security and safety regulation: At the bottom of the scheme we have low levels of regulation. At the top much more regulation comes in as a result of public safety (attacks) and the risk profile of the sector.

10.3 The scenarios – detailed discussion

Based on the combination of endogenous and exogenous drivers the following three scenarios for utilities are distinguished:

- Scenario I: *Old Habits*
- Scenario II: *No Utility*
- Scenario III: *Green Efficiency.*

The answer on the question which scenario reflects business as usual, is quite different for the subsectors and regions. While many electricity companies are already in “Green efficiency”, some Member States lack behind. Parts of waste and especially water are often in “Old habits” or “No utility”. The answer which scenario is relevant for future developments is not easy to answer. Although for some subsectors (especially electricity) “Green efficiency” seems most relevant, for parts of subsectors “Old habits” or “No utility” is still possible. Interestingly, major developments like the financial crisis might influence the relevance of scenarios. It is, for instance, possible that discussions about privatisation and liberalisation are influence by the financial crisis if it is thought that security of supply is at stake when markets cannot organise enough financial means. The main message, therefore, is to include all thinkable options to see whether shortages in skills differ between scenarios. This guarantees that if a scenario becomes relevant, actions have already been taken to organise solutions.

Scenario I: Old habits

In the scenario ‘old habits’ energy, materials, water and space are abundant and cheap. The utilities produce what customers intend to consume. No major regulation is necessary, although utilities are not as efficient as possible. Both in terms of costs and the use of fuels, materials, water and space inefficiencies exist. Competition is on a relative low level due to a slower pace of de-regulation and further liberalisation of transmission networks and distribution services. This results in inefficiencies. Some discussions are carried out about these issues. However, as abundant and cheap inputs are available the pressure for reorganising the sector is low.

Scenario II: No utility

In ‘no utility’ inputs become scarce and expensive. The oil price, and coupled to it the gas price, rises sharply. The same holds for prices of materials and in some regions, water. This leads to a renaissance of ‘clean’ coal fired and nuclear electricity plants as well as some investments in recycling technologies. Due to the absence of stronger environmental regulation, the development of sustainable energy production and ‘cradle-to-cradle´ technology is low. Densely populated regions have shortages in space, making the cheap option of landfilling unattractive. Climate change results in changing raining profiles, leaving certain regions with large water shortages. The institutional reaction in ‘no utility’ is lacking speed and contents. Countries operate unilateral and no true green policies are present with raising demand as a result. Competition is on a relative low level due to a slower pace of de-regulation and further liberalisation of transmission networks and distribution services. This results in inefficiencies. The combination of environmental pressure and inefficiencies asks for a heavier policy reaction.

Scenario III: Green efficiency

In ‘green efficiency’ this reaction is given. Policy instruments are developed and implemented to decrease demand and to substitute old technologies for green technologies (biomass, wind, solar) and nuclear power plants. This makes the energy market less dependable on oil and gas prices and helps to reduce the effects of climate change. The waste market shows a much larger role for cradle-to-cradle technologies, reducing the demand for incineration and especially landfilling. Water shortages are reduced by demand actions and by dealing with the imbalance in regions with water abundance. Stronger competition is stimulated by EU regulation and results in deregulation and further liberalisation of all markets. More security and safety regulation is adopted as a result of the high risk profile and the increase in possible attacks.

11 Job functions – towards a workable structure

In order to determine the quantitative and qualitative implications of the scenarios for jobs and skills, a workable job classification is needed. The occupational classification of the available sector data derived from the Eurostat Labour Force Survey (LFS) is used as a starting point (see Box 3). The advantage of using this classification is that

developments in the past as observed in the LFS can help to foresee likely trends for the future. For example, it might be expected that future developments in new Member States in some cases will follow similar paths as old Member States in the recent past. Moreover, where strong growth of certain job functions appeared in most recent years, one might have a reason to cautiously weigh and re-assess any further increases in future years, as the situation (markets and other factors) might have stabilised in the mean time. The share of job functions in total sector employment is not unimportant either; sizeable shares call for adequate attention. This does not imply that job functions with only very minor shares of the total should be ignored altogether. It might well be that occupations that have small shares now will face strong growth in the oncoming years, or are strategic and vital for growth of the sector as a whole, even if small in size.

However, the LFS job classification cannot be taken over one to one. First, the given LFS definitions of the job function groups are highly aggregated and cover therefore highly heterogeneous but not always comparable job functions. Reporting on this most aggregate level therefore would not be very illuminating. Second, some functions which may be strategic for the sector when looking at the future can be 'hidden' in a broader statistical category. This also includes 'new' emergent job functions. For both reasons some of the aggregated categories have been split up into separate job function categories, which have been given a more in-depth treatment. For this reason some specific functions are selected from a broader category. From the broader category "computer professionals" programmers are chosen, because in some scenario they are an important occupation to implement processes in the energy distribution. They can become a bottleneck for stimulating productivity in the sector. The same procedure was carried by selecting office clerks and customer services out of the broader category of office clerks and secretaries, which is in quantitative terms also an important group within the sector. The opposite case, where certain job functions may be closely related, but do not fall within the same statistical LFS class, may also apply. Here it would be logical to combine them.

Box 3. The European Labour Force Survey

The European Union Labour Force Survey (LFS) is conducted in the 27 Member States of the European Union and two countries of the European Free Trade Association (EFTA) in accordance with Council Regulation (EEC) No. 577/98 of 9 March 1998. The data collection covers the years 1983 to 2006 and covers all industries and occupations. The national statistical institutes are responsible for selecting the sample, preparing the questionnaires, and conducting the direct interviews among households. The Labour Force Surveys are centrally processed by Eurostat, using the same concepts and definition, based on the International Labour Organisations guidelines and common classifications: (NACE (rev 1), ISCO-88 (COM), ISCED, NUTS).

Although the LFS can be used for comparative purposes, the relative small sample size (in 2002 the sample size was about 1.5 million of individuals, which represents 0.3% of the EU population) means that error margins can be high, especially when the industry itself is rather small.

Source: Eurostat (2008)

Third, in the trend analysis it was already observed that whereas in some countries employment shares of a particular (production) job function were extremely large, similar shares in other countries appeared extremely low, often with another closely related job function being much higher. A very likely explanation for this phenomenon is that in

some countries workers are reported as job function x while in others they are reported as job function y, where basically similar tasks on the job are performed. By taking aggregates for these function types, this sort of reporting bias can be avoided. Fourth, the job functions that appear from statistical data analysis might not always be similar to what a person in or familiar with that sector would rank as the job functions that matter "in reality", i.e. from a work floor perspective. On the basis of discussions with experts and national sector skills studies, an attempt was made to provide a job classification that is both workable and recognisable by the sector in practice. This classification is shown as Table 11.1 below. In the energy, gas and water sector this is the case for extraction and building trades, electronic equipment mechanicals and other craft trade workers and blacksmith and machine workers. The shares of the latter two groups are in quantitative terms of less importance than the other two occupational functions. They, to some extent, dominate the sector.

In order to establish a meaningful and appropriate classification, the existing LFS occupational classification for the electricity,gas,water and waste sector was adapted by either aggregating and/or selecting further differentiating some professions out of the original LFS statistical classification. This exercise was based on four criteria:

- employment shares (aggregating);
- closely related job functions (aggregating);
- strategic role in sector (disaggregating by further selecting among the occupational groups identified in the statistical classification);
- emergent job functions not yet covered and/or brought fully to light by current statistics.

Table 11.1 Adaption of the original job classification

Classification in statistical data	Adapted classification used in our analysis	Names in tables
Managers	Managers	Managers
Business and finance professionals	Business and finance professionals	Business and finance professionals
Engineers and technicians	Engineers and technicians	Engineers
Computer professionals	Computer professionals	ICT professionals
Other professionals Office clerks and secretaries Service workers	Aggregation: Administration and customer service	Administration and customer service
Extraction and building trades Blacksmith & machine workers Electronic equipment mechanicals Other craft and trade workers	Aggregation: Construction workers	Construction workers
Chemical process plant operators	Aggregation: Plant operators	Plant operators

Other plant and machine operators Domestic helpers, cleaners, launderers Drivers & mobile plant operators Skilled agricultural and fishery workers Other elementary occupations	Aggregation: Labourers	Labourers

The functions used in this analysis can be described as follows:

- The category managers contains top management, but also entrepreneurs and different management occupations, such as Human Resource Management (HRM), Finance and Production management.
- The category business and finance professionals includes accountants, financial controllers and finance professionals, but also sales professionals.
- The category engineers includes mainly electrical and mechanical engineers and engineering technicians. Engineers are a dominating occupation within the sector. They are also responsible for the working of the grids and production plants. These activities are very essential as security of supply is very important.
- The category ICT professionals includes computer operators, system designers, equipment operators, programmers and industrial robot controllers.
- The category administration and customer service consists of administrative functions, including order administration, order preparations and customer service.
- The category construction workers are mainly pipe fitters, electricians, welders and electrical mechanics fitters, which are necessary to build, keep up and maintain the plants and infrastructure.
- The category plant operators is responsible for the working of the plants and infrastructure.

The category labourers are responsible for the basic workload like collecting waste, driving trucks and operating mobile plants at landfills or recycling sites.

12 Implications of scenarios by job function - volume effects

Different futures will have different implications for jobs, both in quantitative and in qualitative terms. In this chapter the implications of the four scenarios in terms of volume effects for each of the identified job functions are assessed. Trends and developments of the recent past provide an important starting point in forming an idea about these future developments. This quantitative trend information has been combined with expert opinions of a core expert team and supplemented with insights from invited sector experts

in a dedicated workshop to assess which volume effects would be likely to occur for which job functions. It should be emphasized that the referred expected changes are qualitative in nature, reflecting the outcome of expert judgements and expert discussion as well as desk research taking into account the results of other studies. The results of the following chapter should therefore be used as a supplement and an independent expert assessment in addition to other more formal analyses, e.g. based on mathematical and/or econometric modelling and simulation.

In this section we project and assess the volume effects of each of the scenarios for each of the identified job function categories. To this end Table 12.1 presents possible changes in the quantity of workers in the specified job functions for each scenario. Each cell translates the impact of a particular scenario to possible future developments by job function. Developments in the recent past as described in Part 1 are an important starting point in forming an idea about overall developments in the future. The expert team that filled in the table used this starting point and discussed and analysed in detail whether, in their opinion, the scenarios will lead to changing effects in their opinion. Given the nature of this analysis it should be kept in mind that all estimated changes are the consensus judgement of the expert team only. This means that it can be used as a supplement and independent expert assessment to more formal analysis to be carried out in possible future research, for example based on econometric or model analysis.

Table 12.1 Expected volume changes in job function structure, 2009-2020

	Green efficiency	No Utility	Old habits
Managers	I	I	M
Business and finance professionals	I	M	M
Engineers	I	I	M
ICT professionals	I	M	M
Administration and customer service	D	M	M
Construction workers	I	I	M
Plant operators	I	I	M
Labourers	D	M	M
Overall	D	I	M

Note: D=decrease, I=increase, M=maintain, EGW= Electricity, gas and water sector

The results for the electricity, gas and water sector are presented in Table 12.1. The table shows the different occupations selected and the changes expected for each of the scenarios.

Main changes in the quantity of employment can be expected in the Scenario “Green efficiency”. Due to the development of new technologies and a stronger regulation of the sector a positive impact of the overall quantity of employment can be expected for most occupations in the energy, gas and water sector (EGW) as well as in the waste sector. However, two important occupations show a decline as a result of competitive forces. As

these occupations dominate, the overall effect will probably still be negative.[14] However, subsectors will probably differ as an overall increase is likely in waste and renewable and 'clean' energy, while the decrease will mainly concentrated in electricity, gas and water. In the opposite scenario "No Utility" a slightly positive impact on employment can be expected as a result of more investments in new energy and recycling technologies. In Scenario "Old habits" an equal level of the workforce can be expected due to business as usual. This means that competitive forces are very important for the answer on the question whether overall employment decreases can be expected. However, these figures do not reflect that even with a maintaining or decreasing level, replacement demand is rather high as a result of ageing.

As regards managers in the utility sector major shifts are expected in the Scenarios "No Utility" and especially "Green efficiency". In "No utility" it is expected that more fossil fuel and nuclear power plants as well as more regenerative energy power plants will be erected. In waste investments are made in recycling as material prices are rising. These developments will be accompanied by a lack of competition within the sector, hence management can improve its position. In the scenario "Green efficiency" management functions are expected to increase further. On the one hand side there will be a stronger competition leading to a reduction in management and overhead costs. On the other side, however, classic forms of production will diminish and large investments will be done in sustainable energy, 'cradle-to-cradle' technologies and water reduction.

The volume of business and finance professionals is expected to increase where fast changing market conditions, large investments and further liberalisation of the sector induces demand. Both developments only come about in scenario "Green efficiency". Therefore a rise of employment in this job function can be expected. In the past years business professionals were the biggest growing occupational function in all Member States (see Part 1). In the other two scenarios no major changes are expected.

The demand for engineers in is supposed to rise in the scenario "Green efficiency" and "No utility" for various reasons. In the first scenario the main reason is that political pressure urges for more eco-efficiency, in the second scenario the scarcity of natural resources makes it necessary to re-develop old forms of fossil fuels (coal) and regenerative energies (to become more interdependent from oil and gas prices) while the waste sector becomes an important supplier of raw materials (European Commission, 2008b).

