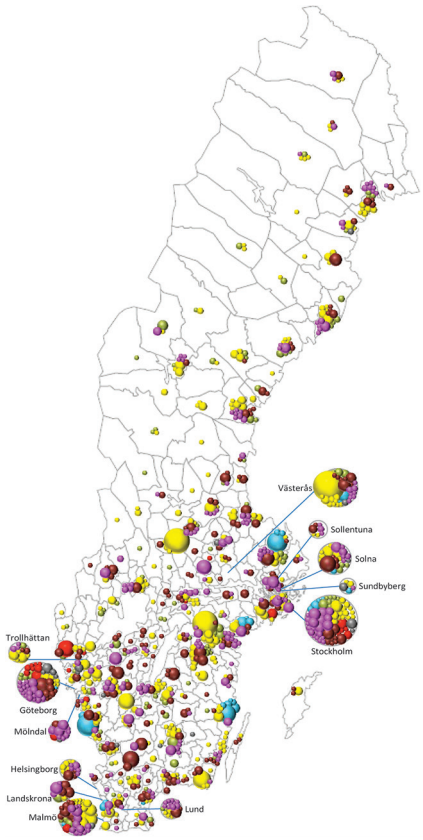
VINNOVA ANALYSIS
VA 2017:01

The Energy Industry in Sweden continues to grow

Analysis of companies in the energy industry 2007-2014 - business segments, age structures, gender equality and competence

Maria Engzell, Andreas Lepa & Samuel Strömgren



VINNOVA

VINNOVA IN COOPERATION WITH

ENERGI FÖRETAGEN

Swedish Energy Agency

Title: The Energy Industry in Sweden continues to grow - *Analysis of companies in the energy industry 2007-2014 - business segments, age structures, gender equality and competence*
Author: Maria Engzell, Andreas Lepa & Samuel Strömgren - ECC, Competence Center/Work in Västerås (Jobba i Västerås)
Series: Vinnova Analysis VA 2017:01
ISBN: 978-91-87537-59-2
ISSN: 1651-355X
Published: February 2017
Publisher: Vinnova - Swedish Governmental Agency for Innovation Systems/Verket för Innovationssystem

Vinnova - develops Sweden´s innovation capacity for sustainable growth

Vinnova is Sweden's innovation agency. Our mission is to promote sustainable growth by improving the conditions for innovation, as well as funding needs-driven research.

Vinnova's vision is for Sweden to be a world-leading country in research and innovation, an attractive place in which to invest and conduct business. We promote collaborations between companies, universities, research institutes and the public sector. We do this by stimulating a greater use of research, by making long-term investment in strong research and innovation milieus and by developing catalytic meeting places. Vinnova's activities also focus on strengthening international cooperation. In order to increase our impact, we are also dedicated to interacting with other research financiers and innovation-promoting organisations. Every year Vinnova invests about SEK 2.7 billion in various initiatives.

Vinnova is a Swedish government agency working under the Ministry of Enterprise and Innovation and acts as the national contact agency for the EU Framework Programme for R&D. We are also the Swedish government's expert agency within the field of innovation policy. Vinnova was founded in January 2001. About 200 people work here and we have offices in Stockholm and Brussels. Our Director General is Charlotte Brogren.

The **Vinnova Analysis** series includes publications of studies, analyses, official reports and evaluations that have been produced or commissioned by Vinnova´s Operational Development and Analysis Division.

The Energy Industry in Sweden continues to grow

Analysis of companies in the energy industry 2007-2014 - business segments, age structures, gender equality and competence

AUTHORS: MARIA ENGZELL, ANDREAS LEPA & SAMUEL STRÖMGREN

Title: The Energy Industry in Sweden continues to grow -*Analysis of companies in the energy industry 2007-2014 - business segments, age structures, gender equality and competence*
Authors: Maria Engzell, Andreas Lepa & Samuel Strömgren - ECC, Competence Center/Work in Västerås (Jobba i Västerås)
Series: Vinnova Analysis VA 2017:01 (English version of Vinnova Analys VA 2016:05 “Energibranschen i Sverige fortsätter växa)
ISSN: 1651-355X
ISBN: 978-91-87537-59-2
Published: February 2017
Publisher: Vinnova - Verket för Innovationssystem/Swedish Governmental Agency for Innovation Systems
Production & layout: Vinnova's Communication Department

Table of Contents

Preface

The operations at Vinnova - Sweden's innovation agency - require good knowledge base materials about Sweden's national, regional, and sectoral innovation systems in an international comparison. This includes knowledge about the innovation system's actors, their respective roles, position in a global context, networks, and innovation processes. The knowledge base materials are used in strategy processes, for dialogue with the innovation system's actors, in the operational activity as well as support for follow-up, evaluation, and effectiveness analyses of Vinnova's actions.

The knowledge that is needed about the innovation systems includes the following components that impact the capacity for innovation and thus Sweden's competitiveness:

- Business and industrial trends
- Policy and system, including financing
- Research, development, and innovation
- Social Needs and challenges

Within the framework of Vinnova's business intelligence, a series of analyses are performed of business and industry structure, strategic areas for renewal, as well as research and innovation cooperation for a number of industrial branches. Completed studies include: Life Science; Vehicles; Mine and mineral; Metals; Chemical; Maritime; Forest, pulp and paper; Information and Communication Technology; Environment Technology, and finally, Train and railroad. The studies are carried out with the same methodology but with certain adaptation to the different characteristics of the industrial activities. This study analyses companies within the Energy Industry.

The work is done in close consultation with the innovation system's actors by them being active in work groups or reference groups, among other aspects. The processes' designs contribute to establishing the results, to their dissemination as well as to discussions in the innovation system. The processes and result are important parts in Vinnova's dialogue with, and offering to, the regions and other nations. The factual information materials are intended to be used for strategic discussion of different actors and actor constellations. And, in addition to the report, a database is produced with collected information and a graphic interface to visualise the result from the database, with the possibility to design presentations adapted to the context and purpose.

The study has been written by Maria Engzell, Andreas Lepa, and Samuel Strömgren at ECC, Energy Competence Center/Work in Västerås, as well as the consulting companies Addendi and Okatima as commissioned by the Energy Agency (Energimyndigheten) and Swedenergy (Energiföretagen Sverige), in close cooperation with Vinnova. Göran Andersson has been the process leader at Vinnova. The reference group has included representatives from businesses, industry organisations, government agencies, and Vinnova.

Vinnova in February 2017

Inger Gustafsson
Head of Policy & System Development Department
Societal Development - Transport, Environment and the Regions Division

Göran Andersson
Programme Manager

Introduction

Sweden's Energy Industry is in the midst of a transition period. The megatrends that affect all process industry, and often are spelled globalization and digitization, create a melting pot for Sweden's, Europe's, and by extension, the entire world's energy industry. Today, those perspectives are supplemented by the vision of new business models based on decentralization and active “prosumers” farthest out in the user end. In Sweden there has been, and is, political uncertainty surrounding the energy system market design, and the government's appointed energy commission has been tasked with developing a long-term energy agreement across all political party lines. Large population groups go from being low-income to middle class in Asia, Africa, and South America, and the consequence is an increasing need for electricity and fuel, cooling and heating. The climate discussions pinpoint the need for sustainable and fossil-free energy use, and what energy production looks like globally in the future. Energy grids cross previously drawn borders, connecting states and regions.

The purpose of this analysis project is to generate and compile qualitative as well as quantitative data for Sweden's Energy Industry, which then are visualised and analysed. The overall purpose is to offer in-depth knowledge base materials for use in strategy processes and in the dialogue with and between the innovation system's various actors. The term 'innovation system' often means a set of actors, network, and institutions that are interdependent. Often they are made up of companies, colleges, and the public sector.

This study of the companies within the Energy Industry is a series of analyses of structure, strategic areas for renewal, environmental aspects, as well as research and innovation cooperation for different branches of the industry. The report is an update of the report that was published in the year 2013. The time series of employment and other development factors are thus added-on up until the year 2014. As well, this report includes news in the form of data on education levels, areas of expertise, gender, and origin of those employed in the industry.

The work has been done by a work group consisting of Maria Engzell, Andreas Lepa, and Samuel Strömgren within Competence Center at Work in Västerås (Jobba i Västerås). The study has been financed by the Swedish Energy Agency (Energimyndigheten), Swedenergy (Energiföretagen Sverige), and Vinnova. The process has also been linked to a reference group, consisting of Göran Andersson, Vinnova, Liselotte Andersson, E.ON, Rigmor Anshelm, Ellevio, Klaus Hammes, Swedish Energy Agency, Lisa Hjelm, ABB, Anders Nilsson, Swedenergy, Birgitta Resvik, Fortum, Claes Vallin, Svenska Kraftnät, Fredrik Wallin, Mälardalen College (Mälardalens Högskola), Elisabeth Wenåker, Tekniska verken in Linköping, Anna Wärmé, Swedenergy, Lina Öberg, Mälarenergi. The reference group has met twice, at the beginning of the project and at the end of the project to discuss the results and conclusions. At the first meeting there was a discussion on, among other things, identification, limitation, and assignment of the companies, as well as what other aspects of the area that the analysis should include, given the limited scope of the project. The reference group has also had

an opportunity to comment on the present report. However, the assessments and comments contained in the study are those of the authors. This report was at first published in Swedish and the translation of the study into English, has been enabled by the project Smart4U, a project within the EU that is financed by the Swedish Agency for Economic and Regional Growth (Tillväxtverket).

Summary

This report is a comprehensive analysis of the Energy Industry in Sweden. The Energy Industry, as well as Swedish technology within the area, is a very important industry for Sweden. It employs a lot of people and is a major contributor to Swedish export.

The Swedish Energy Industry is represented all over the country. Hydropower from the many rivers, wind power, and the strategic location of different power companies as well as the nationwide power grid, maintained by operators and consultants, come together to take responsibility for the cities and rural areas. People who work within the Energy Industry are found in 261 of 290 Swedish municipalities.

This study includes companies that have their main business within the Energy Industry. The study does not include other parts, or functions, of the innovation system. More than 1,700 companies have been analysed separately. The companies have been differentiated by, for example, various segments of the industry and R&D roles. Then the companies have been systematized into a database that includes, among other aspects, financial information, number of employees, and ranges of export. The companies that have most of their business within the industry, according to our definition, have then been analysed using a number of different perspectives.

This study focuses on the Energy Industry between the years 2007 and 2014. The companies have been categorized into the following business segments: Nuclear, Renewable Energy Sources, Fossil Energy Sources, Electricity, Heating, Fossil Fuels, and Energy Efficiency.

- The employment rate in the industry has increased by 14 percent between the years 2007 and 2014.
- In the year 2014 the industry included 1,064 companies with 68,474 employees at 2,298 different workplaces.
- The total net turnover of the industry was 476 billion SEK in 2014.
- The 10 companies with the most employees have 33 percent of all employees in the industry, and the 10 largest companies with the highest net turnover represent 48 percent of the total net turnover in the industry.
- 14 percent of the companies in the industry have a foreign group parent (regarding ownership) and these companies have almost half of the employees (47 percent) in the industry, and represent 57 percent of the total net turnover in the industry.
- In 2014, 1.1 percent of the total population in Sweden aged 16 to 64 worked in the industry.

This report also includes unique data on different structures of age, education, occupation, gender, and origin during the period between 2007 and 2013. The competence analysis shows that:

- The average age in the industry increased during this period of time (2007-2013) from 43.9 years to 44.5 years.

- Among all employees in the industry, we find the largest increase (in numbers) in the age interval 45-49 years.
- A trend of higher academic education is apparent in the industry due to the fact that there has been an increase of the percentage of employees with a three-year post-secondary education or longer in 2013 compared to 2007.
- The percentage of women (of all employees) has not increased during the period, as it remains at 23 percent. Furthermore, there is no business segment in the industry that can be considered equal regarding the percentage of men and women.
- The percentage of women aged 20 to 24 and 25 to 29 has deacreased during this period.
- The share of female managers has increased by 4 points.

The Energy Industry faces several challenges. The Energy Industry in Sweden is solid, but at the same time there are great needs for competence and skills, especially since the work force, on the average, is getting older. To be able to succeed in the future, the Energy Industry is dependent on development of the work force, the ability to transfer established knowledge, and that integration of innovations continues.