In both scenarios this leads to growing demand for engineers. The demand will be higher in the first scenario because many more new technologies are developed. In the scenario "Old habits" neither regulation nor prices for oil and gas are putting pressure on the sector. So business as usual in all subsectors is expected. The demand for ICT professionals and especially for programmers in the sector is not dominated by technological developments but by regulation influencing competition and environmental issues. Because of these kinds of regulation internal processes are changing and information systems and programmes should be adapted by programmers. Therefore, quantitative shifts in the occupation functions can be expected in the first scenario. In "Green efficiency" the stronger regulation of the sector leads to a rise in employment for this occupational function.

[14] Note that these expected volume changes include workers for contracted out services, while the figures in Part 1 exclude these workers.

The expected changes for administration and customer service staff in scenarios “No utility” and “old habits” are to a large extent similar. Not much happens due to a lack of market regulation. Only in the scenario “Green efficiency” the quantity of administration and customer care service workers will decrease as a result of the stronger market regulation. Efficiency is reached by automation, cutting out inefficiencies and outsourcing to other countries. Although new product developments (‘cradle-to-cradle’, supplier of raw materials, reduction policies, green products) ask for growth in some job functions, the net result is a decrease. Underneath this development is a large shift in functions and people.

Construction workers are expected to increase in the scenario “No utility”. The main reason for this development is the renaissance of fossil fuels like carbon and brown coal and nuclear in energy production because of rising oil and gas prices. New plants have to be built. This holds also for waste recycling. In the scenario “Green efficiency” construction workers are expected to rise also, but now because of investments in sustainable technologies and the modernisation of transmission networks to strengthen efficiency and minimise energy and water loses. In the scenario “Old habits” the number of construction workers will maintain because investments are at a much slower pace than in the other scenarios.

In the scenario “Green efficiency” an increase in plant operators is expected because of the availability of more plants. Additionally no more power plants with fossil fuels are planned, but the existing ones are upgraded to the latest environmental technologies. In “Old habits” the same level of plant operators is expected since there is no need for strong investments in alternative production. Operators are expected to increase somewhat in the scenario “No utility”. The main reason for this development is the renaissance of fossil fuels like carbon and brown coal and nuclear in energy production because of rising oil and gas prices and the rise in recycling technologies.

Employment of labourers in waste management is expected to increase in “No utility”, especially in labour intensive waste recycling. Although an even larger increase is necessary in “Green efficiency” due to much more new technologies, the net effect is negative due to competitive forces. Large reductions in some parts of the sector are present.

13 Implications of scenarios - main emergent competences

13.1 Introduction

Determining emergent competences is at the very heart of this study. In order to identify the main emergent competences by occupational function, the Rodrigues (2007) methodology refers to three main competences: theoretical, technical and social competences. This distinction builds on the distinction between knowledge, skills and competences in the European Qualifications Framework (EQF) and the European Credit system for Vocational Education and Training (ECVET) (see Box 4 below). The term

human capital broadly defined by the OECD as 'the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being' (OECD, 2001:18) captures all three. The use of the term 'capital' leads one to think in terms of investments in education and training which are often necessary in order to acquire skills and knowledge. However, skills and knowledge can also be acquired through work experience, informal on-the-job learning and a variety of other means.

In the actual identification of future competences, the EQF/ECVET definitions are used as indicative. It is noted that the difference between competences and skills is not always clear-cut, for instance where 'soft skills' come into play. A similar comment holds for what determines job or occupational qualifications.[15] Partly because of these identification issues, adequate measurement of competences, knowledge and skills is notoriously difficult. In some of the literature, the problem of skills measurement is sometimes avoided by using indicators (proxies) focusing on qualifications (high-level, intermediate-level, low-level) as well as occupations. For the purpose of identifying *future* skill needs such approach will not deliver useful results. Instead it is the knowledge and skills behind that need to be identified.

Rather than producing a full and exhaustive list of all competences for each job function, the key focus in this chapter is on identifying and describing key and critical competences for the future. The description will be focused but also general enough to be meaningful across countries. A slight extension of the original Rodrigues methodology is that together with the identification of critical skills and knowledge needs, a differentiation by scenario is made. Skills and knowledge needs are operationalised as expected key changes in specific skills and knowledge categories by occupation.

[15] 'Qualification' denotes the requirements for an individual to enter or progress within an occupation. It also denotes an official record (certificate, diploma) of achievement which recognises successful completion of education or training, or satisfactory performance in a test or examination. The concept of qualification varies from one country to another. It may express the ability – formally defined in work contracts or collective agreements – to perform a certain job or meet the requirements of the workplace. A qualification may give rise to a number of rights and prerogatives which determine the individual's position within the hierarchy of his/her occupational context. (Tessaring, 2004: 235).

Box 4. Definition of competences, skills and knowledge in EQF and ECVET

Several definitions of knowledge, competences and skills are nationally as well as internationally under discussion. Moreover, Member States of the European Union still have different approaches in defining these terms. The European Union has set up a joint process to co-ordinate the different existing terminologies and to find a common basis. Aims of this process are for example to strengthen the mobility of the labour force within the European Union and to facilitate sectoral developments. In the following reference is made to the definition used by the European Qualification Framework (EQF) and the European Credit System on Vocational Education and Training (ECVET).
The EQF links national qualification systems and tries to make vocational training and lifelong learning more transparent and understandable. Therefore a common terminology was developed. The following descriptors are taken from the EQF (European Commission, 2008e; see also European Commission, 2008f):

- *Knowledge* refers to the outcome of the accumulation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. In the context of the European Qualifications Framework, knowledge is described as theoretical and/or factual;

- *Skills* refers to the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments);

- *Competence* refers to the proven ability to use knowledge, skills and personal, social and/ or methodological abilities, in work or study situations and in professional and personal development. In the context of the European Qualifications Framework, competence is described in terms of responsibility and autonomy;

- *Qualification* refers to a formal outcome of an assessment and validation process which is obtained hen a competent body determines that an individual has achieved learning

Box 5. Skills needs, skills shortages and skills gaps defined

- *Emergent skills needs* are defined here as the change in skills that is needed to adequately fulfil a certain job function in the future. Addressing emergent skills is needed in order to avoid skills shortages and/or skills gaps in the future.
- *Skills shortages* exist where there is a genuine lack of adequately skilled individuals available in the accessible labour market. A skill shortage arises when an employer has a vacancy that is hard-to-fill because applicants lack the necessary skills, qualifications or experience.
- *Skills gaps* arise where an employee does not fully meet the skills requirements for a specific job function but is nevertheless hired. This skills gap needs to be closed through training. Skills gaps can arise where new entrants to the labour market are hired and although apparently trained and qualified for occupations still lack some of the skills required.

Throughout this report the term *competences* is defined as the "proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development." (see Box 4 for definitions). In the practical elaboration of competence needs hereafter the focus is predominantly on knowledge and skills needs, with a further distinction to what is usually described as 'soft skills' such as team working skills, and planning and organising. Note that the 'personal, social and/or methodological abilities' included in the definition of competences (see Box 5) come very close to what is generally understood as 'soft skills'.

Table 13.1 Overview of skills and knowledge clustered by category

Knowledge ('hard skills')
• Legislative / regulatory knowledge (environmental / safety / labour / contracting); Language*; e-skills; Marketing skills; Technical knowledge; Product knowledge; Product development
Social Skills • Team working skills; Social perceptiveness (listening / understanding); Communication; Networking; Language*; Intercultural
Problem-solving Skills • Analytical skills; Interdisciplinary; Initiative, Multi-skilling; Creativity
Self management • Planning; Stress and time management; Flexibility; Multi-tasking
Management skills • Strategic & visionary; Coaching and team building; Change management; Project management; Process optimizing; Quality management; people skills crucial for collegial management style
Entrepreneurial skills • Supplier and customer relationship / understanding; Business understanding; Trend setting / trend spotting

A number of different skills categories have been taken into account, including social skills, problem solving skills, (self) management skills, skills related to entrepreneurship, as well as knowledge requirements (sometimes labelled as 'hard skills'). Table 13.1 provides an overview of the different skills and knowledge categories taken into consideration. Literacy and numeracy skills are not specifically mentioned in the tables. In practice these skills cannot be taken for granted. However, they are a prerequisite rather than an emerging skill to participate in the workforce especially in highly regulated and science-based sectors.

For each job function key future skills and knowledge needs were identified. This was done in a workshop with a number of invited sector experts, and validated in two subsequent workshops, including the step 10 final workshop; the results therefore remain based on joint expert opinion. The analysis in Part I and the data tables formed a 'levelling' starting point for each of the discussants.

The emergent future competences – defined as skills and knowledge needs - are identified and clustered together with similar ones in a concise overview table per job function (see next sections 13.2 to 13.7). Only *substantive key changes* in skills and knowledge needs are taken into account, which means that only part of the cells in the table is 'filled'.

However, if a certain skill or knowledge type is highlighted in one scenario, but is not addressed in another, this does not mean that it is irrelevant. Rather it means that relative demand for this skill in the latter case will not increase within the time frame 2009-2020. It is assumed throughout all scenarios that currently existing REACH and environmental regulation will be implemented. Their impact on skills demand is taken as an integral part of the next sections therefore.

13.2 Managers

The following qualitative skills and competences for managers are needed today and in the future in all possible scenarios. However, they differ in intensity and urgency in the different scenarios. They are earmarked (see Table 13.2) if the need for competences is intense. For managers the main difference between the scenarios is that in the fast paced scenario ("Green efficiency) managers have to focus on quickly picking up new trends, explore new markets and channels, invest in customer relations and optimize their processes and finance to reduce costs. In the slower paced scenarios ("No Utility and "Old habits") managers have to focus on improving their work and to guarantee the position of their business.

The severe competition and further liberalisation makes **knowledge skills** like finance more important in "Green efficiency". To be able to compete, costs should be minimized asking for more finance skills. Competition and liberalisation is effectuated by regulation. Regulatory knowledge is therefore essential. This holds also for environmental regulation, which becomes stricter and is changing fast.

Social skills like communication and networking are important in the scenario where natural resources are rare and expensive. The shortage leads to major changes in production of energy especially in "Green efficiency", but also in "No Utility". In both scenarios managers need social skills out of different reasons. In scenario "Green efficiency" these skills become important to make new solutions possible. Relations with both the own workforce and third parties are more important and dependent on good communication and networking. Networking skills are crucial in "Green efficiency" in order to develop and implement sustainable technologies and to find new co-operation partners. Due to a lack of stable and good regulations networking skills (e.g. lobbying to governments) are also important in the scenarios "No Utility" and "Old habits". Language and intercultural skills are needed in "Green efficiency" as firms operate more intensively on an international scale.

Problem-solving skills like creativity and initiative and **self management** skills like flexibility are important in "Green efficiency". The circumstances change very rapid in this scenario. Companies with more creativity, initiative and flexibility will react better and quicker to the changing market circumstances and have more chances to get a better market position.

As circumstances are changing rapidly in "Green efficiency" self management skills like Stress and time management and flexibility are necessary. As the sector originates from a much tranquiller environment, managers should adapt quickly. In "Green efficiency" entrepreneurial skills are needed. The possibilities for investments in sustainable energy and 'cradle-to-cradle' technology become more important, larger and more profitable compared with other scenarios. Deciding which options lead to the highest return on

investment becomes essential. This involves trend spotting and setting, business development, marketing and understanding customers.

In all scenarios **management skills** are needed, of course. Still, the degree varies to which these skills become important. In ‘”No Utility” and “Old habits” strategic skills do not vary much from current practice, but in the scenario “Green efficiency” the range of possible strategic options is broader. Competition gets fierce due to further deregulation, liberalisation and environmental regulation. New products have to be developed, current product should be produced cheaper and with a higher quality and the work force should adapt to these changes. This means that change management skills will be more important as forced reorganisations can lead to resistance within the workforce. However, in the scenario “Old habits” the strategic options are limited because there is only little pressure to invest in other forms of energy as environmental regulation is loose and prices are low. In scenario “No Utility” there is a higher need for strategic skills than in “Old habits” due to a price increase for natural resources. Coaching and team building and a collegial management style are important skills in all scenarios. In the utilities the trend was that a company is a lifetime employer. Employees entered the company after school or after university and left the company when they retired. During their employment they went through different stages within the company. In the last years this trend changed, both trough efficiency improving measures, more competition and changes in workers attitudes. Due to more competition human resource management skills become even more important in the scenario “Green efficiency”.

Table 13.2 Emerging skills and competences for managers, 2009-2020

Category	Skills and competences	Green Efficiency	No Utility	Old Habits
Knowledge	Legislative and regulatory knowledge	■		
	e-skills			
	Technical knowledge (finance, security and safety)	■		
Social	Team working skills			
	Social perceptiveness			
	Communication	■	■	
	Networking	■	■	■
	Language	■		
	Intercultural	■		
Problem solving	Analytical skills			
	Interdisciplinary			
	Initiative	■	■	
	Multi-skilling	■		
	Creativity	■		
Self management	Planning			
	Stress and time management	■		
	Flexibility	■		
	Multi-tasking			
Entrepreneurship	Understanding supplier, customers	■		
	Business development	■		
	Marketing skills	■		
	Trend setting / spotting	■		
Management	Strategic and visionary	■	■	
	Coaching and team building	■	■	■
	Collegial management style	■	■	■
	Change management	■	■	
	Project management	■	■	■
	Process optimizing	■		
	Quality management	■		
Total emerging skills and competences		20	8	4
Scenario characteristics: - Globalisation - Technological change - Natural resources - Trade and market regulation - Environmental regulation		 Fast Fast Scarce Liberal Advanced	 Fast Fast Scarce Biased Poor	 Slow Slow Abundant Biased Poor

Note: shaded area means that skills and competences are emerging relatively fast compared with other scenarios.

13.3 Business and finance professionals

Business and finance professionals includes accountants, financial controllers and professionals, but also sales professionals.

For the described changes in “Green efficiency” business and finance professionals require more **knowledge** about regulation, finance, trade (new types of trade like energy exchanges) and environmental issues (as this becomes one of the selling points).

Social skills emerge mainly in “Green efficiency”. Especially for sales professionals communication, networking, language and intercultural become more important as markets have to be developed and different branches and regions are working together. Furthermore, the client is no longer an asset of the firm, but has to be saved for the future. Much better communication is required to convince the client that the firm offers the best price and quality. For finance professionals communication is important, but this is more internally related as more information is required by management, sales and product development.

Problem-solving skills are required in “Green efficiency” due to more competitive pressure. The circumstances change very rapid in this scenario. Companies with more creativity will react better and quicker to the changing market circumstances and have more chances to get a better market position.

Self management is important in “Green efficiency” as vast changes in competitive environment and regulation demands flexibility and high stress and time management skills.

In “Green efficiency” **entrepreneurial skills** are more important. Together with the management trend spotting and setting is one of the key pillars of the business. Sales professionals have to develop effective plans, while financial professional have to guarantee that financial possibilities are present to implement the plans.

Management skills are important in all scenarios. . In the scenario “Old habits” only one emerging skill is identified, project management (process optimizing). The rather stable business surroundings make “business as usual” possible. However, even in this scenario current regulation demands more quality of financial accounting. Professionals have to optimize the internal business processes to guarantee that financial streams are transparent and in accordance with regulation. Change management and project/contract management become increasingly important when the move is made to “No utility” and “Green efficiency”. In “Green efficiency” process optimizing comprises also risk management. As the firm operates now in a competitive environment and large investments are necessary, much more attention should be given to the identification of risks and possibilities to decrease them.

Table 13.3 Emerging skills and competences business & finance professionals, 2009-2020

Category	Skills and competences	Green Efficiency	No Utility	Old Habits
Knowledge	Legislative and regulatory knowledge	■		
	e-skills			
	Technical knowledge (environment, trade, finance, security and safety)	■		
Social	Team working skills			
	Social perceptiveness			
	Communication	■	■	
	Networking	■		
	Language	■		
	Intercultural	■		
Problem solving	Analytical skills	■		
	Interdisciplinary			
	Initiative			
	Multi-skilling	■		
	Creativity	■		
Self management	Planning			
	Stress and time management	■		
	Flexibility	■		
	Multi-tasking			
Entrepreneurship	Understanding supplier, customers	■		
	Business development	■		
	Marketing skills	■		
	Trend setting / spotting	■		
Management	Strategic and visionary			
	Coaching and team building			
	Collegial management style			
	Change management	■	■	
	Project management	■	■	■
	Process optimizing			
	Quality management			
Total emerging skills and competences		17	3	1

Note: shaded area means that skills and competences are emerging relatively fast compared with other scenarios.

Table 13.4 Emerging skills and competences engineers, 2009-2020

Category	Skills and competences	Green Efficiency	No Utility	Old Habits
Knowledge	Legislative and regulatory knowledge	■		
	e-skills			
	Technical knowledge (electrical, mechanical, mechatronic, construction, specialist, security and safety)	■	■	■
Social	Team working skills			
	Social perceptiveness			
	Communication	▒		
	Networking			
	Language			
	Intercultural			
Problem solving	Analytical skills	▒	▒	
	Interdisciplinary			
	Initiative	▒		
	Multi-skilling	▒		
	Creativity	▒		
Self management	Planning			
	Stress and time management	▒		
	Flexibility	▒		
	Multi-tasking			
Entrepreneurship	Understanding supplier, customers			
	Business development			
	Marketing skills			
	Trend setting / spotting			
Management	Strategic and visionary			
	Coaching and team building			
	Collegial management style			
	Change management			
	Project management	▒		
	Process optimizing	▒	▒	
	Quality management			
Total emerging skills and competences		11	3	1
Scenario characteristics: - Globalisation - Technological change - Natural resources - Trade and market regulation - Environmental regulation		 Fast Fast Scarce Liberal Advanced	 Fast Fast Scarce Biased Poor	 Slow Slow Abundant Biased Poor

Note: shaded area means that skills and competences are emerging relatively fast compared with other scenarios.

13.4 Engineers

Engineers are one of the most important occupational functions within the utilities sector in quantity as well as in quality. They are responsible for the working of the grids and production plants. These activities are very essential as security of supply is very important. In recent years there was a trend of gaining highly skilled workers to improve efficiency. This trend will be carried forward in all scenarios, but much more in “Green efficiency” and less so in “No utility”. The main difference between the emerging qualification needs in the different scenarios result from a stronger competition within the sector and from the pace of new technologies stimulated by environmental regulation.

Knowledge skills differ per scenario. Technical skills are emergent and essential in all scenarios, but their intensity differs. These skills are needed especially in the scenario “Green efficiency”, where technological change is vast and new plants are built. In “No Utility” a renaissance of coal power plants is expected, which will result in a higher demand of the skills needs to erect and run this kind of plants. The same holds for recycling plants. In “Old habits” technical, electrical and mechatronic skills are important to guarantee the quality of production and grid. In the scenario “Green Efficiency” much more knowledge is necessary to develop new production technologies. Special technical knowledge is necessary in this scenario caused by the growing importance of wind, solar, biomass, hydro, geothermal, ‘clean’ coals and nuclear energy production and a vast range of ‘cradle-to-cradle’ technologies. This asks also for more environmental knowledge. Especially for electricity, gas and water very good baseline technical skills are absolute necessary to guarantee security of supply. Without these skills ‘black-out’ can occur with very large damage to society.

Social skills are required in “Green efficiency” especially, as the development of new technologies in a competition driven environment asks for good communication with management and business professionals. Goal of this communication is that products are developed that have a good competitive position in the future.

Problem-solving skills are especially important in “Green efficiency”. In the whole sector there is an emerging need in this scenario for multi-skilled personnel comprising skills from different disciplines. The main reason for this multi-skill approach is the wish to increase productivity and efficiency of the workforce without hiring additional staff. Analytical problem-solving skills are necessary to tackle technical challenges arising from investments in new technologies. Companies that can solve problems creatively, quick and thorough will have more opportunities to penetrate the market. These developments are stimulated very much by strict environmental regulation.

Self management and management skills are needed especially in “Green efficiency”. The changing surroundings, the constant development of new initiatives in combination with market pressure asks for project management, flexibility and stress and time management skills. Process optimizing skills are necessary both in “Green efficiency” and “No utility”. In both scenarios to reduce the use of energy and recycling of materials. In “Green efficiency” also to reduce costs.

13.5 ICT professionals

As already mentioned software plays a crucial part in supporting the different business processes in the utilities sector. Programmers are important in the sector not only for business purposes but also for power system management and machines (e.g. CNC-programming). Due to expected modernisation of the transmission and distribution infrastructure in all scenarios, programming of power, gas and system management is a crucial emerging skill. In particular, the digitalisation of geographical information systems will be a key feature in each possible future. However, programming power systems is more important in “Green efficiency” as much more decentralised plants are operating.

The main difference in skills and competences is visible between “Green efficiency” on the one hand and the other two scenarios on the other hand. This is especially caused by the much more competitive environment of “Green efficiency”. Past experience learns that many companies have problems organising the ICT necessary for a competitive position. ICT professionals need to have more **social skills** as they have to cooperate with other branches (e.g. marketing and product development) in several regions (language, intercultural). This cooperation requires also an **entrepreneurial attitude** as understanding customers becomes more important. This means also that more programming **knowledge** is needed, especially in the field of customer relations. More IT knowledge is necessary in all scenarios to better organise the internal processes.

Competition asks for a **problem solving** attitude as demands from customers become more important, while managers ask for more and higher quality data. The pressure on ICT professionals increases, asking for **self management** (stress and time management) and **management (**project management) skills.

Table 13.5 Emerging skills and competences ICT professionals, 2009-2020

Category	Skills and competences	Green Efficiency	No Utility	Old Habits
Knowledge	Legislative and regulatory knowledge			
	e-skills			
	Technical knowledge (IT)			
Social	Team working skills			
	Social perceptiveness			
	Communication			
	Networking			
	Language			
	Intercultural			
Problem solving	Analytical skills			
	Interdisciplinary			
	Initiative			
	Multi-skilling			
	Creativity			
Self management	Planning			
	Stress and time management			
	Flexibility			
	Multi-tasking			
Entrepreneurship	Understanding supplier, customers			
	Business development			
	Marketing skills			
	Trend setting / spotting			
Management	Strategic and visionary			
	Coaching and team building			
	Collegial management style			
	Change management			
	Project management			
	Process optimizing			
	Quality management			
Total emerging skills and competences		10	1	1

Note: shaded area means that skills and competences are emerging relatively fast compared with other scenarios.

13.6 Administration and customer service

The skills and competences for administration and customer services are very much similar in developments compared with ICT professionals. In “No utility” and “Old habits” projectmanagement and IT application is important as, regardless of new developments, many businesses have to invest in their primary processes. The main change in skills needed, however, occurs in “Green efficiency”. New skills are needed that are related to the competitive position. The development of firms depends much more on customer relationships, flexibility, accurateness, team work with other departments and the generation of good information.

Table 13.6 Emerging skills administration and customer service, 2009-2020

Category	Skills and competences	Green Efficiency	No Utility	Old Habits
Knowledge	Legislative and regulatory knowledge			
	e-skills			
	Technical knowledge (IT)			
Social	Team working skills			
	Social perceptiveness			
	Communication			
	Networking			
	Language			
	Intercultural			
Problem solving	Analytical skills			
	Interdisciplinary			
	Initiative			
	Multi-skilling			
	Creativity			
Self management	Planning			
	Stress and time management			
	Flexibility			
	Multi-tasking			
Entrepreneurship	Understanding supplier, customers			
	Business development			
	Marketing skills			
	Trend setting / spotting			
Management	Strategic and visionary			
	Coaching and team building			
	Collegial management style			
	Change management			
	Project management			
	Process optimizing			
	Quality management			
Total emerging skills and competences		9	2	2

Note: shaded area means that skills and competences are emerging relatively fast compared with other scenarios.

13.7 Other occupational functions

In the occupations described in the preceding sections many skills and competences could be identified that are needed in the future, especially in the scenario “Green efficiency”. Main reason for this is that in this scenario two important characteristics are changing. First, competition is introduced at a large scale making competitiveness important. Second, strict environmental regulation is applied changing the product mix of companies providing energy, water and waste services. These changes have a large impact on higher ranked professionals and lower ranked workers facilitating these professionals, but much less on lower ranked workers. The occupations analysed in this section (construction workers, plant operators and labourers) are influenced in quantitative terms (see section

12), but not very significantly in terms of skills and competences. The most significant changes are identified in Table 13.7.

Table 13.7 Emerging skills and competences other occupational functions, 2009-2020

Category	Skills and competences	Green Efficiency	No Utility	Old Habits
Knowledge	Legislative and regulatory knowledge			
	e-skills			
	Technical knowledge			
Social	Team working skills			
	Social perceptiveness			
	Communication			
	Networking			
	Language			
	Intercultural			
Problem solving	Analytical skills			
	Interdisciplinary			
	Initiative			
	Multi-skilling			
	Creativity			
Self management	Planning			
	Stress and time management			
	Flexibility			
	Multi-tasking			
Entrepreneurship	Understanding supplier, customers			
	Business development			
	Marketing skills			
	Trend setting / spotting			
Management	Strategic and visionary			
	Coaching and team building			
	Collegial management style			
	Change management			
	Project management			
	Process optimizing			
	Quality management			
Total emerging skills and competences		5	1	0

Note: shaded area means that skills and competences are emerging relatively fast compared with other scenarios.

In “No utility” the other job functions require up-to-date technological **knowledge**, especially for construction workers and plant operators. The reason is that some new electricity and waste technology is implemented as a result of high prices of natural resources. More knowledge is necessary in “Green efficiency” as in this scenario a vast range of new technologies are implemented. Not only knowledge is necessary to accommodate these changes, but also **problem-solving** skills and the **self management** flexibility, stress and time management skills.

Part III.

Available Options to Address Future Skills and Knowledge Needs, Conclusions and Recommendations

Part III. Available Options to Address Future Skills and Knowledge Needs and Recommendations - Guide to the reader

In the final third part of this report, a range of main strategic options ('choices') is reviewed, including possible actions in education and training. The report concludes with a number of conclusions and recommendations for the sector (individual firms, sector organizations, others) and policy-makers at various levels, ranging from the EU to the local level. Part III reflects steps 7 (Main strategic choices), 8 (Main implications for education and training) and 9 (Main recommendations) of the common methodology. Its contents are as follows: Chapter 14 highlights the various strategic choices in response to future skills and knowledge needs. Chapter 15 focuses on specific implications for education and training. Chapter 16 concludes by providing a number of key recommendations and conclusions.