1 Methodology

1.1 Identification of the Industry

The Energy Industry in Sweden enables industrial operations, functioning buildings, services, and transportation. Energy is an essential prerequisite for any business in today's society. Sweden's welfare is supported and made more efficient by energy. We have chosen to use *The Simplified Energy Chain*, which is described in chapter 1.2, as the starting point in this study since the model simplifies and explains knowledge about energy as well as it makes it clear to follow the development of today's energy mix from fossil to fossil-free.[1]

The main focus of the study is to, over time, follow companies that generate our three sources of energy; nuclear power, renewable energy, and fossil fuels, as well as the three major energy carriers in society; electricity, heating, and fuels. The term 'company' in this study refers to a limited company. The study also looks at energy users as a vital part of the energy's cycle from extraction (supply) to end customer. Therefore, we have chosen to develop the picture of the industry in Sweden by including companies whose operations mainly deal with energy efficiency in industry, buildings, and transportation, in order to highlight the development stages that become apparent in those segments. A description of the business segments is found in chapter 1.3.

The industry has a clear division between *production & distribution* and *system & component.* The former group works close to the energy resources and distribute energy to customers. The latter group is dedicated to manufacturing of systems and components, and are thus the enablers of extraction (supply) and distribution of energy.

The analysis model that is the basis of the study means that only dedicated companies are included in the database and in the visualisations in the study. Dedicated companies are companies that, according to our assessment, have most of their business focused on the ”defined” Energy Industry. This means that some diversified companies are not included in the database and analysis, despite having parts of their activity in the industry. However, these companies are included, as well as their role and importance to the industry, as much as possible in the reasoning and qualitative discussions in the report.

Consulting companies that are diversified in various industries have been omitted in this study. However, consulting companies that have the majority of their business in the energy sector are included.

A unique database of energy companies in Sweden has been compiled based on the above premises. The database has unique qualities and characteristics in relation to general statistical

[1] KvA, Energy Committee, http://www.kva.se/Documents/Vetenskap_samhallet/Energi/Utskottet/scenario_energi_energikarta_2010.pdf

excerpts and summaries since the methodology also has a special selection process. It can be described briefly in five steps.

Initially a gross list of companies was compiled based on the companies included in the analysis 'Companies in the Energy Industry in Sweden 2007 – 2011'.[2] Additional companies were added to the gross list through database searches where the selection criterion was based on the companies' SIC-codes. The SIC-codes used as basis for the analysis are found in Appendix.

Finally, companies were added by gathering information about them trough, e.g., networks, cluster initiatives, and industry organizations[3].

Thus an overall list of companies and organizations was compiled. The gross list was checked in step 1 so that all included companies and organizations could be identified via their unique corporate identity number.

In step 2 the gross list was "washed" by removing duplicates with the same corporate identity number. Thus remained a preliminary net list. In step 3 companies that were deregistered, at their own request or at the Swedish Companies Registration Office's request, were deselected. Then, in step 4, limited companies that had at least one employee during any of the years 2007 to 2014 were saved, and also those that in 2014 were active companies but without employees.

The identified companies' Swedish operations have been analysed one by one. In step 5 information on all the remaining businesses was acquired from, e.g., company websites, or through contact with the companies. Then the companies have been classified and coded according to, e.g., business segment, R & D intensity, and ownership. Thereafter, the resulting database is the basis for the report's pictures, charts, diagrams, statistics and analysis.

From the start, the gross list contained 1,725 corporate identity numbers which the work group reviewed, classified, and categorized within the industry segments. In cases where it appeared that the companies have less than half of their operations based in the Energy Industry, the work group removed the corporate identity number from the analysis' net list.

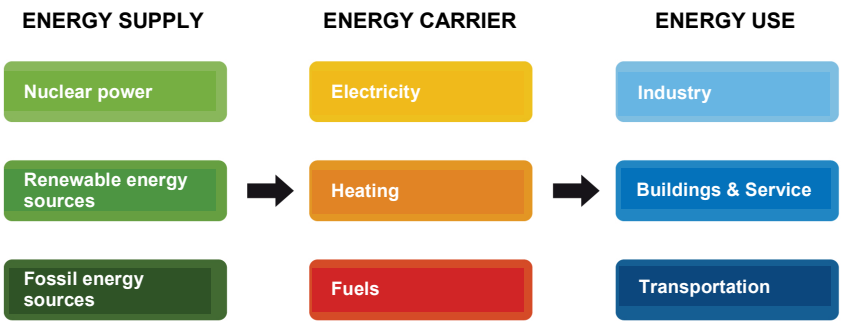
1.2 The Simplified Energy Chain

For all industries it is difficult to create a story and a frame that is understandable and visual. In the analysis ”Companies in the Energy Industry in Sweden 2007 – 2011”, the *The Simplified Energy Chain*[4] was used to give a picture of the Energy Industry and to create a starting point for the division of the industry. The picture has also been used in the present study to further develop the industry's division, and the segments that form the basis for this analysis.

[2] http://www.vinnova.se/sv/Aktuellt--publicerat/Publikationer/Produkter/Foretag-i-energibranschen-i-Sverige/
[3] The following industry organisations were contacted: Svensk Energi, Svensk Fjärrvärme, Energiforsk, Avfall Sverige, Svenska Kyl- & Värmepumpföreningen, Sweheat & Cooling, Svensk Solenergi, Svensk Vindenergi, Energieffektiviseringsföretagen, Svenskt Kärntekniskt Centrum, Energigas, Svenska Kolinstitutet, Nätverket Olja & Gas, Power Circle, Vätgas Sverige, and Svebio.
[4] Harry Frank, the Royal Swedish Academy of Sciences' Energy Committee.

The Simplified Energy Chain contains three main groups that are divided into nine subgroups: energy input, energy carriers, and energy use. Within the group energy input one finds; nuclear power, renewable energy sources, and energy sources. These are the energy types where the energy is produced. Energy carriers are divided into three groups: electricity, heating, and fuels. They carry the energy to the user. Energy users are found in three discernible major groups; industry, buildings & service, as well as transportation.

Figure 1 The Simplified Energy Chain



The Simplified Energy Chain not only fulfils purposes within the frame of the analysis itself, it is also used in the dialogue with people both within and outside the industry centre. An example of the latter is the picture's important function during contact with students at schools to attract people to the industry and to ease attracting competence for the future. The simplified picture can lead to parts of the real complexity being lost in the description, since it is exactly that, simplifications. However, the advantage is that simplifications in a systematic and easy way facilitate the understanding of the overall industry, as well as the operation areas' and energy sources' connection to transmission, distribution, and use.

1.3 Business Segments

Figure 2 The Business Segments of the Analysis

Categorisation of the companies, with regards to within which part of the industry that the company is active, has taken place in two steps; first the work group has pinpointed the business segment within which the company fits, and then categorised the company in the associated subgroup. As a part of the analysis process, a pilot categorisation has been performed with a selection of companies from the preliminary net list to ensure the quality of the business segments and subgroups.

In total, the work group has chosen to use seven business segments with subgroups which will provide a clear picture of the industry specializations. The companies have been categorised in one of the following business segments with associated subgroups: Nuclear power, Renewable energy sources, Fossil energy sources, Electricity, Heating, Fossil fuels, and Energy efficiency.

Based on the company's main activity, each company has been categorized as belonging to a specific business segment and subgroup. Many companies - particularly the majority of larger companies - have operations in many different business segments and subgroups. In some cases the entire company, or entire larger workplaces, have been assigned to only one segment and one specialization. By necessity, this means that some categories have become oversized at the expense of others.

Minor adjustments have taken place in the business segments and subgroups since the analysis 'Companies in the Energy Industry in Sweden 2007 - 2011' was carried out.

The following is a brief description of each business segment, as well as the division of different subgroups within these business segments.

A. Nuclear Power

A.1 Nuclear Power

Companies that generate nuclear power belong to this subgroup. That includes the reactors that are operated in Sweden, in Forsmark, Ringhals, and Oskarshamn, as well as the decommissioned reactors at Barsebäck. As well, companies that own and manage facility and nuclear power assets are also included.

A.2 Dedicated Partners To Nuclear Power

These are companies that have the majority of their work focused at nuclear power operations.

B. Renewable Energy Sources

This business segment includes the companies that generate renewable energy, those that supply products, components, equipment, and services that enable the production of renewable energy and at the same time have a clear industry specialization in one of the renewable energy sources.

B.2 Wind Power

This business segment includes companies involved in wind power production, and those companies that enable production.

B.3 Solar Energy

Solar companies are companies that work with solar energy production, and those companies that enable production.

B.4 Hydropower

This subgroup includes companies involved in hydropower, wave energy, and current power, and those companies that enable production.

B.5 Bioenergy

The subgroup bioenergy includes companies that extract, produce, and enable use of biomass as an energy source, such as biofuels, oils, fuels, and pellets.

C. Fossil Energy Sources

This industry segment follows the division according to *The Simplified Energy Chain* and includes companies in Sweden that work with oil, coal, and gas.

C.1 Oil

This subgroup includes companies that work with crude oil and import oil, as well as those that are dedicated partners in the production of oil and enable oil extraction.

C.2 Coal

This subgroup includes companies that work with coal, and those that are dedicated partners in coal extraction.

C.3 Gas

This subgroup includes companies that extract and handle gas as an energy source. Here there is a differentiation between natural gas and biogas. Biogas is categorized under Bioenergy, and natural gas under Gas.

D. Electricity

In the business segment Electricity we have tried to draw a line where electricity is included, but not electronics in general. Thus construction and building/real estate companies are not included in the study, and hence not the large population of construction electricians.

D.1 Electricity Distribution

The subgroup Electricity Distribution includes companies that work with power transmission and distribution. It comprises both the wide flora of mostly municipal energy companies that target the Swedish power grid, and also the big companies that have their roots in the electrification of Sweden. The subgroup also includes companies that work with a mix of the energy types hydro, solar, wind, and bio to enable production and distribution of electricity.

D.2 Electricity Supply

In the subgroup Electricity Supply we find companies that operate or enable the trade of electricity that takes place in Sweden.

E. Heating

The business segment Heating includes companies that work with district heating, boilers, heat pumps, and supplementary heat production, such as geothermal heat.

E.1 District Heating

To a great extent, this subgroup is made up of the CHP-companies (combined production of heat and power) that operate in Sweden. Most of the companies split their operations between electricity and district heating, and many also have operations including sanitation, MAN (Metropolitan Area Network), and recycling. In this analysis, a company can only be categorized in one industry segment and one subgroup. In cases where companies have large parts of their operations in district heating, these companies have been categorized in that subgroup. The additional tasks carried out by municipal companies, and that are not included in the Energy Ienergyndustry, have not been included in this compilation when they belong to a specific workplace that can be distinguished.

E.2 Boilers and Heat Pumps

Boilers and Heat Pumps includes companies that manufacture, sell, develop, and install boilers and heat pumps, as well as companies involved in supplementary heat production in form of, for example, geothermal, lake-source heat, and ground-source heat.

F. Fossil Fuels

The business segment Fossil Fuels includes companies that refine oil into fuels and work with the product to the end customer.

F.1 Petrol and Diesel

The subgroup Petrol and Diesel is made up of companies that refine crude oil, distribute, and sell petrol and diesel.

F.2 Compressed Natural Gas (CNG)

This subgroup includes companies that are involved in distribution and sales of Compressed Natural Gas (CNG), as well as upgrading of biogas to fuel for vehicles.

G. Energy Efficiency

In the business segment Energy Efficiency, we have tried to gather companies that are a prerequisite for continued efficiency in the Energy Industry. Partly it includes consulting companies that are not dedicated to a single step in *The Simplified Energy Chain* but equally are a prerequisite for the industry. They often cross over between segments. Partly it includes a large group of companies that have a clear focus on energy efficiency based on motor operation and control, regulation, and drive systems within industry and buildings, not least in the ventilation and automation sector.

G.1 Energy Efficiency Within Industry and Buildings

In the subgroup Energy Efficiency Within Industry and Buildings, we find energy and engineering consultants with a main focus on energy efficiency within automation and ventilation.

G.2 Energy Efficiency Within Transportation

Here we find the companies that produce drive and control systems for technology shifts in transportation, i.e., where focus shifts from fossil fuels to the use of fossil-free energy.

G.3 Other

In the subgroup Other, there are companies and consulting companies that work broadly with energy efficiency in the industry and that are not dedicated in any of the two fields above.

1.4 Activity Categories – R & D Intensity

In order to get an idea of the existence, extent or degree of research, development, and innovation work, the work group has made a qualitative assessment and classified each company in one of the following five activity categories: In-House R&D, Cooperation with R&D Performers, In-House Product and Service Development, Production, and Other. The purpose of this work is to highlight the companies that demonstrate their ability to conduct research and development in Sweden. The first four activity categories are production-oriented.

The following is a brief description of each activity category.