14.Strategic choices to meet emergent skills and knowledge needs

14.1 Introduction

This chapter identifies the main strategic choices to meet the skills and knowledge needs identified (step 7). It provides a framework to pick and select the most relevant strategic choices – i.e. solutions to meet future skills and knowledge needs - available. Strategic choices refer and relate to the medium- and longer term, even though emerging skills needs in practice may also apply to the now and tomorrow. Essential in seeking appropriate solutions is to keep this longer time perspective in mind. Rather than focusing on one single solution, a set of linked strategic choices will in most cases be the best strategy to follow. Prioritising both in time (what first, where to follow up) and in allocation of resources (budgetary focus) followed by further fine-tuning is a clear necessity to guarantee that skills needs are targeted and solved. Skill needs can be identified at various levels, ranging from assessments at the national or even European sector level - which are by nature rather general - to more precise assessments at the regional and company level. Especially for large enterprises not only the identification of skills needs but also the search for adequate solutions will be an integral part of an overall longer-term business strategy. Some solutions will be found within the company itself, for instance by reorganising functions within or between plants, by offering (re)training trajectories and by active global sourcing of personnel. For SMEs and especially for micro-enterprises[16] such longer-term, more strategic human resource management often will be more difficult to organise and operationalise. It should be emphasized that at all possible levels identified different actors need to act to address skills needs and offer solutions and preferably also in close concert. These can be individual firms, organised interests at the sector level (employers and employees), but also others. Local, regional and national governments have also a important role to play. This chapter offers first of all a better insight in the 'menu' of possible strategic choices (section 14.2). It also provides for a framework that can identify skills needs at the appropriate level and helps to decide which should be the actual choices to be made (see section 14.3). This framework is subsequently applied to the electricity, gas, water and waste sector (section 14.4).

14.2 Possible strategic choices

The possible strategic choices contained in this chapter refer to the strategic choices originally proposed by Rodrigues (2007: 42) as well as a number of other, additional choices. Whereas *strategic* choices mostly refer to the medium and longer term, most of the choices mentioned can also be implemented in the short run, to 'mend' existing skills shortages and/or skills gaps. Each of the solutions at hand differs in whether or not it can resolve direct skills shortages and/or gaps. A longer term horizon, however, means that there is possibility of adapting, steering and fine-tuning the available solutions towards a more optimal allocation of skills supply and demand. In view of the time horizon, the

[16] Defined as firms with less than 10 employees.

period up to 2020, the strategic choices and instruments with a more long-term impact especially need to be addressed. Identification of possible solutions obviously is not enough. Concrete initiatives, policy and strategic decisions need to be taken at all appropriate levels with each actor having a different responsibility and a different role to play.

Strategic choices to meet future skills needs need to be taken by a number of actors and at different levels (firm, local, regional, national, sectoral). For obvious reasons, firms are an important player in finding solutions for the skills needs – both in volume (skills shortages) and in matching any existing skills gaps. Companies avail of a number of options to meet their skills needs. These include:

A. Recruiting workers from other sectors

B. Recruiting workers from other Member States

C. Recruiting workers from non-Member States

D. Recruiting unemployed workers with or without re-training

E. Recruiting young people coming from the education system, with or without re-training (first job recruits)

F. Training employed workers

G. Changing the work organisation (including network collaboration and mergers)

H. Outsourcing and offshoring.

Sectoral organisations, educational institutions and governments also have a role to play. They will be the prime actors in addressing the following options:

I. Changing general and vocational education

J. Designing and offering new courses (continuing vocational education and training)

K. Providing information about jobs and (emerging) skills: career guidance; updating job profiles regularly.

L. Improve the image of the sector (joint action of companies together)

M. Stronger cooperation with the industry (internships, company visits for participants in education, image improvement).

A more detailed description of these strategic options can be found in annex III. Whether these strategic options are feasible and viable depends on a number of factors. In order to discuss and select from the available list of strategic options, one should first - as described in the introduction - know whether and when skills needs are indeed likely to arise, both in quantitative (number of job functions) and in qualitative terms (what knowledge and skills). An important question that needs to be addressed first is at what level and to whom the skills needs question applies. Obviously for an individual firm different information is required for identifying these needs and taking the right action than for a national ministry or a training institute.

The identification of possible strategic choices would in principle require extensive and detailed future analysis at the Member State and preferably also the regional level of skills and knowledge demand and supply patterns by job function and sub-sector, in a similar way and along the steps provided by the methodology of this study so far. The methodology and step-wise approach followed are applicable at the national and regional level of analysis. Ideally, these results should be complemented by the results of labour market model forecasts to corroborate results. Such an analysis would also need to include an assessment of the numbers and skills composition of currently being educated, i.e. an assessment of all cohorts of primary, secondary and tertiary pupils and students (and their skills potential) currently in the educational system and arriving at the labour market in the oncoming years. It would need a thorough assessment of the current educational and training system itself, including the already decided changes herein for the oncoming years, to see whether the system as it is now in place is able to satisfy the prevailing and future new skills demands both in terms of numbers of new potential recruits and in terms of skills and knowledge.

14.3 Matching future skills and knowledge needs by making the right choices

In order to address the identified future skills and knowledge needs in an encompassing and timely manner, appropriate joint action is needed by all stakeholders, including the industry (firms, sector organisations and social partners), training and education institutes, intermediary organisations and, last but not least, government at all levels (EU, national, regional and local). Collaboration and co-operation between stakeholders will be needed, at all decision-making levels, in order to agree on and implement a package of feasible solutions. In order to prepare for this, timely, targeted and reliable information is essential.

This section presents a targeted short-cut strategic options decision tool to enable and support decision-makers in making the right (mix of) choices, supported by appropriate and reliable information on actual needs, possible choices and stakeholders to be involved. The strategic options decision tool is aimed to provide answers and solutions at the job function level and consists of a shortlist of a number of key questions - a concise menu of choice -, with answers providing decision-relevant information about the need and viability of available options. The questions need to be answered at the national, and where relevant at the regional level so as to map and identify the specific sector needs. The decision tool can also be used at the level of the firm. New job function information (e.g. new upcoming functions) can be added where thought relevant.

The key question list – consisting of six ‘framing’ questions, followed by option-specific questions - should be filled in for each job function. The ‘framing’ questions constitute a summary of main expected quantitative and qualitative skills needs developments. The filling in of the list should, however, only be done on the basis of an informed discussion between several stakeholders involved, representing together an informed body of knowledge on the various aspects at stake, including labour market developments and prospects at the sub-sector level, skill and knowledge requirements at job function level and developments in and make up/orientation of the educational and training system.

Key questions for identifying skills and knowledge needs

Question 1. Is the demand for workers expected to decrease or increase between now and 2020? (both related to market prospects and replacement demand due to ageing)

> If decreasing, there is probably less need for recruiting workers from other sectors and (non-) Member States and less need for recruiting unemployed.
>
> If increasing, analyse whether less radical options are enough to meet demand or whether options should be chosen like recruiting workers from other sectors and (non-) Member States and recruiting unemployed. *[Note: see Table 12.1 for estimated volume effects per scenario.]*

Question 2. Are the required qualitative skills expected to be rather stable between now and 2020?

> If there are not many changes in required skills and knowledge, there is probably no need to apply many strategic options. Please focus on the options that are most effective.
>
> If many skills and knowledge categories are changing, there is probably a need to apply many strategic options. Create a package of strategic options to meet skill needs. *[Note: see Table 13.2 and following for the number of competences changing per job function per scenario.]*

Question 3. Do SMEs and especially small companies (including micro enterprises) play a large role in the sector?

> If yes, several options (like recruiting) are less viable for companies themselves as it is often difficult for small companies to organize this. If this is the case, sector organisations or intermediary organisation might play an important role in helping to match supply and demand. Another solution could be found in changing the work organisation. Through cooperation or mergers, for instance, the relevant scale can be increased which makes it easier to use these options. The same holds, more or less, for the organisation of training and re-training. Larger (associations of) companies have less difficulties to organise this and the need for support from other actors is lower. *[Note: see Table 3.12 for share of firms per size class.]*

Question 4. Are companies in general active on Member State level, EU level or global level?

> Companies who are active on a larger regional level will have, in general, more opportunities to use the option of recruiting workers from other Member States (for companies active at the EU level) and the option recruiting workers from non-Member States (for companies active at the global level). The same holds for the option offshoring. *[Note: see chapter 3]*

Question 5. Are workers in a job function in general low-educated?

> If yes, training is less easy to implement as a viable option as difficulties arise in organising this, while the need for training might be even higher. *[Note: see Table 3.13, for education shares]*

Question 6. Are workers in a job function in general old (i.e. older than the average age in the subsector and compared to other sectors)? *[Note: see section 3.2, for age structure.]*

> If yes, training is less easy to implement as a viable option as difficulties arise in organising this and less new knowledge endogenously enters the companies, while the need for training might be even higher.

Key questions for identifying suitable options and relevant acting stakeholders

The six questions form the first part of the short-cut approach. The second part discusses the viability of strategic options to tackle and solve emergent skills and knowledge needs for each of the job functions identified. It confronts the list of available strategic options with the analysis of quantitative and qualitative developments on headlines based on the preceding six questions. For each job function identified an assessment is made on whether the available strategic options are relevant or not, and who should be prime actors to change the current situation into a more favourable direction. If the strategic option is considered relevant, a "yes" is filled in, else a "no" is included. If the strategic option is dependent on specific characteristics of the sub-sector or components thereof, this is included in the table. For example, if recruiting workers from other Member States is only an option for large companies a "Yes, but only for large companies" will be included. Characteristics that are dealt with in the table are based on the six question analysis, representing:

- The change in volume (as a reference we include the most challenging scenario, requiring most change)
- The change in skills (as a reference we include the most difficult scenario, which is often the scenario with the largest change in skills and knowledge needs)
- Education level
- Age of the workforce
- Scale of the company and region the company is working in.

In the following tables 14.1 to 14.6 various actors are identified. It should be noted, however, that in nearly all cases companies should have the lead. They have the knowledge to identify skill gaps and needs. An important difference in this respect exists between large scale companies and SMEs. Where large companies can identify needs and provide answers to these needs, SMEs and especially small companies have much less possibilities to do that. They should be helped by sector organisations, intermediary organisations and governments. But also for large companies these organisations are often needed to arrive at the optimal package of needs handling. Cooperation, therefore, is a key word in fighting skill gaps. It is absolute necessary that a powerful leader is present who organises the changes needed. Here, timing is also important. While large companies are able to cope with medium term options and small companies are probably more focused on the short term, governments and organisations will have to take the lead for long term options beyond the scope of companies.

It should be noted that not all occupational functions are crucial for a positive future development path. Most crucial are engineers. If they lack in volume or technical skills, major problems like 'black-outs' can occur with disastrous results in the future. It is

absolutely essential that actors guarantee that utilities can function constantly at a level needed by people and companies.

In principle, the following tables can be made scenario-dependent. In the descriptions below, the *Green Efficiency* scenario has been taken as the point of reference as the most demanding and dynamic in terms of up-skilling, knowledge upgrading and change.

Table 14.1 Strategic options managers

1. What is the maximum volume effect?	Increase
2. What is the maximum change in skills?	20
3. Do SME's play a large role?	Yes
4. Is the sector national/EU/global?	National/EU
5. Is the workforce old?	Somewhat
6. Is the workforce low educated?	No

Option	**Is this option viable?**	**Actors[1]**
A. Recruiting workers from other sectors	Particularly from the private sector (e.g. the trade banking sector)	C
B. Recruiting workers from other Member States	Yes, but difficult for SME's and often language barrier	C, E, G, I
C. Recruiting workers from Non-Member States	Possible but not very plausible (high-skilled managers available in Europe), for SME's impossible	C, E, G, I
D. Recruiting unemployed with or without re-training	In rare cases	C
E. Recruiting young people from the education system	Apprenticeships and manager training for young professionals is solution for long term	C, E
F. Training and re-training employed workers	In-house promotion and further training in the firm, difficult for aged workforce	C, E
G. Changing work organisation	Team work, upscaling (mergers, acquisitions)	C
H. Outsourcing and offshoring	Yes, but not for many skills	C
I. Changing vocational education	Not necessary	
J. Designing and offering new courses	Custom-fit courses	C, S, E
K. Providing information about emerging skills	Not necessary	
L. Improve the image of the sector	Yes	
M. Stronger cooperation between stakeholders	Not necessary	

Notes: 1. C (company), S (sector organisations and chambers of commerce), U (trade unions), E (education & training), G (governments and regulators), I (intermediary organisation, public or private).

Table 14.2 Strategic options business and finance professionals

1. What is the maximum volume effect?	I	
2. What is the maximum change in skills?	17	
3. Do SME's play a large role?	Yes	
4. Is the sector national/EU/global?	National/EU	
5. Is the workforce old?	Somewhat	
6. Is the workforce low educated?	No	
Option	**Is this option viable?**	**Actors[1]**
A. Recruiting workers from other sectors	Yes (banking sector, sales and marketing managers from other industry sectors)	C
B. Recruiting workers from other Member States	Yes, but difficult for SME's and often language barrier	C, E, G, I
C. Recruiting workers from Non-Member States	Possible but not very plausible (high-skilled managers available in Europe), for SME's impossible	C, S, E, G, I
D. Recruiting unemployed with or without re-training	In rare cases	C
E. Recruiting young people from the education system	Yes (apprenticeships and manager training for young professionals)	C, E
F. Training and re-training employed workers	Yes , but difficult for older workers	C, S, E
G. Changing work organisation	Yes (team work, job enlargement and enrichment)	C, I
H. Outsourcing and offshoring	Yes, but limited and often option of last resort (finance, trade, marketing, sales)	C
I. Changing vocational education	In some Member States necessary	
J. Designing and offering new courses	Yes (custom-fit courses dedicated to sector)	C, E
K. Providing information about emerging skills	Not necessary	
L. Improve the image of the sector	Yes	
M. Stronger cooperation between stakeholders	Not necessary	

Notes: 1. C (company), S (sector organisations and chambers of commerce), U (trade unions), E (education & training), G (governments and regulators), I (intermediary organisation, public or private).