In-House R&D

This activity level includes companies that conduct their own in-house research or development work. In this context, Own R&D refers to systematic efforts in order to search for new knowledge. Companies and/or workplaces that run their own in-house R&D are placed in the upper part of the matrix in Figure 3.

Cooperation with R&D Performers

This activity level includes companies that run research & development in cooperation with external R&D performers. In this context, 'R&D Performers' refers to companies, organizations, research institutes, or departments at colleges/universities involved in research and development. Companies and/or workplaces that are involved in Cooperation with R&D Performers are placed in the second highest part of the matrix in Figure 3.

In-House Product and Service Development

This includes companies that are involved in development of products and/or services. At this activity level we find companies that improve existing products and services such as design, engineering, and business models. The development level varies among the companies depending on, e.g., business focus. Companies and/or workplaces in this group are located in the middle part of the matrix in Figure 3.

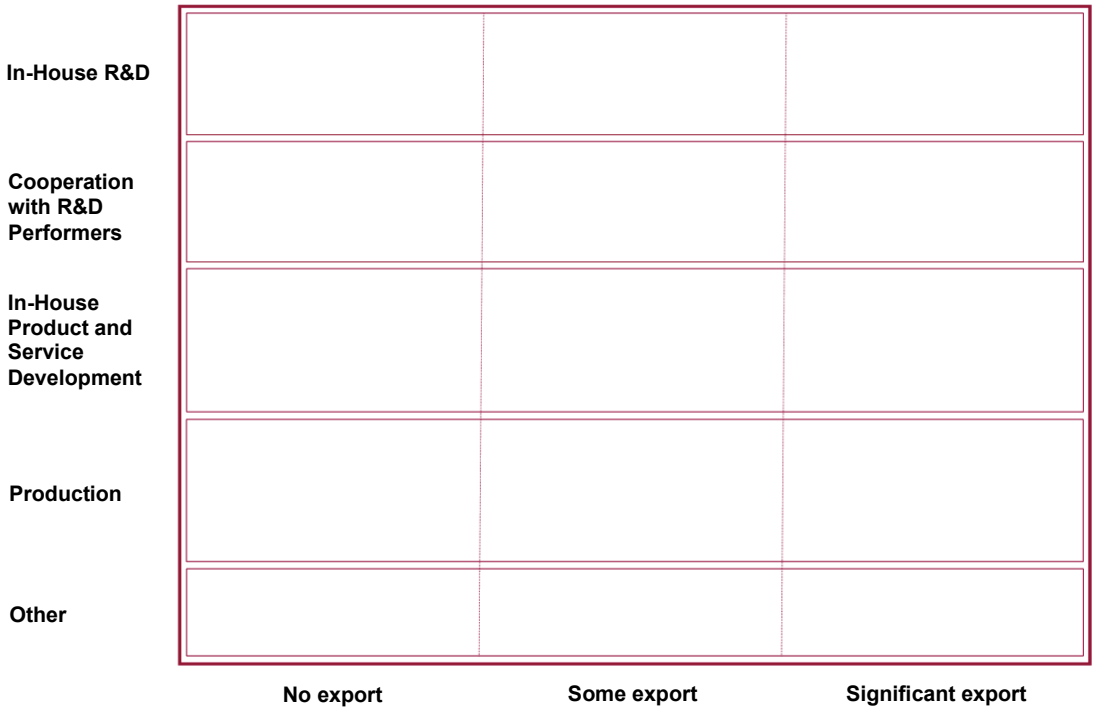
Production

This activity level includes companies significantly involved in production and contract manufacturing within their existing systems and business area. These companies and/or workplaces are located in the second lowest level of the matrix in Figure 3.

Other

This activity level primarily includes companies that lack any form of production-oriented activities in our qualitative assessment. For example, this can include companies involved in sales, training, warehouse operations, administration, and financing within the various business segments. These companies and/or workplaces are located in the lower part of the matrix in Figure 3.

Figure 3 The Y-axis shows R&D Capacity and the X-axis Level of Export



1.5 Export Classes

The companies are classed by the level of export and categorized according to three export classes:

- *No export* – The company does not have any export or there is no information about exports.
- *Some export* – Export less than 1 MSEK or export is less than 50 percent of the net turnover.
- *Significant export* – Export more than 50 percent of the net turnover or the company exports are valued at more than 100 MSEK. Companies with exports valued at less than 1 MSEK have been excluded even though exports constitute more than 50 percent of the net turnover.

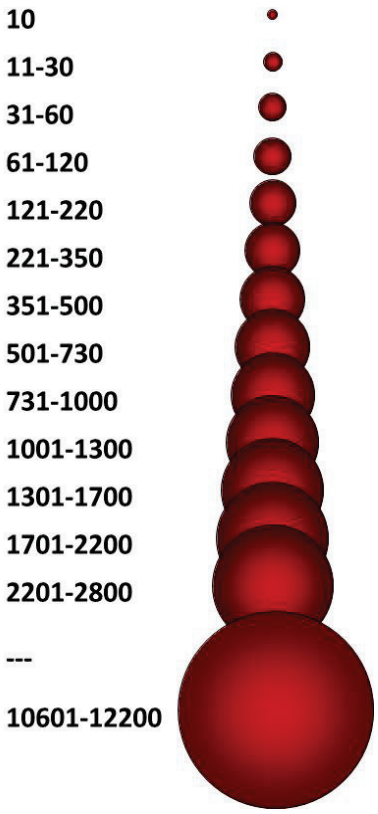
1.6 Visualisation

The size of the companies, in terms of number of employees, is indicated with a sphere where the company's or the size of the operation is proportional to the sphere's volume on the map of Sweden and the matrix used to visualise the industry structure. This means that small companies visually look bigger than they are, and that large companies look smaller in the pictures. The analysis visualises companies that have at least 10 employees. The smallest companies, with 1-9 employees, are not represented as spheres in the figures, but are included in the statistics of, e.g., business segments and development over time. Companies with operations in different regions are reported proportionally to the number of employees in each region. For companies with several workplaces, different workplaces have been assigned different activity categories on the Y-axis of the matrix, when relevant. Similarly, employees at workplaces with more than 500 employees have been divided into the different activity categories on the Y-axis of the matrix, if it has been considered relevant.

1.7 Number of Employees

The study reported the number of employees in the companies, which means an average number of full-time equivalents during a given year, that is, the number reported by companies to the Swedish Companies Registration Office. The actual number of persons employed in the companies is usually 20-30% higher depending on part-time work, leave of absence, etc.

Figure 4 Sphere Size in Visualisation Based on the Workplaces' Number of Employees



1.8 Competence Analysis – Scope and Parameters

Due to reasons of confidentiality, it is not possible to produce company-specific statistics for employees, but the statistics will be more overall for the industry. However, this is the first time in this analysis series of the Energy Industry that this kind of data has been analysed and the data is very valuable to enable one to say something about the various parameters within the area of expertise, such as education level, age structure, gender equality, and origin.

According to the database, the companies included in the Energy Industry and their CFAR-numbers have been the starting point for ordering data from Statistics Sweden (SCB), which means that the underlying data are company-specific, while numbers from Statistics Sweden (SCB) are presented in aggregated form.

The data on employees comes, via SCB, from the Register-based Labour Market Statistics (RAMS), Occupational Register and Business Statistics, and applies for each year from 2007 to 2013. The statistics refer to persons who are/were employed by the companies included in the database each year during the period 2007 to 2013 according to RAMS.

It is important to note that, at the time this analysis was written, employee information was only available for 2007 to 2013 (compared to VINNOVA's database which also includes data for the year 2014).

The data contained in VINNOVA's database regarding the number of employees in the industry does not match 100 percent with the data to which the authors have had access via SCB, but there is a discrepancy according to Table 1.

Table 1 Discrepancies Regarding the Number of Employees in the Energy Industry Between Data in the Database and Data from Statistics Sweden (SCB)

YEAR	NUMBER OF EMPLOYEES ACCORDING TO COMPETENCE ANALYSIS (STATISTICS SWEDEN, SCB)	DIFFERENCE COMPARED TO THE DATABASE FOR THE ENERGY INDUSTRY (VINNOVA)
2013	66731	- 0.9 percent
2010	61353	- 4.9 percent
2007	55287	- 8.1 percent

The competence analysis and the data about employees consist of, and can thus also be analysed, based on the following parameters:

Business Segment

Classification of business segment is shown in chapter 1.3.

Age

With regards to the age of employees in the industry, it has been calculated based on the age reached as of December 31 of each indicated year.

The age spectrum ranges from 16-19 years and then in intervals of five years at a time up to 60-64 years, thereafter listing the oldest group as 65+.

Gender

In order to define gender, the starting point is the second last digit of the employee's social security number. If the second last digit of the social security number is odd (1) that person is indicated as male, and if the second last digit is even (2) then that person is indicated as female.

Origin

The classification used in this analysis, with regards to if an employee is considered to be of foreign or Swedish background, is based on the guidelines described in *Notes about coordination issues for Sweden's official statistics, MIS 2002:3*. For our starting point, we have chosen the recommended division described in Table 2.

Table 2 Definition of Foreign versus Swedish Origin used in this Analysis[5]

ORIGIN:	PERSON IS EITHER:	OR:
FOREIGN:	Foreign-born	Domestic-born with two foreign-born parents
SWEDISH:	Domestic-born with one domestic-born and one foreign-born parent	Domestic-born with two domestic-born parents

The following applies in case there is no information about a parent's country of birth:

- *For a person who is domestic-born, the parent is assumed to be domestic-born.*
- *For a person who is foreign-born, the parent is assumed to be foreign-born.*

Education

Education is described using two different parameters - *education level* and *education group*. Both of these parameters are based on the highest completed education for each person the indicated year.

Education level is defined in seven different levels (as well as a level for information missing):

1 Compulsory education shorter than 9 years
2 Compulsory education 9 years (corresponding)
3 Secondary education max. 2 years
4 Secondary education 3 years
5 Post-secondary education shorter than 3 years
6 Post-secondary education 3 years or longer
7 Postgraduate education

*(*Data not available)*

According to the division above, one can see that the first four levels refer to primary and secondary education while the last three levels relate to different levels of higher education, such as education at vocational school, college, and university.

The second parameter with regards to education is *education group*, which, in addition to education level, also indicates in detail the specialization of the education, that is, the focus of the educational program. There are eleven thematic divisions according to Statistics Sweden's

[5] SCB, MIS, Persons with foreign origin, Guidelines for reporting statistics, 2002:3

grouping[6], and within each group there are a number of different specializations at various educational levels. The different groups are as follows:

- General Education
- College Preparatory Education
- Pedagogy and Teacher Training
- Humanities and Arts
- Social Sciences, Law, Commerce, and Administration
- Natural Sciences, Mathematics, and Computer Science
- Technology and Manufacturing
- Agriculture and Forestry, Veterinary Care
- Health and Social Care
- Services
- Unknown

Overall there is a large amount, hundreds, of different codes available in the form of various combinations of specialisation and education within the education groups.

Occupation structure

According to Statistics Sweden's division of various occupational groups (via SSYK-codes), there are a total of 10 different groups, and within each group there is a range of different occupations. The 10 different occupational groups are divided as follows:

- Military work
- Managers
- Work requiring theoretical specialist expertise
- Work requiring shorter college education or corresponding knowledge
- Office and customer service work, clerks
- Service, care, and sales work
- Work in agriculture, horticulture, forestry, and fishing
- Craftsmen work in construction and manufacturing
- Plant and machine operators, transportation, etc.
- Work without requirement for special occupational training

*(*Data not available)*

A complete list of the different occupations that were represented among the employees in the Energy Industry in the year 2013 is found in Appendix (in total, 89 different occupations).

[6] Further description can be found in the report: MIS 2000:1. Swedish Education Terminology, SUN 2000.

2 Companies Within the Energy Industry 2007-2014

2.1 Location of Companies

The Energy Industry is a concern for all of Sweden. Hydropower from rivers, wind power, and the various municipal CHP-companies' (combined production of heat and power) locations basically draw a comprehensive map of Sweden. The electricity distribution's nationwide networks involve installers and consultants, and assume responsibility for urban and rural areas. All over Sweden, work is done with energy, electric power and heat. The Energy Industry's future and its competence supply affect all of Sweden's welfare.

In total the study has identified 1,064 companies with at least one employee, distributed across 2,298 workplaces in the year 2014. Together, the companies have 68,474 employees (full-time equivalents). The industry's total net turnover in the year 2014 amounts to 475.7 billion SEK.

Figure 5 Companies in the Energy Industry With At Least 10 Employees, Year 2014

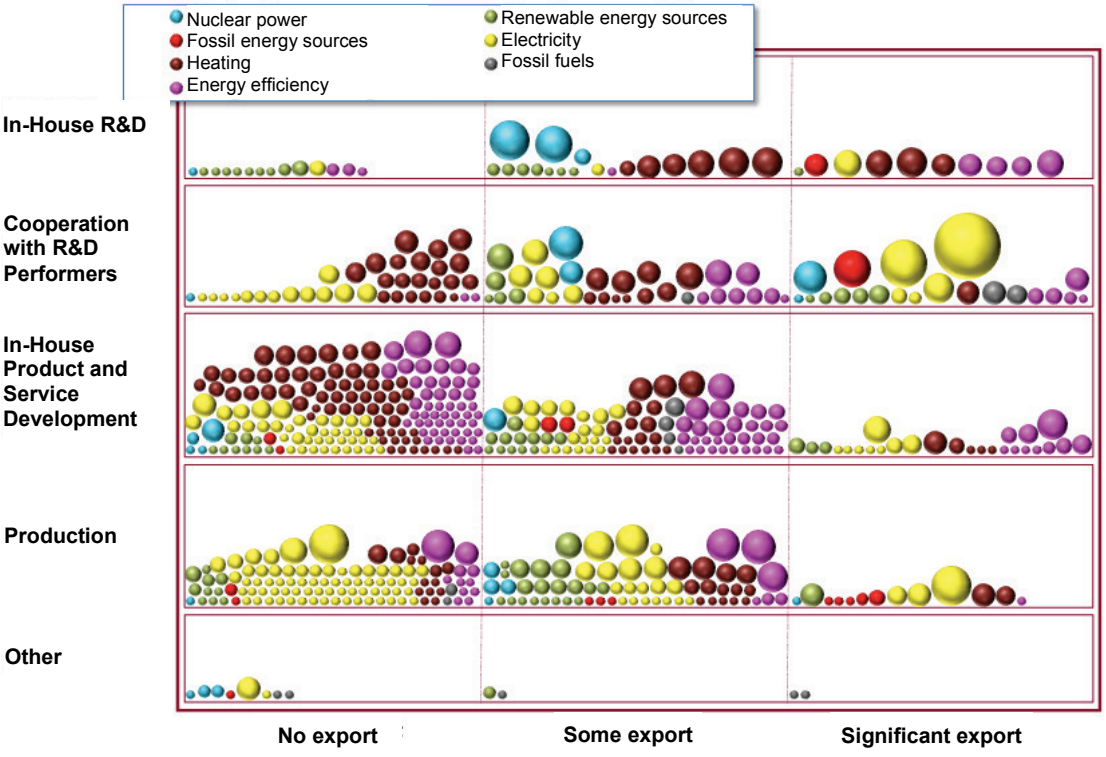
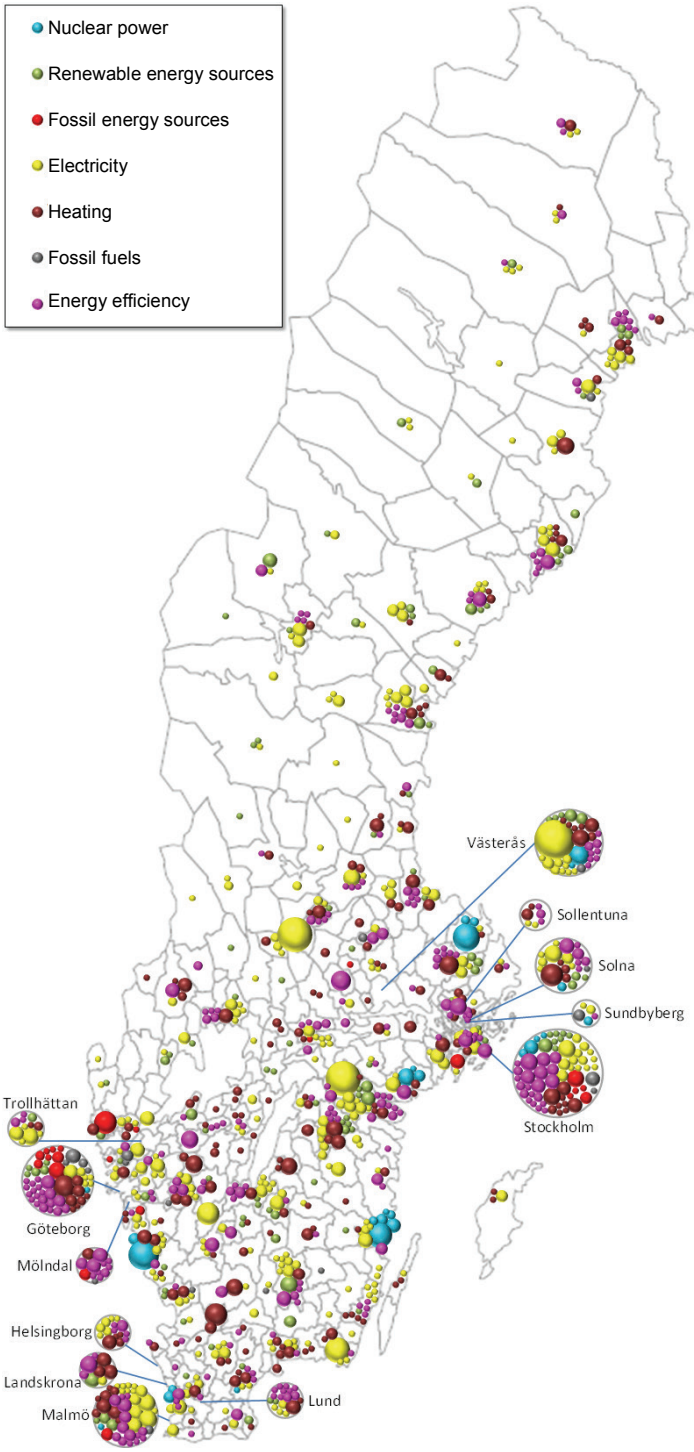


Figure 5 shows companies in the Energy Industry with at least 10 employees. In the figure, the companies are divided according to their R&D intensity (Y-axis) and the amount of exports (X-axis). The categorization of both R&D intensity as well as export classification is further described in chapter 1.4 and 1.5. Simplified, one can say that the vast majority of companies in the Energy Industry categorized as In-House R&D/Consultation with R&D performers/In-House Product and Service Development also have Production. Thus, in the box at the top right

of the matrix is where we find the companies that have both In-House R&D as well as Significant Export.

Figure 6 Geodiagram of All Workplaces With At Least 10 Employees, Year 2014



The geodiagram in Figure 6 shows all workplaces with at least 10 employees. The energy companies are visualised as spheres, where the colour indicates business segment, the size indicates the number of employees per workplace. Thus, the volume of the spheres in this

geodiagram is proportional to the workplace's size and the colour indicates the operation's business segment. The Energy Industry demonstrates an even geographic distribution, and of Sweden's 290 municipalities, 261 of them are represented by (at least) one workplace with at least one employee. The blue colour visualises Sweden's nuclear power centre, with nuclear power plants and companies that work specializing in and dedicated to nuclear power in different ways. We see green spheres referring to Renewable Energy Sources, and these are represented throughout all of Sweden. The red spheres indicating Fossil Energy Sources are found primarily in the major metropolitan regions of Stockholm, Gothenburg, and Malmö. The business segment Electricity is visualised with yellow spheres and these are found throughout all of Sweden. The brown colour for Heating and the pink colour for Energy Efficiency are both evenly distributed across the country. The grey spheres representing Fossil Fuels are mainly found in Stockholm and Gothenburg.

Figure 7 Companies in the Energy Industry For Production & Distribution, With At Least 10 Employees, Year 2014

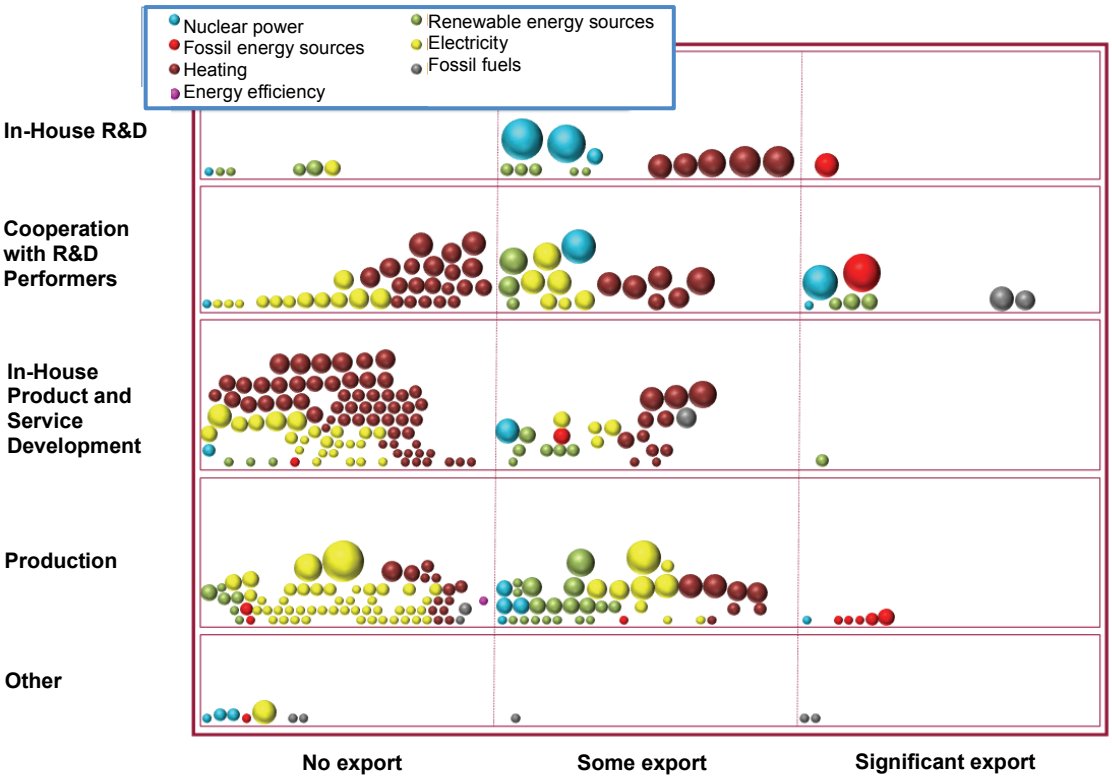
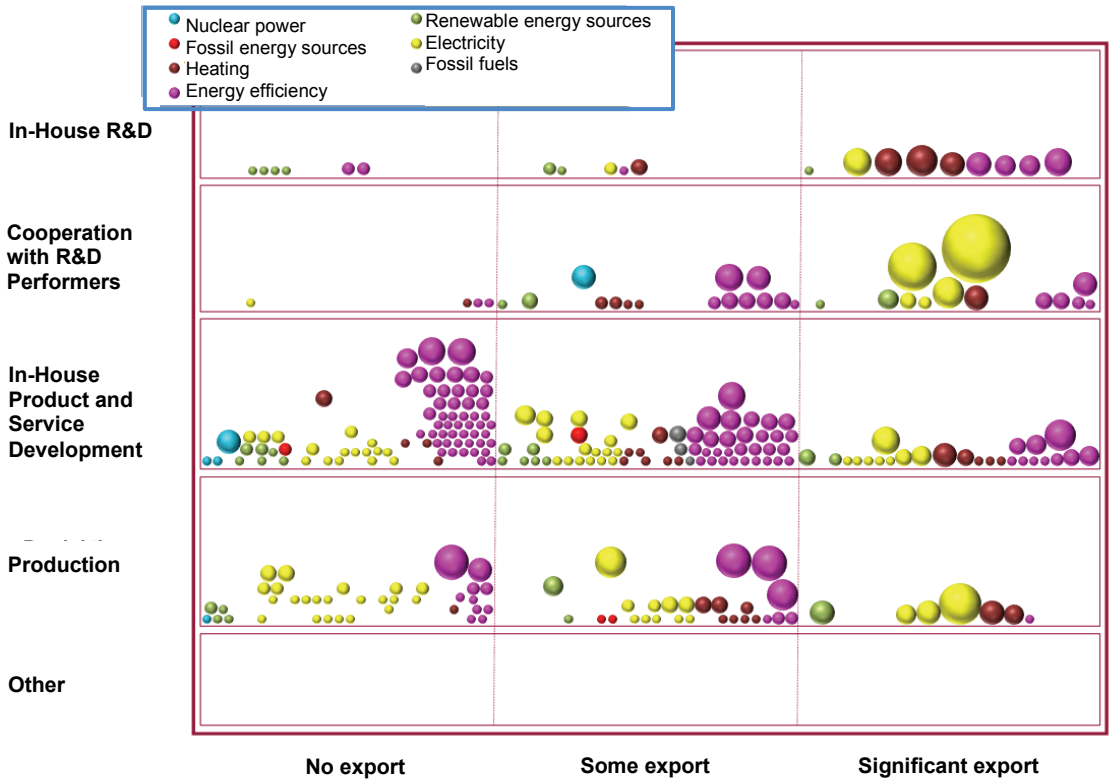
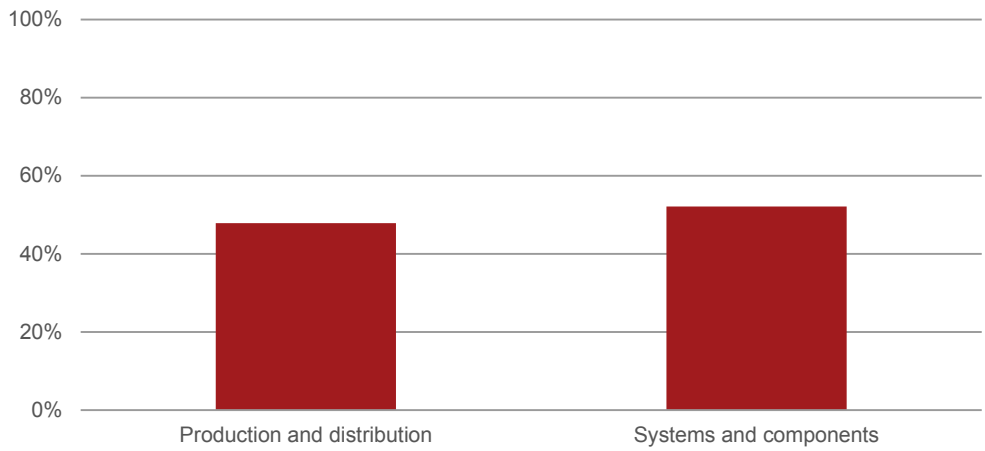