Table 14.3 Strategic options engineers

1. What is the maximum volume effect?	I	
2. What is the maximum change in skills?	11	
3. Do SME's play a large role?	Yes	
4. Is the sector national/EU/global?	National/EU	
5. Is the workforce old?	Somewhat	
6. Is the workforce low educated?	No	
Option	**Is this option viable?**	**Actors[1]**
A. Recruiting workers from other sectors	Yes, particularly for construction, but limited due to specific knowledge and often short term	C
B. Recruiting workers from other Member States	Yes, but difficult for SME's and often language barrier, limited due to specific knowledge and language	C, S, E, I
C. Recruiting workers from Non-Member States	Limited option , very difficult for SME's, for some countries easier than for others (language)	C, S, E, I
D. Recruiting unemployed with or without re-training	Yes, but training often necessary, dedicate it to special groups with high potential (e.g. women)	C
E. Recruiting young people from the education system	Yes	C
F. Training and re-training employed workers	Yes, but often (not always) more difficult for older workers	C, E
G. Changing work organisation	Team work, job enlargement and enrichment, reorganising processes	C, I
H. Outsourcing and offshoring	Yes for outsourcing, no for offshoring, but everybody has same problems (no long term solution, but solution of last resort)	C
I. Changing vocational education	Yes, especially for technical specialist, but takes much time. Life long learning is important. In many countries not yet available.	C, S, E
J. Designing and offering new courses	Yes, especially for technical specialist, custom-fit courses. Life long learning important, short courses at workplace preferable, also online education.	C, S, E
K. Providing information about emerging skills	Yes, but country specific	C, S, E, G
L. Improve the image of the sector	Yes, start early (basic education)	C, S, I, G
M. Stronger cooperation between stakeholders	Yes	C, S, E, G

Notes: 1. C (company), S (sector organisations and chambers of commerce), U (trade unions), E (education & training), G (governments and regulators), I (intermediary organisation, public or private).

Table 14.4 Strategic options ICT professionals

1. What is the maximum volume effect?	I	
2. What is the maximum change in skills?	10	
3. Do SME's play a large role?	Yes	
4. Is the sector national/EU/global?	National/EU	
5. Is the workforce old?	Somewhat	
6. Is the workforce low educated?	No	
Option	**Is this option viable?**	**Actors[1]**
A. Recruiting workers from other sectors	Yes (IT software developers, programmers within other business sectors)	C
B. Recruiting workers from other Member States	Yes, but difficult for SME's and often language barrier	C, S, E, I
C. Recruiting workers from Non-Member States	Yes, but very difficult for SME's and often language barrier	C, S, E, I
D. Recruiting unemployed with or without re-training	In rare cases	C
E. Recruiting young people from the education system	Yes	C, E
F. Training and re-training employed workers	Yes, but difficult for older workers	C, E
G. Changing work organisation	No	
H. Outsourcing and offshoring	Yes	C
I. Changing vocational education	Not necessary	
J. Designing and offering new courses	Yes, for specific skills	C, S, E
K. Providing information about emerging skills	Yes	C, S, E, G
L. Improve the image of the sector	Yes (no IT-image yet)	C, S, I
M. Stronger cooperation between stakeholders	Yes	C, S, E, G

Notes: 1. C (company), S (sector organisations and chambers of commerce),), U (trade unions), E (education & training), G (governments and regulators), I (intermediary organisation, public or private).

Table 14.5 Strategic options administration and customer service workers

1. What is the maximum volume effect?	D	
2. What is the maximum change in skills?	9	
3. Do SME's play a large role?	Yes	
4. Is the sector national/EU/global?	National/EU	
5. Is the workforce old?	Somewhat	
6. Is the workforce low educated?	In some regions/firms	
Option	**Is this option viable?**	**Actors[1]**
A. Recruiting workers from other sectors	Yes (e.g. wholesale sector)	C
B. Recruiting workers from other Member States	Yes, but limited in scope due to language, difficult for SME's	C, S, E, I
C. Recruiting workers from Non-Member States	Unlikely option	
D. Recruiting unemployed with or without re-training	Yes, training necessary	C, S, E
E. Recruiting young people from the education system	Yes	C
F. Training and re-training employed workers	Yes, difficult for older workers	C, E
G. Changing work organisation	Yes (team work, job enlargement and enrichment)	C
H. Outsourcing and offshoring	Yes (e.g. sales, e-commerce, CRM)	C
I. Changing vocational education	No	C, S, E
J. Designing and offering new courses	Yes (dedicated to utility sector)	C, E, S
K. Providing information about emerging skills	Yes	C, S, I
L. Improve the image of the sector	No	C, I, G
M. Stronger cooperation between stakeholders	Yes	C, S, I, G

Notes: 1. C (company), S (sector organisations and chambers of commerce), U (trade unions), E (education & training), G (governments and regulators), I (intermediary organisation, public or private).

Table 14.6 Strategic options other occupational functions

1. What is the maximum volume effect?	I	
2. What is the maximum change in skills?	5	
3. Do SME's play a large role?	Yes	
4. Is the sector national/EU/global?	National/EU	
5. Is the workforce old?	Somewhat	
6. Is the workforce low educated?	No	
Option	**Is this option viable?**	**Actors[1]**
A. Recruiting workers from other sectors	Yes	C
B. Recruiting workers from other Member States	Yes, especially for low skilled labour, difficult for SME's	C, S, E, I
C. Recruiting workers from Non-Member States	Yes, especially for low skilled labour, difficult for SME's	C, S, E, I
D. Recruiting unemployed with or without re-training	Yes	C
E. Recruiting young people from the education system	Yes	C, E
F. Training and re-training employed workers	Yes, difficult for older workers	C, E
G. Changing work organisation	Yes (team work, job enlargement and enrichment)	C, I
H. Outsourcing and offshoring	Yes, mainly outsourcing	C
I. Changing vocational education	Not necessary	
J. Designing and offering new courses	Not necessary	
K. Providing information about emerging skills	Yes	C, S, I
L. Improve the image of the sector	Not necessary in general (important exceptions exist)	
M. Stronger cooperation between stakeholders	Yes	C, S, E, G, I

Notes: 1. C (company), S (sector organisations and chambers of commerce),), U (trade unions), E (education & training), G (governments and regulators), I (intermediary organisation, public or private).

14.4 Scenario implications, future skills and knowledge needs and possible solutions: summary and main conclusions

Implications of the scenarios in terms of expected volume changes in employment (jobs), future skills and knowledge needs as well as ways to address and solve these needs (strategic choices) have all been analysed so far at the individual job function level. This section serves to summarise the main implications and solutions for each of the job functions presented in chapters 12, 13 and 14. It serves as a bridge to the next chapter where we shift from a micro perspective (job functions) to a meso (sector and policy) perspective.

Table 14.11 Summary of job volumes, skills changes, strategic choices and main players for anticipatory action by scenario				
		Old habits	**No utility**	**Green efficiency**
Managers	1. Employment volume change	M	I	I
	2. Skills changes counted	Count 4	Count 8	Count 20
	3. Emerging skills needs	Management, Social	Management, Social	Management, Entrepreneurial, Social, Problem-solving, Knowledge
	4. Most important solutions	Recruitment from other sectors, custom-fit training, apprenticeships, image-building	Recruitment from other sectors, custom-fit training, apprenticeships, image-building	Recruitment from other sectors, custom-fit training, apprenticeships, image-building
	5. Most important actors	C, E	C, E	C, E
Business and finance Professionals	1. Employment volume change	M	M	I
	2. Skills changes counted	Count 1	Count 3	Count 17
	3. Emerging skills needs	Management, Social	Management, Social	Management, Entrepreneurial, Social, Knowledge, Self-management, Problem-solving
	4. Most important solutions	Recruitment from other sectors, recruitment young staff, custom-fit training, apprenticeships, image-building	Recruitment from other sectors, recruitment young staff, custom-fit training, apprenticeships, image-building	Recruitment from other sectors, recruitment young staff, custom-fit training, apprenticeships, image-building
	5. Most important actors	C, E	C, E	C, E
Engineers	1. Employment volume change	M	I	I
	2. Skills changes counted	Count 1	Count 3	Count 11
	3. Emerging skills needs	**Knowledge**	**Knowledge**, Management	**Knowledge**, Problem-solving, Self-management, Management
	4. Most important solutions	Recruitment from other sectors, custom-fit and new training, changing vocational education, provision information, image-building, stronger cooperation	Recruitment from other sectors, custom-fit and new training, changing vocational education, provision information, image-building, stronger cooperation	Recruitment from other sectors, custom-fit and new training, changing vocational education, provision information, image-building, stronger cooperation
	5. Most important actors	C, S, E	C, S, E	C, S, E
ICT professionals	1. Employment volume change	M	M	I
	2. Skills changes counted	Count 1	Count 1	Count 10
	3. Emerging skills needs	Knowledge	Knowledge	Social, Problem-solving, Knowledge, Self-management,Management, Entrepreneurial
	4. Most important solutions	Recruitment from other sectors, recruitment young staff, training, provision information, image-building, stronger cooperation	Recruitment from other sectors, recruitment young staff, training, provision information, image-building, stronger cooperation	Recruitment from other sectors, recruitment young staff, training, provision information, image-building, stronger cooperation
	5. Most important actors	C, S, E	C, S, E	C, S, E

		Old habits	No utility	Green efficiency
Administration and customer service	1. Employment volume change	M	M	D
	2. Skills changes counted	2 Count	Count 2	Count 9
	3. Emerging skills needs	Knowledge, Management	Knowledge, Management	Knowledge, Self-management, Social, Problem-solving, Entrepreneurial
	4. Most important solutions	Recruitment from other sectors, recruitment young staff, training, changing work organisation, provision information, stronger cooperation	Recruitment from other sectors, recruitment young staff, training, changing work organisation, provision information, stronger cooperation	Recruitment from other sectors, recruitment young staff, training, changing work organisation, provision information, stronger cooperation
	5. Most important actors	C, S, E, I, U	C, S, E, I, U	C, S, E, I, U
Cother functions	1. Employment volume change	M	I	I
	2. Skills changes counted	Count 0	Count 1	Count 5
	3. Emerging skills needs	-	**Knowledge**	**Knowledge**, Problem-solving, Self-management
	4. Most important solutions	Recruitment from other sectors, recruitment young staff, training, changing work organisation, provision information, stronger cooperation	Recruitment from other sectors, recruitment young staff, training, changing work organisation, provision information, stronger cooperation	Recruitment from other sectors, recruitment young staff, training, changing work organisation, provision information, stronger cooperation
	5. Most important actors	C, E, I, S, U	C, E, I, S, U	C, E, I, S, U

C=Companies; S=Sectoral organisations, U=trade Unions; E=Education and training institutes; G=Government (EU, Member State, regional, local)

15. Conclusions and recommendations for education and training

15.1 Introduction

This chapter presents the main conclusions and recommendations for education and training; chapter 16 presents the main other conclusions and recommendations. Whereas the earlier chapters very much take a micro perspective by focusing on job functions in terms of expected volume changes, skills and knowledge needs and ways to address and solve these needs (strategic choices), chapter 15 takes a *meso* or *sector* perspective. It addresses a number of issues, part of which coming already to the fore in earlier chapters, and part being 'new' issues although much related to those already raised. The conclusions and recommendations are mostly based on the results of the preceding chapters; they were discussed during the final workshop with social partners, the industry and other experts. It includes examples of initiatives from some of the larger EU Member States, in particular the UK, Germany and France, based on a review of the literature.

The recommendations contained in this chapter should not be seen as fully exhaustive. They rather form the basis for further discussion and elaboration at various decision-making levels, ranging from the European Union and the Member State to the regional and local level. Industry itself – firms – have an important role to play, as do education and training institutes, social partners and the government (EU, national, regional and local). In most cases action should be taken jointly, by involving various actors, sometimes even at different levels. Collaboration and co-operation as buzzwords in today's economy are easily coined. Making collaboration work in practice is, however, a challenge which requires mutual understanding, compromise and perseverance.

15.2 Conclusions and recommendations for education and training

1) Adapt and modernise vocational education and training (VET) and general education systems, but do this on a national basis rather than for the EU as a whole

Both vocational education and training (VET) systems and the general education systems (primary, secondary and tertiary education) differ considerably between Member States, in terms general set-up, organisation and implementation (see Box 6).

Most conclusions and recommendations should be based on the particularities of the existing education systems in the Member States, or even regions. This obviously is beyond the scope of this study. Some general observations can, however, be made. As a general trend most Member States at all levels of education tend to focus more than in the past on 'teaching' soft skills, by integrating soft-skills related lessons in existing curricula. One also observes a counterdevelopment in that in some Member States there is again a call for conventional knowledge and the teaching of 'harder' skills, as the attention for soft skills would go at their expense. This holds both for secondary education (relating to essential knowledge of foreign languages, mathematics, physics and chemistry) as well as university education (too broad curricula).