Figure 8 Companies in the Energy Industry For Systems & Components, With At Least 10 Employees, Year 2014



The Energy Industry consists of two almost equally large parts. One part that works with production and distribution, supplying Sweden (and to some extent its local neighbours) with heat and electricity. The other part is involved in manufacturing systems and components for the energy system.

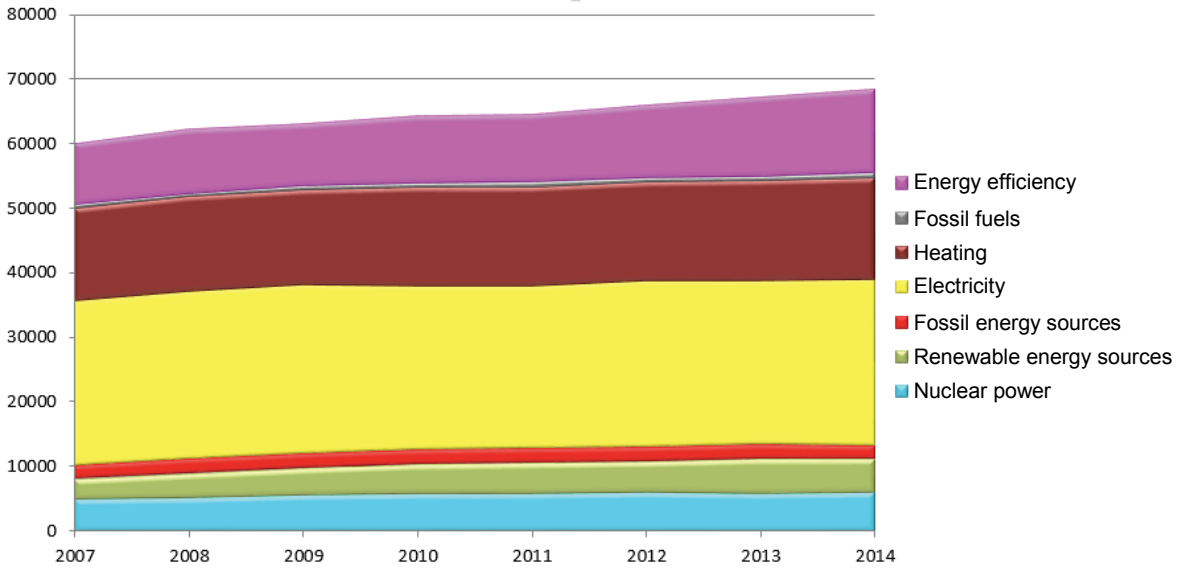
Figure 9 Percentage of Employees Within Production & Distribution and Systems & Components



Energy production and energy distribution in Sweden are based on 39.7 percent of companies (with at least one employee) and involve 47.9 percent of the employees while they account for 77.9 percent of the net turnover. Manufacturing of energy systems and components account for 58.0 percent of companies, 52.1 percent of employees, and 21.4 percent of the net turnover. With regards to competence there is a natural flow where staff trained within energy technology move between production and distribution on the one hand, and the creation of energy systems and components for production and distribution on the other hand. See Figure 7 and 8 concerning companies distributed partly based on production and distribution, as well as systems & components. 2.3 percent of the companies are located in the category "Other", with a very small share of employees and net turnover of the total.

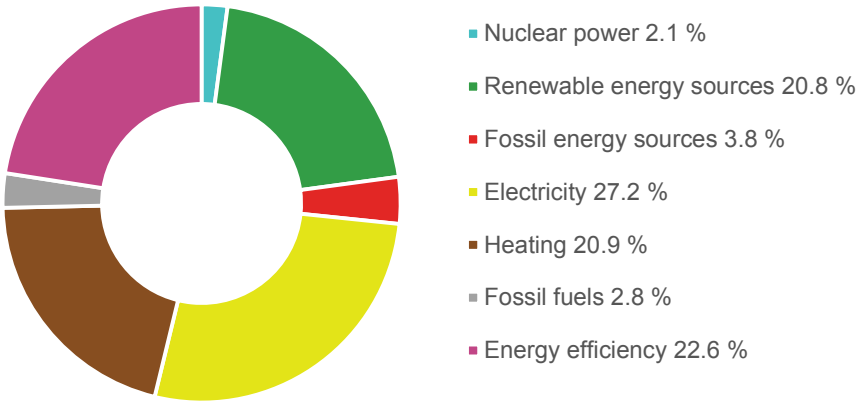
2.2 Energy Industry Development, Year 2007 to 2014

Figure 10 Number of Employees Within Each Business Segment Between Year 2007-2014



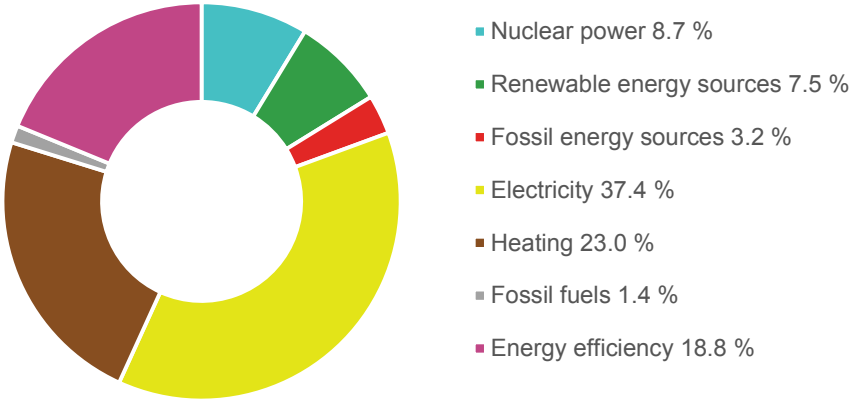
Despite the recession in 2009, and the following aftermath, the Energy Industry is an industry that shows a continuous increase in the number of employees between 2007 and 2014. During this period the industry has increased by 13.9 percent. Figure 10 visualises the number of employees in each business segment between the years 2007-2014, where a steady increase can be noted from 2007 up to and including 2014.

Figure 11 Percentage of Companies Within Different Business Segments, Year 2014



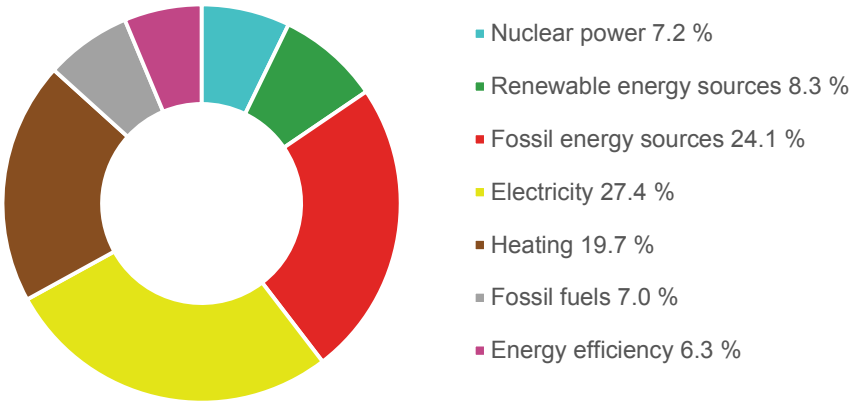
In the year 2014, most companies were found in the business segment Electricity, with 27.2 percent. Then it is fairly even between second to fourth place. Energy Efficiency comes in second place with 22.6 percent, in third place Heating with 20.9 percent, and in fourth place Renewable Energy Sources with 20.8 percent.

Figure 12 Percentage of Employees Within Different Business Segments, Year 2014



Regarding the most employees in the different business segments, this follows the same curve as within which segments most companies are found. This means that most employees are found in the business segment Electricity with 37.4 percent, Heating comes in second place with 23.0 percent, and Energy Efficiency comes in third place with 18.8 percent. Renewable Energy Sources comes in fourth place with 7.5 percent of the employees.

Figure 13 Percentage of Net Turnover Within Different Business Segments, Year 2014



A few things are quite noticeable with regards to the industry's net turnover. Fossil energy sources and fossil fuels have a high turnover in relation to their number of companies and the size of the workforce. Companies in energy efficiency have a much lower turnover when comparing to the number of people who work in that segment.

Figure 14 Histogram of the Number of Included Companies (Y-axis) in Different Size Intervals (X-axis)

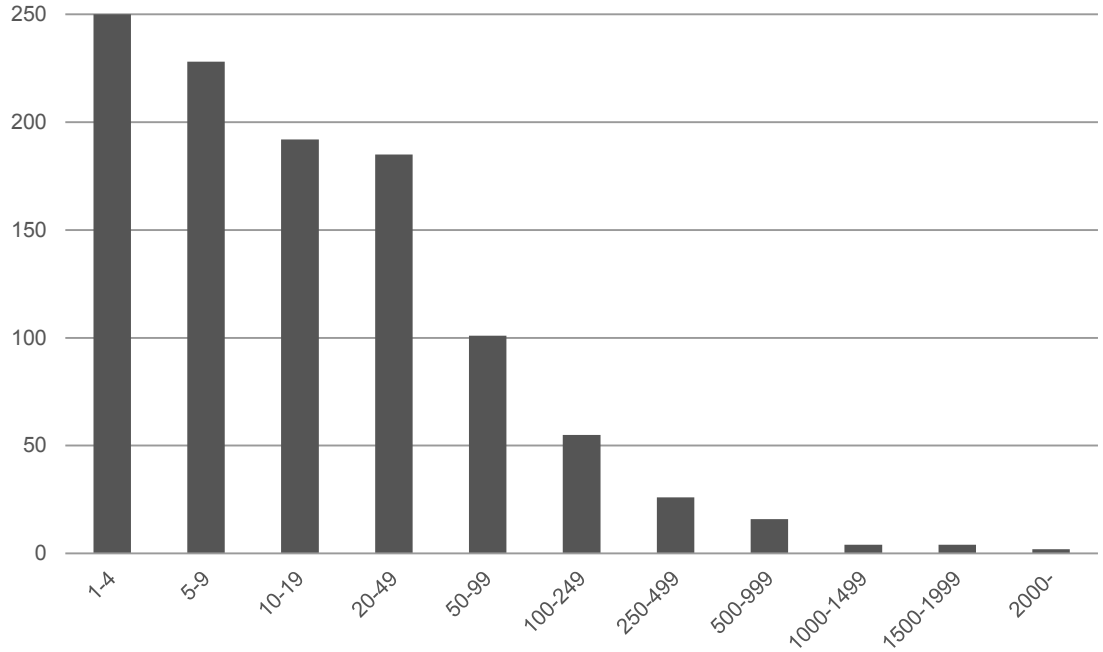


Figure 14 shows the number, in the analysis, of included companies in different size intervals. Here it can be noted that, in the industry, there are many smaller companies (a total of approx. 475) that have 1-4 employees or 5-9 employees. As well, there are a lot companies that have 10-19 and 20-49 employees (a total of approx. 370), and hundreds of companies that have between 50-99 employees. There is also a smaller number of larger companies that employ a large part of the industry, ranging anywhere from 250 to over 2,000 employees. A large part of the Energy

Industry consists of small and medium-sized companies. In total, 95.1 percent of the companies have 1-249 employees. That represents 37.7 percent of the employees and 33.9 percent of the net turnover.

Table 3 The 10 Largest Companies With Regards to Net Turnover, Year 2014

COMPANY	COUNTRY GROUP COMPANY	OWNER PROFILE	NET TURNOVER THOUSAND SEK
PREEM AB	Cyprus	Foreign private	84418000
VATTENFALL AB	Sweden	Swedish public	31676000
ABB AB	Switzerland	Foreign private	31564000
NYNAS AB (PUBL)	Venezuela	Foreign private	18401300
OK-Q8 AB	Sweden	Swedish private/Foreign public	14938740
E.ON FÖRSÄLJNING SVERIGE AB	Germany	Foreign private	10448910
SIEMENS INDUSTRIAL TURBOMACHINERY AB	Germany	Foreign private	9663576
FORTUM GENERATION AB	Finland	Foreign public	9157980
VATTENFALL ELDISTRIBUTION AB	Sweden	Swedish public	8988546
RINGHALS AB	Sweden	Swedish public	8007820

A compilation of the 10 largest companies (Limited Company and not the Group as a whole) with regards to net turnover in 2014 is shown in Table 5. Of the 10 largest companies, six have a foreign Group, and of these six companies five are privately owned and one is publicly owned. One company, OK-Q8 AB, has a shared ownership structure between Swedish private ownership and foreign public ownership. Three of the 10 largest companies have Swedish public ownership. It is notable that there is no company, among the top 10 on the basis of net turnover in 2014, that is Swedish with full private ownership.

Table 4 The 10 Largest Companies With Regards to Number of Employees, Year 2014

COMPANY	COUNTRY GROUP COMPANY	OWNER PROFILE	NUMBER OF EMPLOYEES
ABB AB	Switzerland	Foreign private	9364
SIEMENS INDUSTRIAL TURBOMACHINERY AB	Germany	Foreign private	2662
RINGHALS AB	Sweden	Swedish public	1618
VATTENFALL AB	Sweden	Swedish public	1589
VATTENFALL SERVICES NORDIC AB	Sweden	Swedish public	1561
SIEMENS AB	Germany	Foreign private	1519
PREEM AB	Cyprus	Foreign private	1266
FORSMARKS KRAFTGRUPP AB	Sweden	Swedish public	1156
EITECH ELECTRO AB	Norway	Foreign private	1024
ONE NORDIC AB	Sweden	Swedish private	1023

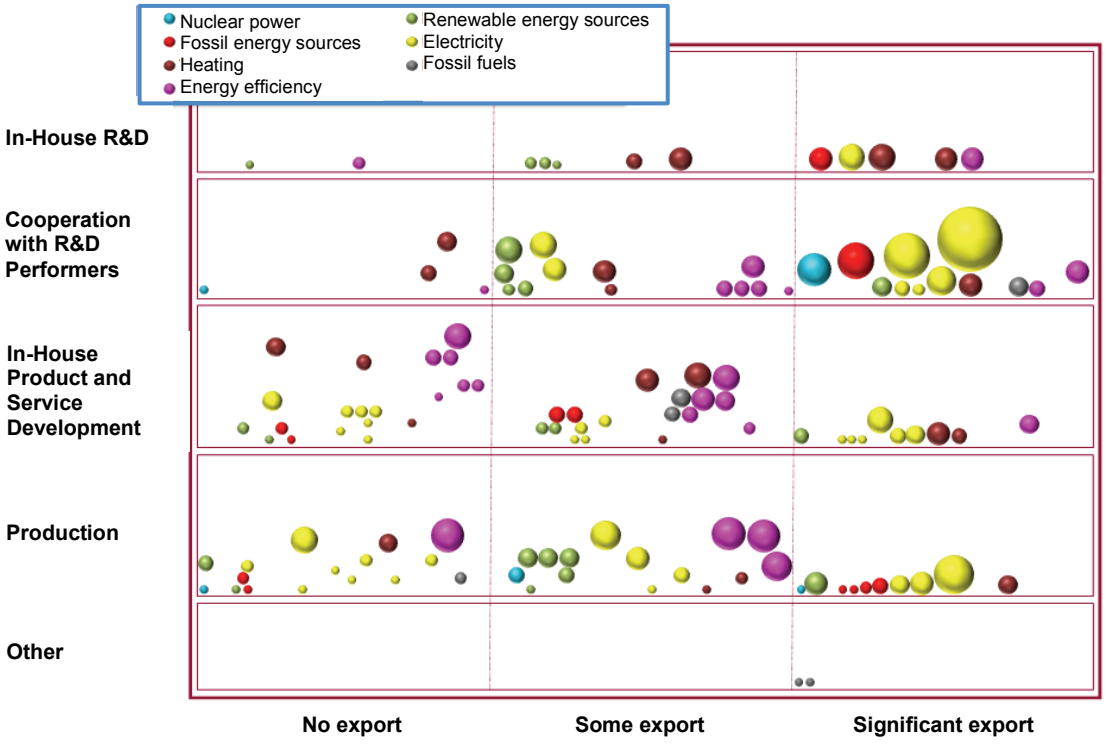
Instead, if one looks at the 10 largest companies (Limited Company and not the Group as a whole) in the industry based on the number of employees in 2014, then that includes an addition of a Swedish and privately owned company, One Nordic AB, see Table 6. Other companies that

are added to this list, as opposed to the list for net turnover, are Vattenfall Services Nordic AB and Forsmarks Kraftgrupp AB, which are both Swedish and publicly owned, as well as Siemens and Eitech Electro AB, foreign and privately owned.

2.3 Company Ownership Structure

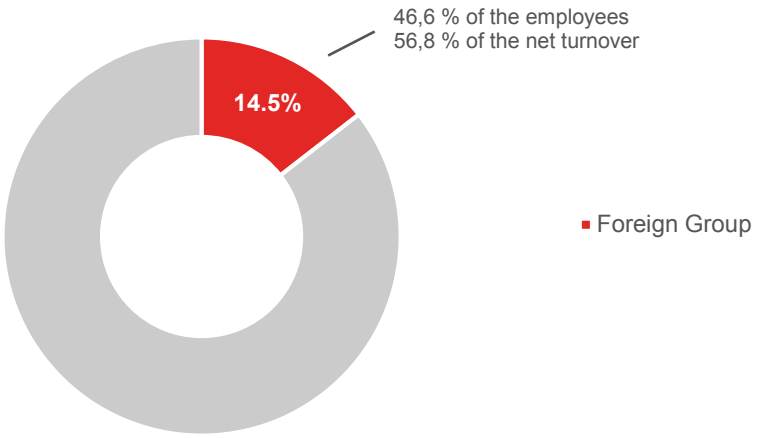
In terms of turnover, the Energy Industry is dominated by the large companies with a foreign Group. If one looks at the 25 companies with the highest net turnover, then the capital-intensive fuel industry ends up in three of the five top spots. Among the 25 companies, only six are fully-owned Swedish companies. The Vattenfall Group is the sole owner of four of them: Vattenfall AB, Vattenfall Eldistribution AB, Vattenfall Vattenkraft AB, and Vattenfall Services Nordic AB. In addition to these, one also finds Stena Oil AB and Skellefteå Kraft AB with Swedish Group. Vattenfall is also majority owner in Ringhals AB and Forsmarks Kraftgrupp AB. The latter two have a foreign minority ownership via E.ON and Fortum's ownership. Some other companies have large Swedish ownership interests in the top 25; OK-Q8 AB, Ellevio AB, and Fortum Värme AB, jointly owned with the city of Stockholm.

Figure 15 Companies in the Energy Industry With Foreign Group, Year 2014



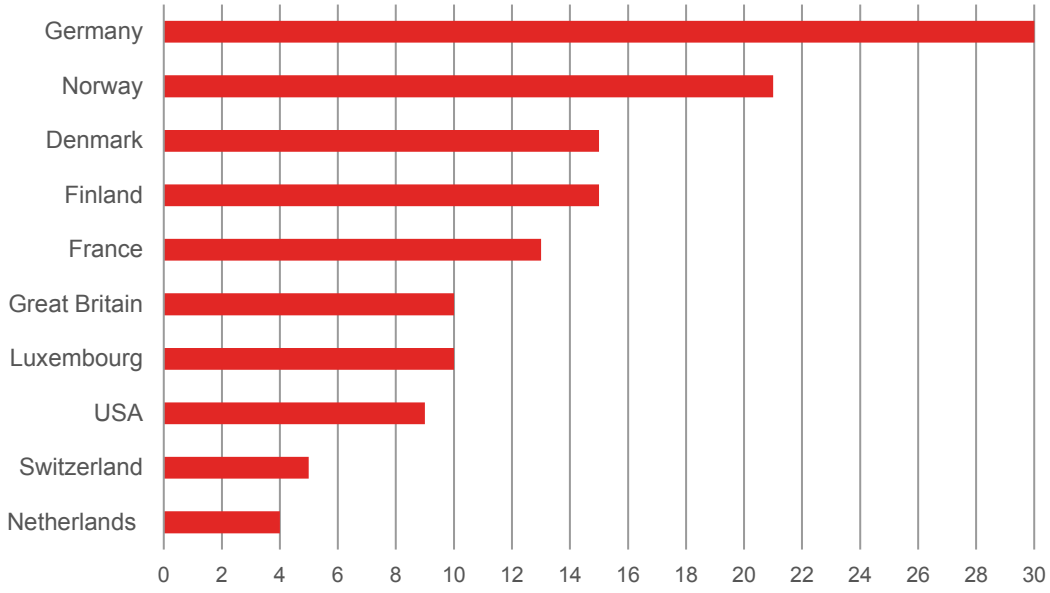
14.5 percent of the companies in the Energy Industry have a foreign Group. Their net turnover amounted to 270 billion SEK, thus constituting 56.8 percent of the industry's net turnover. They also account for nearly half of the employees in the Energy Industry, 46.6 percent. There is a clear connection to the industry's export value and the yellow Electricity segment with production of energy systems, turbines, and transmission systems, see Figure 15.

Figure 16 Percentage of Companies With Foreign Group



With the exception of Sweden, altogether there are 23 nations represented as country for the Group. 85.5 percent of the companies are Swedish-owned. The highest number of companies with a foreign Group is represented by the following nations: Germany (30 companies), Norway (21 companies), Denmark (15 companies), Finland (15 companies), and France (13 companies).

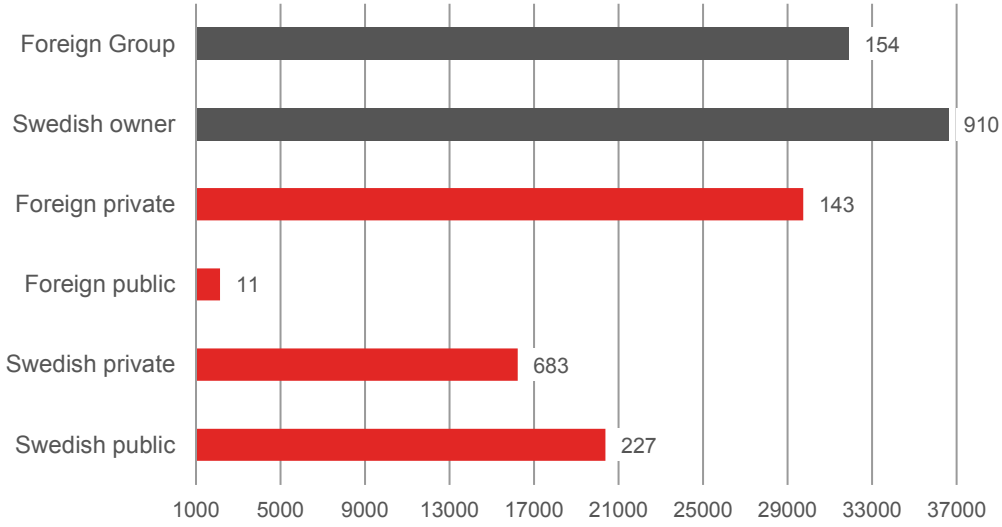
Figure 17 The 10 Most Common Nations Represented as Foreign Group, Number of Companies (X-axis)



For production and distribution, the vast majority of the companies are Swedish-owned, however, companies with foreign Groups represent sizeable market shares. E.ON Sverige AB is owned by German E.ON AG, which is the world's largest privately owned energy company. Fortum Sverige AB is a part of the Finnish Fortum Group, with the Finnish state as majority

owner. Statkraft Sverige AB is a wholly owned subsidiary of Statkraft, which is owned by the Norwegian state.