Box 6. Vocational education and training– rich variety between Member States

A number of different systems in Vocational Education and Training (VET) as well as Initial and Continuing Vocational Education and Training (IVET and CVET) can be observed throughout the European Union. Various characteristics of these systems have to be taken into consideration when discussing possible specific implications for education and training. Existing VET-systems can be grouped into three main categories ('idealtypes'), (i) liberal, (ii) state-controlled and (iii) corporatist VET-systems, each having a different underlying rationale and distinguishing characteristics. Key in this distinction are those who decide about the structure and content of VET: business itself, the state or the state together with social partners (see Table to box 6 below). The three VET-systems of Germany, France and the United Kingdom are of special importance as they can be taken as representative for each of the three 'idealtype' categorisations. They are evidence of the rich variations in existing VET systems and their implementation in Europe. The enterprise-based training system of Germany (the 'Dual System') is implemented by the social partners and the state. Next to this prevailing system other forms of VET exist. In France, a school-based training system is established and implemented by the state. Even though the full-time school-based training system competes to some extent with an upcoming apprenticeship training system, it is still the dominant form of vocational training in France. The system implemented in the UK, the national vocational qualification, is regulated and driven by market forces in several important segments. Although national vocational qualifications (NVQ) and general national vocational qualifications (GNVQ) are regulated at national level, the implementation of training is not yet regulated at national level. Commercial certification systems are still competing with national ones. Work-based, as well as full-time school-based training can be found. Special training schemes for unemployed, such as school-based schemes for unemployed youths or work social enterprises for long-term unemployed, are present in several European Member States. Besides these 'idealtypes' several mixed forms in Europe exist. In Spain, for example, one finds more informal forms of VET and in Central and East European countries the trend can be detected, that VET moves from a state centred model to a stronger corporatist model, while also business driven approaches exist in some sectors.

Table to Box 6. Three 'ideal-type' VET-models (elaborated from Clematide, 2005)

	A. Liberal	**B. State-controlled**	**C. Corporatist**
Decision maker	Business (and individuals)	State	State and social partner organisations
Rationale	Liberalistic competitive	Centralistic state-centred	Corporative – social consensus
Programmes	Business and individual	Education and citizen	Occupation
Content	Needs of business and individual, utility oriented, short term and specific	Politically determined, general knowledge, course-oriented, academic	Determined by social partners, occupation centred, traditions
Labour markets VET relates to	Internal (business) labour markets	Occupational and internal labour markets	Occupational labour markets
Strengths	Flexible, cheap for the state, close to the needs of production	Strong linkage to the education system, no lack of training places	Broad vocational educations with status equal to general education
Weaknesses	Under-investment in training and education	Weak linkage to the labour market	Inertia in the institutions
Representatives	United Kingdom, Ireland	France	Germany, Austria, Denmark
Trends	Stronger state involvement in certification and quality	"Dual system" emerging and stronger orientation on business needs	Internal labour markets Marketing of VET

The different VET systems in Europe all have their own merits. It would make no sense to try to standardise VET throughout Europe. Rather expected future developments in the sector and important differences in how the various VET-Systems function in practice, call for a different set of measures in each of the Member States. The remainder of this section includes

a discussion the most important measures to adapt and modernise existing systems at the Member State level.

2) Improve the information provision on skill needs and job requirements: essential for improving training and education

The information gap between existing and future education and training needs as well as education and training supply is still obvious. Consequently, a mismatch between actual VET supply and demand in quality as well as - to a lower extent - in quantity is observed for some occupational functions. Training providers are often not meeting the training needs and do not respond on emergent training needs in a sufficient way (especially regarding vocational training systems).

SME's often have difficulties in financing CVET and in finding suitable solutions to training leaves of their staff. Consequently, a major implication for education and training is the establishment of improved information systems on current and emergent skills needs and job opportunities. Information systems on the sectoral level as well as on the regional, the national and the European level assist in minimising information asymmetries in order to overcome skill gaps resulting from information deficits. Facilitating students by entering the labour market and finding a suitable occupation is just as much important as assisting employees to find new job opportunities based on their existing skills or guiding them in finding the fitting vocational training course.

3) Collaborate with all relevant stakeholders and intensify co-operation in education and training

Close collaboration between all relevant stakeholders, such as companies, education and training organisations, social partner organisations, research institutions and public authorities, supports minimizing information deficits on current and emergent skills needs. This is important in utilities in the scenario "Green efficiency" as many volume and skill changes take place. The old system has to adapt to the new situation and collaboration is an effective instrument to stimulate that in VET these changes are implemented. A stronger linkage between industry and education and training is recommended in state driven full-time school-based VET-Systems (Koch and Reuling, 1998). In all countries, and in the new Member States in particular, co-operations are essential to improve the practical orientation in VET (Skjølstrup and Mayen, 2007). The 'Sector skills councils'[17] in the United Kingdom and the 'FreQueNz' research network[18] are examples of this kind of co-operation and are described below.

The 'Sector skill councils' in UK are funded by the Department for Innovation, Universities and Skills and are part of the government's skills strategy for the 21st century. The councils ensure that individuals gain the skills they need so that persons with fitting skills are available. Sector skills strategies are defined for each sector based on the analysis of present and future skills needs.

FreQueNz is a research network located in Germany and funded by public means. The network comprises scientific institutes, education and training organisations, social partner organisations, companies and public authorities and contributes to early identification of

[17] www.sscalliance.org
[18] www.frequenz.net

qualification needs. This network has conducted a number of evaluative research projects on human and ICT resources, staff qualifications, tests, career guidance for adults, computerised career guidance programmes, and beneficiaries of guidance services.

4) Strengthen co-operation in sector-specific training measures

In order to keep pace with technological and subsequent organisational developments flexible and up-to-date training offers are required in the sector. The demand for building up co-operation between companies, social partners, training providers and research institutions is obvious. Interactions between the actors involved should take place on a regular basis and should be implemented in a dynamic way. Such cooperation would help to implement the concept of the "knowledge triangle", that is to say, to connect education with research and the innovation processes. Thus, trainings should aim to make workers acquainted with emergent processes in sector-specific innovations, research processes, and new educational settings (such as micro-learning, the use of social software and other networking practices). Since the trainings should especially meet the specific demands of SMEs, the participation of SMEs in the design process of the trainings should be promoted and encouraged. Chambers of Commerce and training providers are expected to play a major role in organising joint efforts.

5***) Facilitate training co-operations between SMEs***

The prevalence of SMEs in parts of the utilities sector makes co-operation for initial and continuing vocational training necessary. These co-operations should be supported by national training bodies and sectoral social partner organisations and supported by public funding. Existing models should be made public and good practice examples should be disseminated. Joint training networks should be used for apprenticeships but also for the training of the employees of the sector. In regional centres of the sector provincial or regional authorities can support the establishment of training co-operations.

6) Build joint training facilities

Especially for small companies training is costly. Therefore, joint training facilities financed by sector organisations, companies (also engineering companies) and public authorities should be established for initial and continuing vocational training to keep the workforce up-to-date.

7) Enhance flexibility through modularisation of education and training

Strengthening the information basis on skill demands and supply of training as well as career possibilities are the basis for an enhanced flexibility (and adaptability) of continuing vocational education and training. In our view, flexibility refers to the capability of the VET System to adapt effectively to new training needs in terms of quality and quantity. A flexible VET-System is required in particular in circumstances in which profound changes take place and job functions and occupational profiles are modified quickly (as is the case in the scenario "Green efficiency"). In order to achieve more flexibility and to respond in-time with altering training contents and enhanced quantity a modularisation of education and training is recommended. Even if problems will occur in the modularisation of training in some IVET-Systems modular systems facilitate the building up of competences and ease the interaction between IVET and CVET Systems. Flexibility is also required for different forms of education and training. Flexible forms of blended learning contribute to enhanced participation of, in particular, SME employees in continuing vocational training (SMEs often face difficulties in releasing workers for training).

Blended learning is a mixture of different learning media, learning methods and forms supporting decentralised, self-directed and efficient learning more independently in time and space. In principle, blended learning combines face-to-face and group-based learning with up-

to-date offline media and online e-learning forms, as for example digital learning modules on websites, video conferences, joint learning applications, newsgroups and blogs for interactive online learning. This is not only a possibility to reduce costs of further training and enhance flexibility to combine work with training, but it also has positive effects on skills which will be needed in the future. Because large parts of this training are self-directed and informal, the learner has to build up several competences, like self reflection, self motivation, strength of purposes and an effective information processing.

8) Supply special courses dedicated to sector characteristics

For some job functions special courses are needed. The lack of available courses, the suitability of existing courses and the missing flexibility on offer are currently already pointed out in several studies on the energy, gas, water and waste sector.[19] This is especially the case in the scenario "Green efficiency" for the existing workforce as they have to operate in a changing environment. This asks for a different attitude and knowledge base. Especially in cases where firms are used to operate in a tranquil environment, the challenges of fast changes in environmental regulation and competition are demanding. Firms that are able to improve the skills of the workforce fast, have a competitive advantage. Education and training institutions can exploit this situation to provide dedicated courses.

9) Supply special courses for older workers

The workforce in several occupational functions is ageing. Education and training institutions should take this development into account for the design of their further training measures and develop specific courses. Older workers are able to learn, but they learn differently compared with younger workers. Older learners have in some cases more problems with theory-based, upfront teaching only focused on examinations. For older learners this kind of training is less effective, because they can not relate it to their practical knowledge. The practical application is often missing, and the passivity of the situation is not supporting mature age learners. For mature age workers learning is more effective if they can integrate practical experience in training.

10) Enhance transparency of the quality of training as well as improving the trans-national recognition of vocational qualifications

Due to the fact that a common certification system is still missing in EU, vocational qualifications are not recognised in all countries. In addition training often takes place in form of non-standardised and not-certified courses, which limits the possibility to assess its quality and to include it in worker skills profiles. Difficulties in assessing workers' skills also occur when workers are recruited from other countries or sectors. The implications of the missing certification system are crucial. The setting up of a common certification system is a necessity in order to also make the quality of further training more transparent and to increase mobility of the workforce. Programmes to stimulate mobility as such (by short- and mid-term exchange programmes) might help in this respect. This sheds light on the need to make better use of existing European programmes (e.g. Leonardo da Vinci) and of support made available by the Structural Funds.

11) Include multi-skilling

For several occupations multi-skilling becomes important in the scenario "Green efficiency". For engineers, for instance, not only up-to-date technical knowledge is essential, but also knowledge about customer demands. Multi-skilling refers to training an amployee in covering a range of activities ('jobs') in one workplace. To pursue this goal and be able to offer

[19] www.euskills.co.uk/home/index.php?pageID=30

applicable courses for the industry, not only co-operations between the training sector and companies of the utilities sector are needed but also between different training providers. In several countries, there are already existing stable co-operations between the industry and universities, colleges and other private training providers, but these could be enhanced and strengthened. The main purpose for this should be to provide combined and interlinked training modules for the sector.

12) Pay more attention to combining technical and soft skills
While technical skills are very essential for the sector, soft skills become more important. The sector, together with education and governments, should organise training facilities that stimulate the combined development of technical and soft skills. It is absolute essential that the development of soft skills does not have a negative impact on technical skills as these are essential to guarantee security of production. However, if soft skills are combined with technical skills firms can compete better in the increasing competitive market.

13) Pay more attention to interdisciplinary and multidisciplinary studies
In vocational education and training more attention should be paid to inter- and multidisciplinary studies as different technical skills need to be combined with the required non-technical skills. Even though a sound technical education still provides the basis attention will have to be paid to enhance other skills such as project management, languages and competencies in business development. Such elements should also be an integral part of apprenticeship and traineeship programmes.

14) Ensure the up-skilling of low skilled technical production workers
To ensure employability of lower skilled technical production workers in utilities and to train them for other occupations in the sector, up-skilling and retraining is a necessary investment. Public authorities such as the public employment service or communities (as their responsibility for regional development) should engage and support companies and individuals in their training efforts. For this reason an adult apprenticeship model could be developed and applied.

16 Main other conclusions and recommendations

16.1 Introduction

This report concludes with a number of ‘other’ (i.e. going beyond eduction and training) conclusions and recommendations based on the results and insights gained during the course of this study. They include the results of an intensive two day workshop with various stakeholders and the European Commission during which the draft final results, including preliminary recommendations, were discussed. The conclusions and recommendations apply to the sector at large (including individual firms, sector organisations, chambers of commerce, social partners), intermediary organisations, education and training institutes, as well as policy-makers (EU, Member States, regions).

The recommendations point into viable and useful directions rather than that they represent ready-made proposals for change. Reflection and debate, and finding creative answers to

plausible futures in skills and jobs is, in the absence of a crystal ball, the way forward. The bandwidth between the expected developments in the most extreme scenarios is indicative for the degree of uncertainty by which the future should be approached. Solutions to future skills needs should therefore be flexible, smart and encompassing enough to address the differences between the various scenario outcomes, not knowing what real future will eventually emerge.

16.2 Main other recommendations

1) Improve collaboration between all stakeholders

A principal recommendation to meet emerging skills needs is to intensify co-operation between all relevant stakeholders in the sector. The challenge to overcome sectoral skill gaps and shortages will only be met sufficiently if industry, training providers, social partners, research and public authorities act in concert. This was demonstrated in section 15 A collaboration is not only required to meet skills needs, but also to support the development of sectoral learning strategies and the establishment of partnerships for innovation and job creation.

2) Improve the image of the sector – among the young and the overall working population, especially women

Especially the image of lower skilled and ICT workers in the utilities sector is poor. Campaigns to improve the image of the sector should also integrate the objective to attract more women to the technical occupation functions in the sector. This approach is recommended where skill gaps are expected to occur. Such campaigns can be carried out in regions with a high density of sector companies but also at national level. Besides sector representatives also public actors such as regional governments and education system should play an active role in such campaigns.

Improvement of the image and the visibility of the sector as well as the visibility of its technical occupations among the young constitutes another important contribution to meet the emergent skills needs. The utilities sector should be actively presented at schools in order to reach young people with a possible affinity for working in this sector.

3) Anticipate drivers of change

Changes in (prices of) natural resources and environmental and market regulation are very important for the sector. The same holds for technological development and applications. The sector should organise its knowledge bases better to anticipate fully the effects of these changes on volume and skill needs. Main challenge is to stimulate that the sector has a 2020 view.

4) Provide stability in legislation

Instability in legislation makes it very difficult for the sector to forecast changes. This is especially the case for policy choices towards environmental technologies such as cradle-to-cradle applications and nuclear and sustainable energy. Governments should organise their regulation policies such that the sector is able to have a clear view on the developments towards 2020.

5) Improve career guidance

Regularly, persons equipped with required skills and qualifications are available, but do not apply for vacancies due to the lack of information of the labour market possibilities. Systems for the recognition of prior learning (RPL) support the determination to what extent people possess necessary competences for a new job. The integration of RPL in career guidance and

targeted training bridges the gap of hidden competences especially for mature workers. Some Member States included this in their system. In Portugal, for instance, a National System of Recognising, Validating and Certifying Prior Learning (RVCC) is implemented through a network of centres. Adults, whether employed or unemployed, are offered a three-tiered service, namely information, counselling and complementary training, including the accreditation of competencies (OECD/European Communities, 2004, p. 31). Career guidance can be supported by user friendly online-tools, also for self guidance. An extraordinary example in this respect is the Polish multi-dimensional career information system called 'Counsellor 2000' (ibidem, p. 44) in which information about educational and training pathways, and the relevant occupations they lead to, is linked to the personal profile of the client using an online-system.

6) Increase international and intersectoral acknowledgement of certificates

For some job functions international and sector mobility is an option to meet future skill needs. To increase the viability of this option, acknowledgement of certificates is helpful. This is also the case for in-house training as several of these training measures are not certified. This prevents a greater mobility of the workforce and hinders the matching of skill demand and supply because of a lack of skills transparency. Educational institutions that are able to provide broad accepted certificates, increase their value added for students. However, they need often governments to build effective acknowledgement systems.

7) Organise transfer of knowledge and expertise from old to new Member States

As new Member States have overloaded networks, they can use knowledge and expertise from old Member States to solve problems and to guide investments in the networks. Cooperation between companies and sector organisations in old and new Member States can help to transfer knowledge and expertise better from old to new Member States.

8) Organise the transfer of experience of older to younger workers

As ageing occurs, it is essential that no skill gaps occur as a result of retirement of older workers. An important opportunity is to organise the transfer of their experience to younger workers. One example is to make teams combining older and younger workers.

9) Keep older longer in employment and support vocational training for older employees

Inside the sector parts are confronted with an ageing workforce, but investment in further training of older workers is still underdeveloped. To keep the knowledge and the experience of older workers available and to avoid skill gaps, special part time retirement schemes should be developed by the responsible authorities and applied by the companies. Additionally, further training of older workers in SMEs should be supported by public authorities.

10) Invest strongly in human capital and lifelong learning

Enhanced investment in human capital is required. Cost sharing mechanisms between actors such as public authorities, companies and individuals need to be developed and lifelong learning (LLL) throughout the life cycle should be promoted. Learning must be made more attractive to all, e.g. via tax incentives or a change of attitudes in order to integrate learning into all phases of life and to incorporate a lifecycle approach to work. In addition, the training and education systems in the Member States need to be improved to cope with more modular based needs for VET to cover knowledge shortages and up-skilling needs, as already stated in the above implications for education and training.

Lifelong learning is the key to keep up with competitiveness and to prevent less favourable scenarios. Governments should further develop the legal framework for supporting life long

learning at all ages. Social partners should develop joint programmes of lifelong learning in cooperation with public authorities and other relevant stakeholders such as training organisations and universities in order to up-grade skills of the workforce in the sector. The programmes should be tailored to the specific needs of SMEs in the sector. Lifelong learning should encompass all skills levels aiming at raising basic social skills as well as technical sector skills. All available international, national and, if available, regional and local pathways should be used in order to finance lifelong learning.

Annex I. Contributors to this study

This report appears in a series of 11 sector reports on the future jobs and skills commissioned by the European Commission and executed by a core consortium of TNO (Delft/Leiden, the Netherlands), SEOR Erasmus University (Rotterdam, the Netherlands) and ZSI - Zentrum für Soziale Innovation (Vienna, Austria). The consortium was led by Dr F.A. van der Zee (TNO Innovation Policy group; TNO Innovation & Environment).

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Annex III. Strategic options – a detailed description

A. Recruiting workers from other sectors

A possible solution to meet skill needs is to recruit workers from other sectors, which have and can provide the abilities needed for the sector and/or fulfil the requirements of a specific job. For managers of large corporations it is quite usual to bring their general know-how to bear in different sectors. Also for business professionals (e.g.financial analysts, software engineers) the sector they are working in is of lower importance. For instance, for the emergent energy trading several financial analyst and traders moved from the financial service sector to the energy, gas and water sector in the last years. On the other hand, the sector mobility of low skilled workers is much more limited than the mobility of higher educated and higher paid employees, although it is also quite easily possible for them to move from one sector to another. The less the grade of sector specialisation of the occupational profile the easier employees are able to change between sectors. In other cases recruiting workers from other sectors will need training of sector specific skills. In some cases it is also possible for highly specialised workers to change sectors.

B. Recruiting workers from other Member States

Recruiting workers from other Member States could be in some cases a possibility to overcome skills problems. However, owing to language, cultural and other problems, mobility within the European Union is still underdeveloped. Furthermore, it has to be considered that this strategic option could turn out to be a zero-sum game not for the national but for the European economy. Border regions are attracting workers from other countries mainly because of wage advantages and can in this way succeed in closing their skills shortages and gaps. However, the regions that face such outward migration (e.g. Poland, East Germany, parts of Austria, Hungary, Czech Republic, Slovenia, Bulgaria) will face serious problems in meeting their labour market demands. These countries therefore have to recruit workers from non-Member States. Even if this might appear a temporary problem, from a longer term perspective, such developments could have serious consequences for the growth of the regional economy (‘brain drain”).

C. Recruiting workers from non-Member States

Recruiting workers from other Member States is not a zero-sum game for the European economy. Yet this strategic choice is as limited in its overall impact as the strategic choice that proposes to recruit workers from other Member States. Moreover, in all Member States significant barriers for entering the labour market for workers from outside the EU exist, even for temporary workers. To increase the influx of these workers by, e.g. increasing the immigration quota several political hurdles have to be mastered. Action can be taken here at Member State as well as at EU level. In all scenarios the modernisation of the transmission networks has to be carried out, which has already started and will continue for the next years. Additionally, all scenarios detected a skills gap in occupational functions building and maintaining transmission networks. China, for example, has modernized its transmission networks in the last years and the workers gained skills and competences. Therefore,

recruiting workers from China could be one strategic option to meet the emergent skill need related with the modernisation of the transmission networks. But it has to be taken into account that a language barrier exists which limits the effect of this strategic option.

D. Recruiting unemployed workers with or without training

Recruiting unemployed workers without training is a strategic option, especially in case of skill shortages (if there are not enough skilled workers to meet the employers demand). This option should in these cases be combined with adequate training. Unemployed workers might have various placement handicaps, especially skills deficits and poor levels of basic qualifications. Low educated groups are still representing the gross of the unemployed labour force, but also highly skilled workers like engineers could be threatened by unemployment. For the energy, gas, water and waste sector, several occupational functions could be filled with unemployed persons. For example, in Germany there are more than 90.000 vacancies for engineers while there are still more then 20.000 unemployed. Naturally there are different disciplines, but still the whole potential of labour is not developed and can be used for the development of the sector. Without doubt prejudices against the unemployed and especially mature age unemployed in the human resource departments have to be reduced and training, which could be costly, has to be financed. Moreover, the waste sector could present a way out of unemployment for unskilled or low skilled workers, while it has to be kept in mind that in the long run the qualified work in this sector will rise, if one takes the Scenario “Green efficiency” or “No Utility” into account.

E. Recruiting young people coming from the education system, with or without re-training

This strategic choice is always a possibility to overcome skill shortages as well as skill gaps. But demographic change should be taken into account. While in the next few years, until around 2015, there will be a continuous inflow of students entering the labour market, a significant reduction is expected in 2020. In some regions as well as the energy, gas, water and waste sector there is already a need for young qualified and skilled workers or apprentices in Europe. But despite the fact that the sector pays relatively high wages and offers stable carrier prospects, it is not easy for the sector to attract enough labour in critical occupational functions. While in the last years labour in business and finance professionals as well as administrative staff and customer services could be attracted the situation in technical occupations (engineers/technicians, construction workers, plant operators) is still critical. Hence, the recruiting of young people can only be successful, if this measure is supported with the other strategic options “Improving the image of the sector” (particularly waste and to some extent improving the image of technical occupational functions) and a “Stronger cooperation within the industry”. To be more precise, a stronger cooperation between schools, university, training organisations, career managers on the one hand and the industry on the other is needed. The principal aim should be to overcome the mismatch of requirements and wishes of individuals on the one hand and the economy on the other.

F. Training employed workers

In some cases training and re-training could also constitute a strategic choice to meet skill demands. In this case, the employee will be trained for a new working place or task. In

general, re-training ends with a formal graduation or certificate. Re-training is an option if the work place or the occupational function is not needed any more. But re-training is only one option. Further education or further training, refresher training and updating courses, or advanced vocational qualification to adapt the workforce to emergent skills needs are also options, which should be taken into account. Re-training or further training of employees can encompass all levels of skills. Training and qualification could be done in-house and on the job as well as by an external education institution. It is more likely that less fundamental variations of up-skilling or re-training will be a strategic choice because re-training has to be regarded as a long term and quite expensive measure compared to the other vocational education forms. The energy, gas and water sector has a long tradition of up-skilling and training of the workforce. For example, managers in the sector frequently fill in technical occupations like engineers or technicians. They were mostly trained and re-trained by vocational training organisations, in-house and external. In the energy, gas and water sector this is quite common due to high profit margins in the sector. The waste sector does not share the same strong tradition of training and upgrading of skills.

G. Changing the work organisation

Work organisation can be defined in different ways. First, it can be defined as a system of work organisation (e.g. Taylorims, Fordism and Post-Fordism) and second, as a form of division of labour and specialisation. In modern economy productivity is based on the division of labour and therefore also on the division of skills. There are several instruments of work organisation to react on skill shortages and gaps. Thus, changes in the work organisation can help to overcome skill gaps. In general, work can be reorganised in the following possible ways:

- Group work: A group is a limited number of people who work together over a longer period with a frequent, direct interaction. A group is defined through the differentiation of roles and joint values. Groups are able to produce better results than single persons due to the combination of different competencies and experiences, the reduction of wrong decisions, stronger work motivation, the direct use of information, new insights and creativity and a better acceptance of decisions, just to mention a few of the many advantages. There are several kinds of group work, like project groups, quality groups and learning circles, as well as committees.

- Job rotation: Within this type of work organisation several people change their work places in a planned alteration. Job rotation enhances the overview of the different production processes, the understanding of different tasks and the feeling for group work. Additionally, monotony and dissatisfaction are reduced.

- Job enlargement: Extension of the scope of work through the combination of several structurally equal or similar tasks. It can produce similar effects as job rotation.

- Job enrichment: Extension of the scope of work through the combination of several structurally different tasks. The scope of decision making and self-control increases, as well as the quality and quantity of work. In general, up skilling of the employee is necessary, but this is also implemented on the job.

Under the influence of new technologies, like information and communication technologies, virtual forms of work organisation, which substitute hierarchies through a horizontal network co-ordination, are also possible. In this sense, mergers and acquisitions as well as project

based business co-operations are also available options to change the work organisation. Both measures are strategic possibilities to get access to needed resources or to incorporate new competences. Modern (communication) technology can support the co-ordination and co-operation of labourers working at different places and in combining their respective strengths. Due to expected further changes in business processes in view of the scenario "Green Efficiency", changing work organisation can combine several competences if the workforce lacks multi-skills (skills from different disciplines like finance and technical skills) which are necessary to fulfil the future tasks.

H. Outsourcing and offshoring

In public discussion the terms outsourcing and offshoring are mainly used together, yet it must be emphasised that they describe different technical approaches. While outsourcing means the transfer of management or day-to-day execution of business functions or processes (production, manufacturing, services) to an external service provider, offshoring describes the relocation of business functions or processes from one country to another. Both could be applied as a strategic choice on company level to meet skill needs, by integrating the knowledge, experience and competences of the other firm in the production process.