Figure 18 Number of Employees (X-axis) and Number of Companies according to Foreign Group

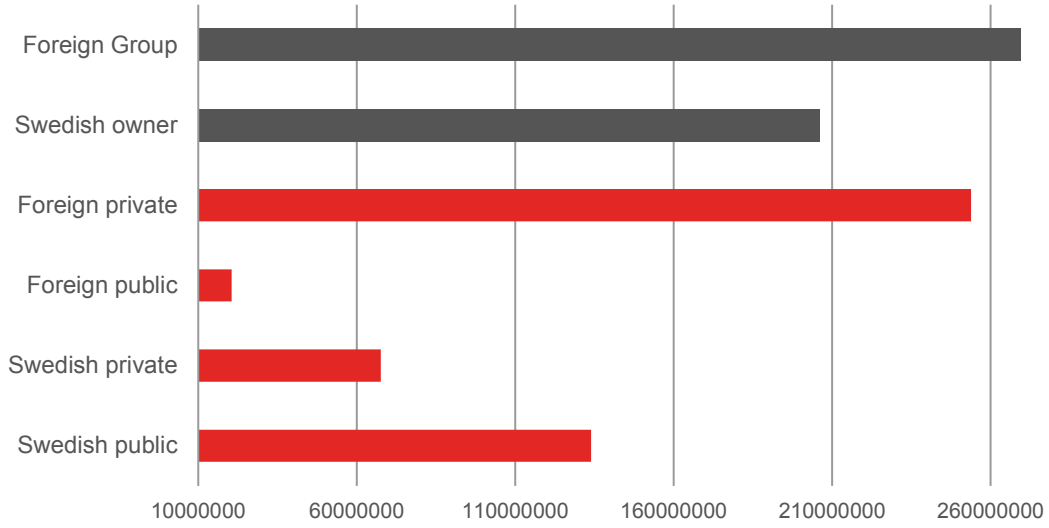


The majority of companies in the Energy Industry, 64.3 percent, have Swedish and private owners. The companies represent 23.7 percent of the employees and 14.2 percent of the net turnover. Foreign private ownership involves 143 companies (13.4 percent) and constitutes all of 43.4 percent of employees in the industry. In terms of turnover, they account for 53.3 percent of the industry's net turnover. The Swedish state's ownership in the Energy Industry centres on the Vattenfall Group. Vattenfall is the largest Swedish-owned company with nearly 9,000 employees. At present, the whole Group has a total of nearly 28,600 employees. Vattenfall has nuclear power and hydropower as the basis in production, and the main operation centres on production of electricity. They are also the largest wind power operator within the Nordic countries.[7] The Group's share of employees represents more than 13.0 percent of the Energy Industry.

A large share of the 21.3 percent Swedish publicly owned energy companies are municipality-owned companies, primarily made up of three main groups; CHP-companies, grid companies, and trading companies. The Swedish-owned public companies represent 29.8 percent of the employees 28.1 percent of the net turnover.

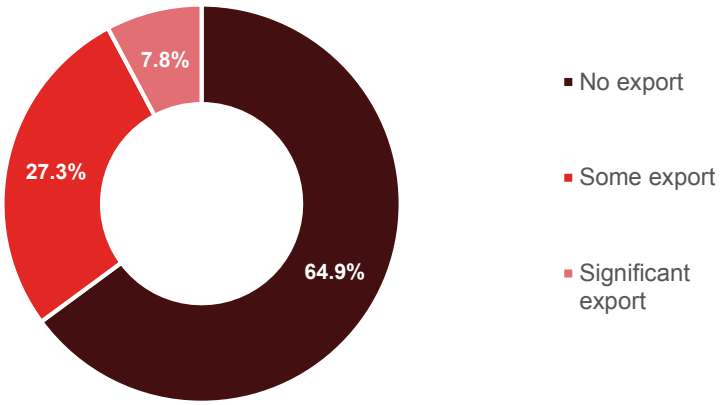
[7] www.vattenfall.se

Figure 19 Net Turnover (Thousand SEK) according to Foreign Group



2.4 Company Exports

Figure 20 Percentage of Companies Within Different Export Intervals



The larger companies in Sweden that design and manufacture energy systems or parts of systems and components, such as ABB AB, Siemens Industrial Turbomachinery AB, and Westinghouse Electric Sweden AB, represent a large percentage of exports. The Energy Industry's exports are shown in three intervals; No export, Some export and Significant export. 'Significant export' refers to companies with a relative export amounting to at least 50 percentage points of the net turnover, or has a value exceeding 100 million SEK per year.

Companies with 'Significant export' make up 7.8 percent of the study's population in number, but their total net turnover amounts to 203 billion SEK, 42.8 percent of the industry's total net turnover. Companies with 'Significant export' represent 32.5 percent of the employees in the

industry. Companies with foreign ownership and 'Significant export' represent 3.2 percent (34 companies) in the study, with 36.4 percent of the industry's net turnover. They account for 27.3 percent of employees. It is worth noting that there are common historical origins among several of the companies that make parts or whole systems. There is a historical link between several of the companies that at one time have been part-owned by ASEA and later ABB. The bigger yellow spheres represent ABB (Västerås, Ludvika, and Karlskrona) and Siemens (Finspång). The blue are Westinghouse (Västerås), and also green spheres for Alstom Power (now General Electric) are included here (Norrköping, Västerås).

According to Swedenergy (Energiföretagen Sverige), all together the electricity generating companies exported a net of 22.5 TWh of electricity through trading on the power exchange during 2015, a new record high since records began. Swedenergy (Energiföretagen Sverige) estimate the value of exports in 2015 to 5.5 billion SEK. Sweden's electricity exports can vary from year to year, depending on production and consumption in Sweden as well as neighbouring countries. However, in the last five years (2011-2015), Sweden has had a positive net export. The main reason that the production generated a record level of electricity exports is based on a "warm year with continued economic use", while production had "abundant hydropower production" and a "usual production record for wind power".[8]

A generalization that can be stated is that the larger spheres represent companies that base their export capacity on research, development, and production being located in Sweden. As well, the companies that represent electricity exports within Nordpool have a clear proximity to research, development, and production in Sweden. Based on the study's visualisation, and Swedenergy's (Energiföretagen Sverige) estimate of the net value of electricity exports, one can rightly assume that the Energy Industry's export is based on 1) the presence of Groups in the industry, and 2) Groups noting the investment in research and development in Sweden, and 3) that they also have chosen to let production remain in Sweden. The companies that are among those with lower export values are scattered across the entire Y-axis, while Groups with their own in-house R&D or research-production in Sweden characterize the companies in the highest export interval.

It is notable that net turnover for companies without export lands at 110 billion SEK. Among those companies, a big part is municipal and state-owned, with grid operations, power trading (electricity), and district heating. Thus, a large share of the companies (64.9 percent of the population), has no exports, and most of these are mainly within the business segments Heat and Electricity. The companies that do not have any export account for 29.8 percent of employees and 23.3 percent of the net turnover.

In order to obtain an understanding of the actual value of exports in the Energy Industry, further studies are needed. The estimation that this study can present with reliability is that the 1,064 companies included in the study for 2014 have an export somewhere between 60 and 100 billion SEK. Thus, 373 companies in the study account for an export value of approx. 15-20 percent of

[8] http://www.svenskenergi.se/Pressrum/Pressmeddelanden/Elaret-2015-lagt-elpris-rekordhog-elexport--satsa-pa-natutbyggnaden/

the industry's net turnover. ABB, which represents about 13.7 percent of the industry's number of employees, states that 80 percent of their net turnover is based on export sales, which in 2014 would mean 25.2 billion SEK. Siemens Industrial Turbomachinery AB in Finspång states that 95 percent of their production is exported, which in 2014 would mean 9.2 billion SEK.[9] Preem, Sweden's largest fuel/oil company, states that two-thirds of the refining capacity of crude oil in Sweden is exported. In 2014, Preem had a turnover of 84 billion SEK.

Previously, Power Circle, an organisation following the electric power industry since 2004, estimated the value of exports of electric power to approx. 90 billion SEK per year for both 2011 and 2012.[10]

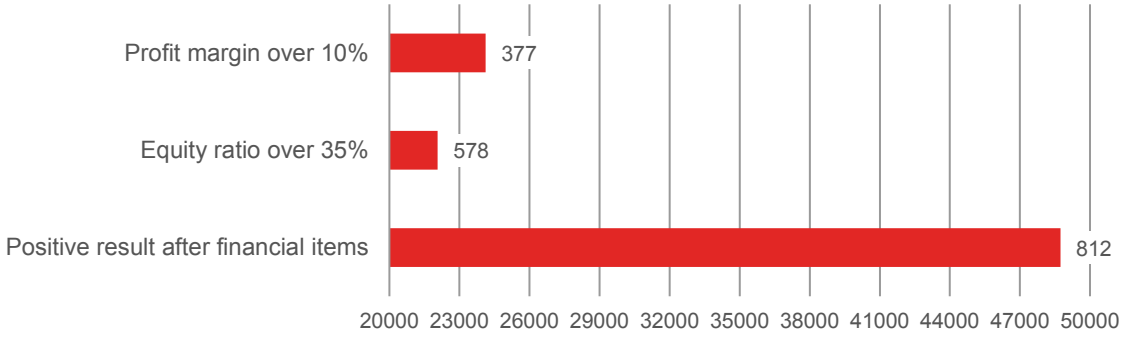
Swedenergy (Energiföretagen Sverige), but also the Environmental Protection Agency (Naturvårdsverket) and the Energy Agency (Energimyndigheten) estimate that there is an even greater potential for exports of electricity in their projections for 2050. Certain surplus capacity should also be required since the secured supply of solar, wind, and hydropower have large variations in the short and long term.[11]

2.5 Company Results

The Energy Industry's total net turnover for the year 2014 amounts to 475.7 billion SEK. 1.1 percent of the total population aged 16-64 works in the industry in 2014.[12]

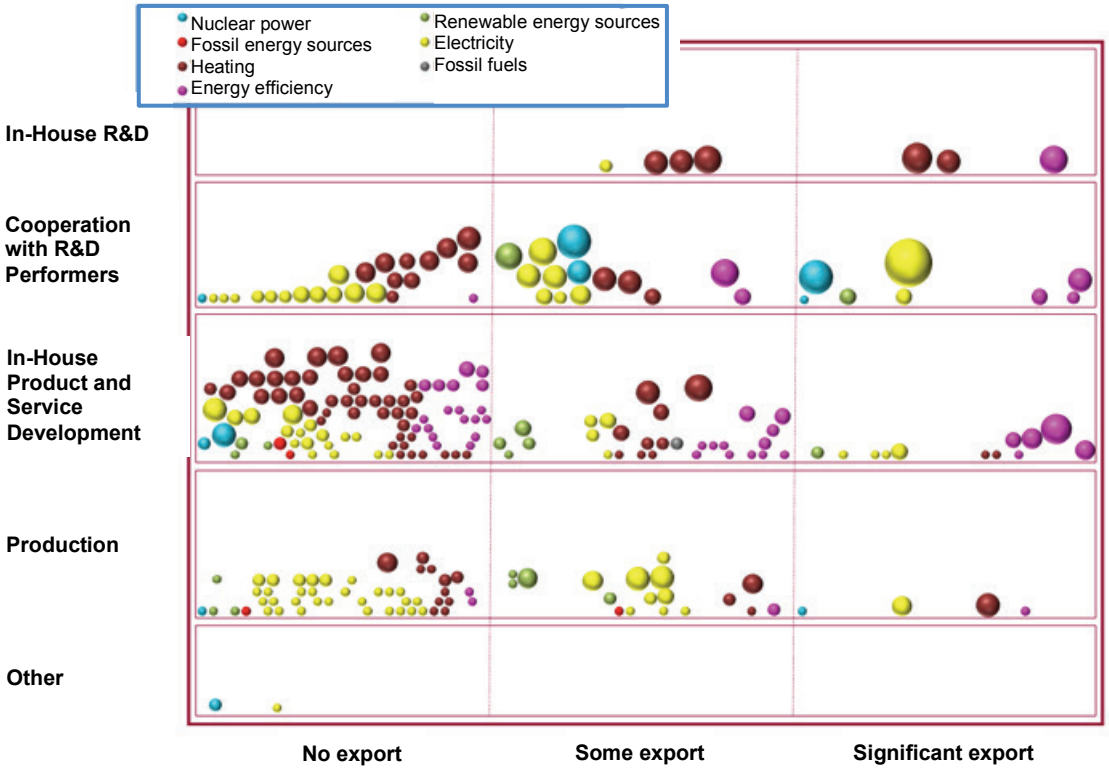
In 2014, a large majority of companies in the Energy Industry, 76.3 percent, show a positive result after financial items. 23.7 percent of the Energy Industry's companies have both a positive result after financial items, a net margin exceeding 10 percent, *and* an equity ratio over 35 percent. Together they represent 18.9 percent of the industry's employees and 14.5 percent of the industry's net turnover.