Outsourcing of personnel as a result of technological change and economic pressure was and still is an ongoing trend. Due to de-regulation and privatisation several tasks and with it skills and competences in the sector were outsourced and in some countries dislocated to other countries to increase labour productivity. Several occupational functions in the production chain were affected by outsourcing, for example maintenance workers of plants in the energy, gas, water production and transmission networks, services of energy, gas, water production (e.g. metering) and by outsourcing, for example administration services of energy plants in the United Kingdom to India. Skill gaps can be closed by hiring subcontractors with the needed knowledge and competences. If one considers this strategic option to meet skill needs, it has to be taken into account that for subcontracting firms, freelance or contractual workers continuing vocational training often plays a marginal role, because employees are all too often indispensible. One should also bear in mind that freelancers are not available at any time and in unlimited numbers. Outsourcing and offshoring is therefore a limited strategic option to overcome skill gaps. It seems to be more adequate to overcome skill shortages.

I. Changing vocational education

Changing vocational education has a long-term effect. It must be taken into account that changes will have a substantial impact in quality and quantity starting at the earliest within three years time after the changes. The process of changing initial vocational education in content or in structure takes itself several years. The process from defining the needs and problems to the implementation of a new curriculum involves several stakeholders from different expert levels like companies, social partner organisations, training institutes as well as representatives of national and regional education administration. These bargaining processes could take several years and are dependent of the VET-system of the European Member State. Hence, this strategic choice will only be drawn if major structural changes are expected.

Despite these facts, possible changes can be seen in a stronger modularisation of curricula of initial vocational training as well as in building up or strengthening interplant and interregional training infrastructure. The first option could in the long run help to overcome identified skill needs in a sound, flexible and a relatively quick way. The second option is amongst others a possibility to provide the latest high-value equipment for training quickly by sharing resources of several partners.

J. Designing and offering new courses (continuing vocational education and training)

Once it is clear that the current content of vocational training is not up to date and therefore does not address the demands, the development of new courses for continuing vocational education and training could be a strategic option with a short term impact (see also L *Stronger cooperation between stakeholders)*. In the energy sector especially new courses for specialised skills in renewable energy are needed. The broad apprenticeships of engineers and construction workers are not always able to satisfy the special skill needs of this emerging subsector. Therefore, for example, in Germany a re-design of training measures is this subsector is underway (e.g. Abicht 2005).

K. Providing information about jobs and (emerging) skills

There is still a lack of transparency concerning current and emerging skill needs and job opportunities in different economic sectors. Information systems on regional, sectoral, national or European level could help to minimise information asymmetries and in that way overcome skill gaps resulting from information deficits. As a consequence, it could prove highly effective in helping students to enter the labour market and find a suitable occupation, just as much as in assisting employees to find new job opportunities based on existing skills or guide them in finding the suitable vocational training course.

Career guidance impacts rather short term. Therefore, it can help to overcome the mismatch between the needs and interest of the individual and those of the prevailing economy. The basic assumption of this strategic choice is that there already exist people who are equipped with the required skills and qualifications, but, due to a lack of information about the labour market possibilities, do not apply for these jobs. Career guidance for students and employees can help to overcome this mismatch. In this respect there can be a clear connection to training. Systems for recognition of prior learning (RPL) can help to determine to what extent people possess necessary competences for a new job. Targeted training can bridge the gap for the failing competences.

L. Improving the image of the sector

Improving the image of the sector could be a suitable measure especially to overcome skill and labour market shortages and attract new employees. Several instruments could be implemented by sector organisations in co-operation with different non sector actors like schools, career management organisations, training organisation, public employment services, and public administration. Instruments could be company visits for pupils, offering internships for pupils and enhanced public relation. Especially in sectors where framework

conditions and occupational functions changed fundamentally, due to technological or organisational restructuring or low wage levels, this offers a possibility to overcome stereotypes as much as old fashioned views and to attract more labour. Moreover, this measure does not only provide a chance to overcome stereotypes in relation to the sector but also to some occupational functions. The effect of this strategic option is long-term. In consideration of the apprenticeship system, which can take up five to seven years (if the specialisation of high qualified jobs in the sector is taken into account) until the volume effect is reached, one must arrive at the conclusion that in some occupational functions it has to be initiated right now.

M. Stronger cooperation with the industry

A stronger co-operation between industry and training institutes on a regular basis is one possibility to meet the skill needs in the sector. In some sectors and countries training of employees does not seem to be in line with the industry's emerging needs. New training and teaching solutions are to be developed between the industry, sector representatives, education institutions and research centres, public bodies, etc. Information exchange and a stable cooperation between the relevant stakeholders could improve the matching of training needs and demands. In the long run it will enhance the efficiency of training output, strengthen the quality of training and maximize the individual potential. To build up this kind of cooperation takes time, but in the long run it might well be capable to provide accurate solutions for problems. Networks and partnerships between these stakeholders to forecast skill needs in the sectors also present a long term measure. They could help to define emergent skill needs. While knowledge about the development of skill supply is quite high, the knowledge about the development of skill demand in different sectors is still improvable. These kinds of networks can cooperatively detect the need for action and contribute to the development of recommendation of actions.

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Glossary

Apprenticeship. Systematic, long-term training alternating periods at the workplace and in an educational institution or training centre. The apprentice is contractually linked to the employer and receives remuneration (wage or allowance). The employer assumes responsibility for providing the trainee with training leading to a specific occupation. (Cedefop, 2004)

Competence. Competence refers to the proven ability to use knowledge, skills and personal, social and/ or methodological abilities, in work or study situations and in professional and personal development. In the context of the European Qualifications Framework, competence is described in terms of responsibility and autonomy;

Compulsory education. The minimal legal standards and duration of obligatory schooling. (ILO, 1998)

Concentration index. The concentration index assesses the relative contribution of a specific sector to the national economy compared to a greater entity, such as the EU, thereby correcting for the size of the country. In more general terms, the concentration index is a measure of comparative advantage, with changes over time revealing changes in the production structure of a country. An increase of the concentration index for a sector signifies relatively fast growth of that particular sector in the country concerned compared to the same sector in the EU. How does the concentration index work in practice? A few (hypothetical) examples: if sector x represents a 5% share of the German economy and a 5% share of the EU economy, the concentration index of sector x equals a 100. If sector x represents 5% of the German economy, but 10% of the EU economy, the concentration index of sector x is 50. If the same sector x represents 10% of the German economy and 5% of the EU economy, the concentration index of sector x is 200.

The concentration index concept can be applied using different indicators (variables). In our study we measure the concentration index using employment, value added and trade, in order to make a distinction between the relative performance of countries EU-wide. We distinguish between four country groupings, each signifying a different sector performance over time. If a sector in a country has a strong position (hence showing a concentration index higher than 100) and has experienced a clear index growth over the last years, the sector is defined as winning in that country. If the sector has a strong position, but experienced a decline of the concentration index, we say the sector is losing momentum. If the sector has a weak position, but gained in the past, we say that the sector in that country is upcoming. If the sector has a weak position and experienced a decline of the index, we say that the sector is retreating.

Employability. The degree of adaptability an individual demonstrates in finding and keeping a job, and updating occupational competences. (Cedefop, 2000)

European Credit system for Vocational Education and Training (ECVET). A device in which qualifications are expressed in units of learning outcomes to which credit points are attached, and which is combined with a procedure for validating learning outcomes. The aim of this system is to promote:

- mobility of people undertaking training;
- accumulation, transfer and validation and recognition of learning outcomes (either formal, non-formal or informal) acquired in different countries;
- implementation of lifelong learning;
- transparency of qualifications;
- mutual trust and cooperation between vocational training and education providers in Europe. (Cedefop)

European Qualification Framework for life-long learning (EQF). A reference tool for the description and comparison of qualifi cation levels in qualifi cations systems developed at national, international or sectoral level. (Cedefop)

Full-time employment. Traditionally means a 'regular job'. Work that is about eight hours a day, five days a week and forty-eight weeks of the year with four weeks paid leave.

Informal learning. Learning resulting from daily activities related to work, family or leisure. It is not organised or structured in terms of objectives, time or learning support. Informal learning is in most cases unintentional from the learner's perspective. (Cedefop, 2008)

Interdisciplinary (multidisciplinary). Interdisciplinary refers to research or study that integrates concepts from different disciplines resulting in a synthesised or co-ordinated coherent whole. New disciplines have arisen as a result of such syntheses. For instance, quantum information processing amalgamates elements of quantum physics and computer science. Bioinformatics combines molecular biology with computer science. An interdisciplinary team is a team of people with training in different fields. Interdisciplinary teams are common in complex environments such as health care.

Job mobility. Any change of job, regardless of where the new job is located.

Knowledge. Knowledge refers to the outcome of the accumulation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. In the context of the European Qualifications Framework, knowledge is described as theoretical and/or factual.

Knowledge society. A society whose processes and practices are based on the production, distribution and use of knowledge. (Cedefop, 2008)

Learning outcomes. Learning outcomes refer to statements of what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and competence.

Lifelong learning. All learning activity undertaken throughout life, with the aim of improving knowledge, skills/competences and/or qualifications for personal, social and/or professional reasons. (Cedefop, 2008)

Low, medium, high educated. See also under qualifications. The Labour Force Survey

(LFS) collects data for a number of characteristics of employees, one being the level of education of an employee. The LFS is is based on the ISCED 1997 classification (International Standard Classification of Education).

- Low-educated encloses all levels up to the compulsory education (ISCED 1+2). ISCED 1: primary education or first stage of basic education. ISCED 2: lower secondary education or second stage of basic education.
- Medium-educated comprises all the post compulsory education not tertiary (ISCED 3+4). ISCED 3: (upper) secondary education. ISCED 4: post-secondary non tertiary education
- High-educated comprises all tertiary education including university education (ISCED 5+6). ISCED 5: first stage of tertiary education). ISCED 6: second stage of tertiary education (leading to an advanced research qualification).

Low, medium, high skilled. In general this classification refers to the skills required for a specific occupation that an employee currently holds. In existing taxonomies skills levels are usually proxied by educational attainment (see low, medium, high educated).

Mobility. See job mobility.

Multi-skilling. Multi-skilling refers to training an employee to cover a range of different jobs in one workplace. A multiskilled worker is an individual who possesses or acquires a range of skills and knowledge and applies them to work tasks that may fall outside the traditional boundaries of his or her original training. This does not necessarily mean that a worker obtains or possesses high-level skills in multiple technology areas. However, the worker can be an effective and productive contributor to the work output of several traditional training disciplines.

Multi-tasking. The ability of a person to perform more than one task at the same time.

Profession. An occupation which requires knowledge gained through academic study, such as law, medicine or teaching.

Qualification. Qualification refers to a formal outcome of an assessment and validation process which is obtained hen a competent body determines that an individual has achieved learning outcomes to given standards.

Qualifications, Comparability of –. The extent to which it is possible to establish equivalence between the level and content of qualifications (certificates, diplomas or titles) at sectoral, regional, national or international levels. (Cedefop, 2000)

Qualification, level of –. Low: at most lower secondary (ISCED 0-2); medium: upper secondary (ISCED 3-4); high: Tertiary (ISCED 5-6).

Qualification framework. An instrument for the development and classification of qualifications (e.g. at national or sectoral level) according to a set of criteria (e.g. using descriptors) applicable to specified levels of learning outcomes. (OECD, 2007)

Retraining. Training enabling individuals to acquire new skills giving access either to a new occupation or to new professional activities. (Cedefop, 2004)

Revealed Comparative Advantage (RCA). Relative comparative advantage compares the relative contribution of sector x to the comparative advantage of the national economy with other sectors. It is calculated as follows:

$$RCA = \tanh (\ln ((\text{Exports S} / \text{Imports S}) / (\text{Exports C} / \text{Imports C}))) \times 100$$

Interpretation: 0 = the comparative advantage of sector x equals the average of the comparative advantage of the entire national economy. Near -100: the sector contributes nothing to the comparative advantage of that country. Near + 100: the sector contributes strongly to the comparative advantage of the country.

The use and logic of the country groupings winning, losing momentum, upcoming and retreating in combination with revealed comparative advantage is similar to the concentration index (see above).

Skills. Skills refer to the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).

Skills gaps. Skills gaps arise where an employee does not fully meet the skills requirements for a specific job function but is nevertheless hired. This skills gap needs to be closed through training. Skills gaps can arise where new entrants to the labour market are hired and although apparently trained and qualified for occupations still lack some of the skills required.

Skills needs, emergent –. Emergent skills needs are defined in this study as the change in skills that is needed to adequately fulfil a certain job function in the future. Addressing emergent skills is needed in order to avoid skills shortages and/or skills gaps in the future.

Skills shortages. Skills shortages exist where there is a genuine lack of adequately skilled individuals available in the accessible labour market. A skill shortage arises when an employer has a vacancy that is hard-to-fill because applicants lack the necessary skills, qualifications or experience.

Tertiary education. Tertiary education refers, in most settings to non-compulsory education provided via a specialist institution once secondary schooling is completed, usually labelled as a college, polytechnic or university (in English) with variants of these in other languages. Tertiary education may be delivered virtually or at a distance.

Trade balance. Exports minus imports.

Training. The development of skills or knowledge through instruction or practice; a kind of vocational learning such as an apprenticeship or traineeship which includes both formal education and on-the-job experience.

Unskilled work. Work which lacks specialist training or ability and generally involves simple manual operations which can be learned in a short time.

Up-skilling. Short-term targeted training typically provided following initial education or training, and aimed at supplementing, improving or updating knowledge, skills and/or competences acquired during previous training. (Cedefop, 2004)

Vocational Education and Training (VET). Education and training which aims to equip people with skills and competences that can be used on the labour market. (adapted from ETF, 1997).