Figure 21 Number of Employees (X-axis) and Number of Companies according to Profit Margin, Equity Ratio, and Positive Result after Net Financial Items



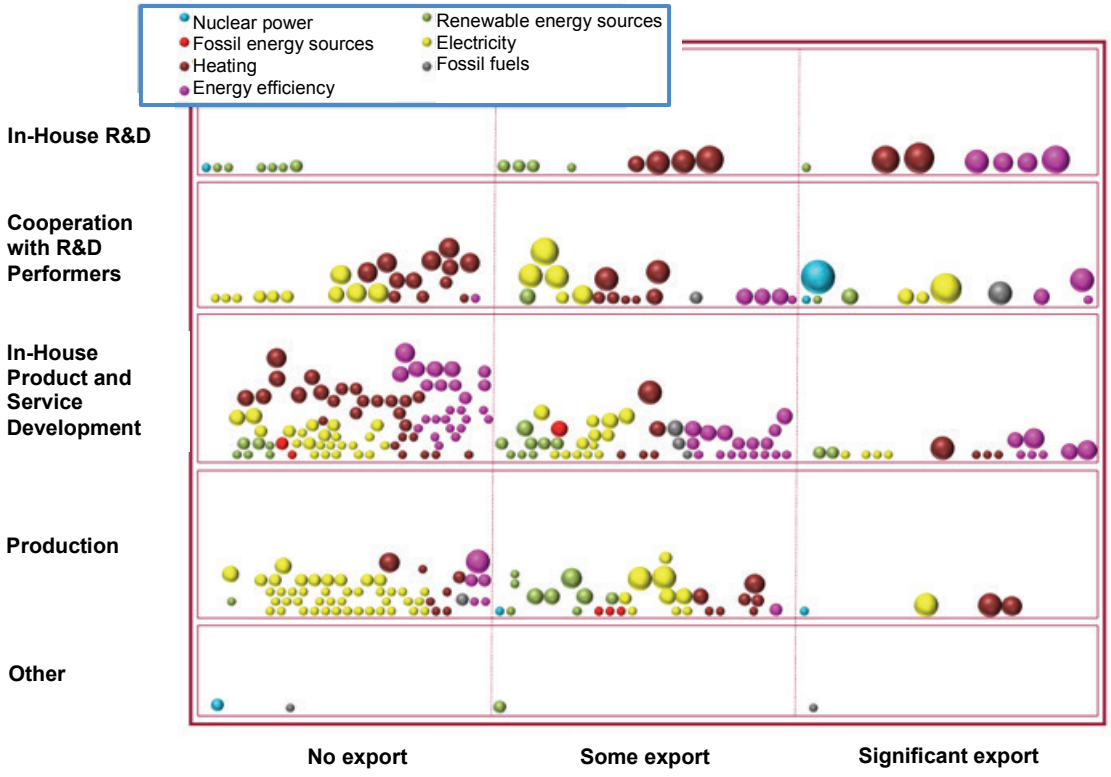
[9] E-mail conversations in the authors' possession
[10] Power Circle, PP-presentation
[11] see, e.g., http://www.naturvardsverket.se/fardplan2050
[12] http://www.sverigeisiffror.scb.se/bnp

Figure 22 Companies With Profit Margin Over 10 Percent, Year 2014



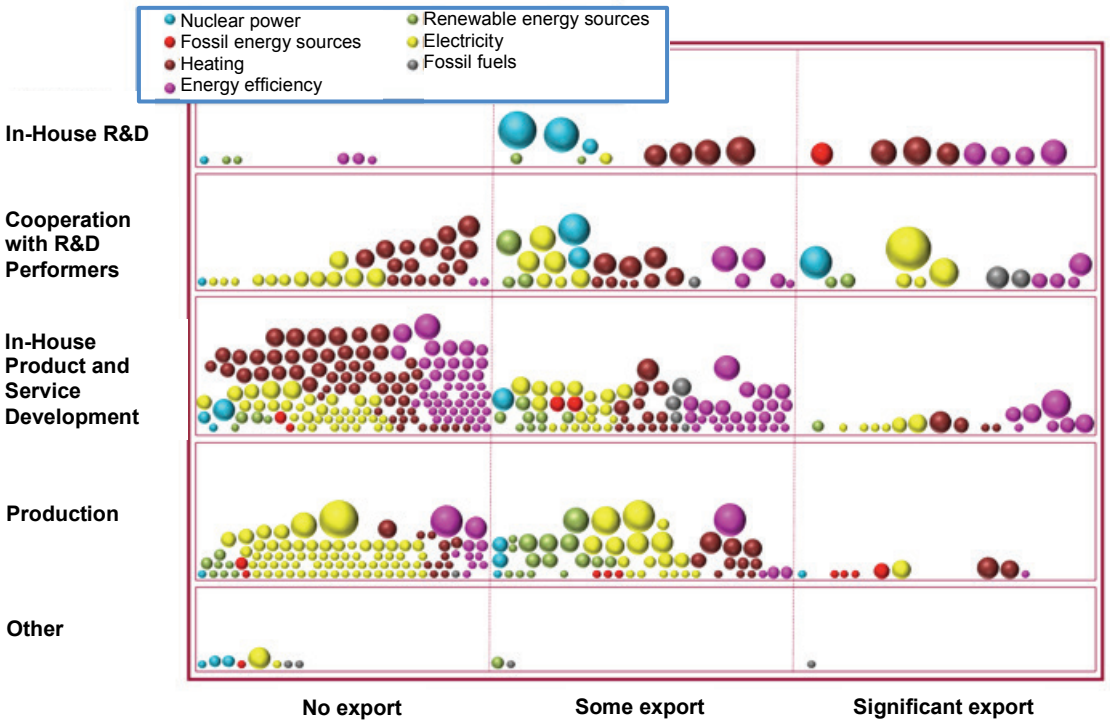
The Energy Industry's net margin indicates that one in three companies (35.4 percent) has a net margin over 10 percent. Electricity represented by yellow spheres and Heating represented by brown spheres are clearly visible, and most companies are found on the level In-House Product and Service Development on the Y-axis. The companies are relatively uniformly distributed between the export intervals, even if most companies have No export. One cannot see that the R&D intensity in the company affects the net margin, see Figure 22.

Figure 23 Companies With Equity Ratio Over 35 Percent, Year 2014



More than half of the companies (54.3 percent) have an equity ratio over 35 percent for 2014. They are distributed uniformly within the export intervals, even if once again there is an emphasis for No export. Primarily they are small and medium-sized companies, and together they account for 32.2 percent of the industry's employees. Once again, the level In-House Product and Service Development has the most companies. The three large segments, Electricity, Heating, and Energy Efficiency, are represented most frequently.

Figure 24 Companies With Positive Result after Net Financial Items, Year 2014



76.3 percent of the companies in the study have a positive result after financial items in 2014. Once again we see a relatively wide distribution in segments, on both the Y-axis and X-axis.

3 Competence Mapping in the Energy Industry

It is the first time in this analysis series of the Energy Industry that we have had the opportunity to work with information and data about those who actually work in the industry. The parameters that are illustrated in the various figures in this chapter are described further in chapter 1.8.

It is important to note that the underlying information for the figures, analysis, and conclusions in this chapter (ordered separately from SCB) does not fully correspond to the information in the database (developed by Vinnova), which is the basis for the other chapters in this analysis. Of course, both are based on the above-mentioned sources from the same companies in the Energy Industry in Sweden. The difference between the two different information materials is described further in chapter 1.8.

Due to the differences in the information materials, and also differences in SCB's data from 2007 to 2013, it is important to view the figures, analyses, and conclusions presented herein as snapshots of competence and expertise in the Energy Industry.

Despite these differences, the data from Statistics Sweden enable us (for the first time) to get an idea of the competence structure of the people that work the in the industry based on parameters such as age, education, gender equality, and origin.[13] Corresponding data was presented in a study of the chemical industry and thus there are also opportunities to make comparisons between the two industries.[14]

[13] Note that the figures, analyses, and conclusions in this chapter are based on data from Statistics Sweden (SCB), and is a supplementary picture of the industry.
[14] http://www.vinnova.se/en/Publications-and-events/Publications/Products/Chemical-Industry-Companies-in-Sweden1/

3.1 Age Structure

Figure 25 Number of Employees per Age Interval, Year 2007 and 2013

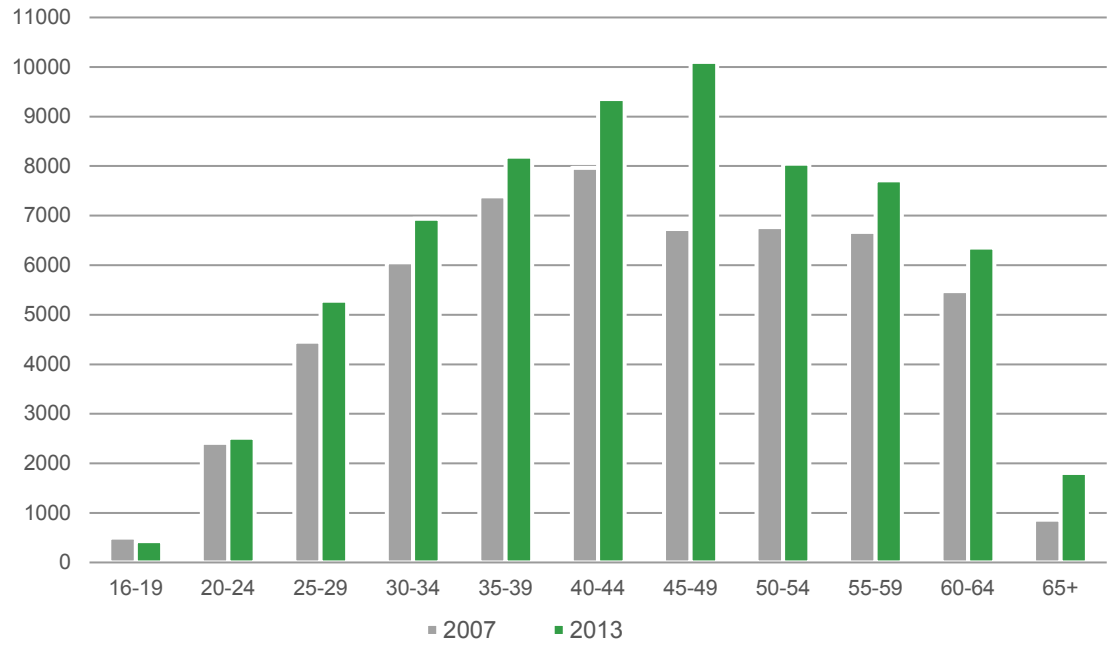


Figure 25 shows the age structure for the employees in the Energy Industry for year 2007 and 2013. As can be seen in the figure, the employees in the Energy Industry are on average older year 2013 compared to year 2007. The number of employees in all age intervals has increased with one exception, which is the age interval 16-19 years where the number of employees has decreased slightly. The largest increase in the percentage of employees has taken place between the ages of 45-49 years and, overall, this increase in the percentage of employees in the age interval from 40-44 years up to and including 65+ is larger than the increase in the lower age interval from 20-24 years up to and including 35-39 years. It is also worth noting that the percentage of employees who are 65+ has increased a great deal in 2013 compared to 2007, which may be due to the number of employees who have reached retirement age but choose to continue working to a greater extent.

The increase in the age interval 45-49 years is noteworthy. It shows that the industry's percentage-increase during the time interval is based primarily on the new middle-aged employees who have been hired. The actual number by which the age interval 45-49 years grows from 2007-2013 is 3,375 persons, which is 29.5 percent of the industry's entire growth.

Figure 26 Change in Number of Employees per Age Interval between Year 2007-2013, as well as percentage change

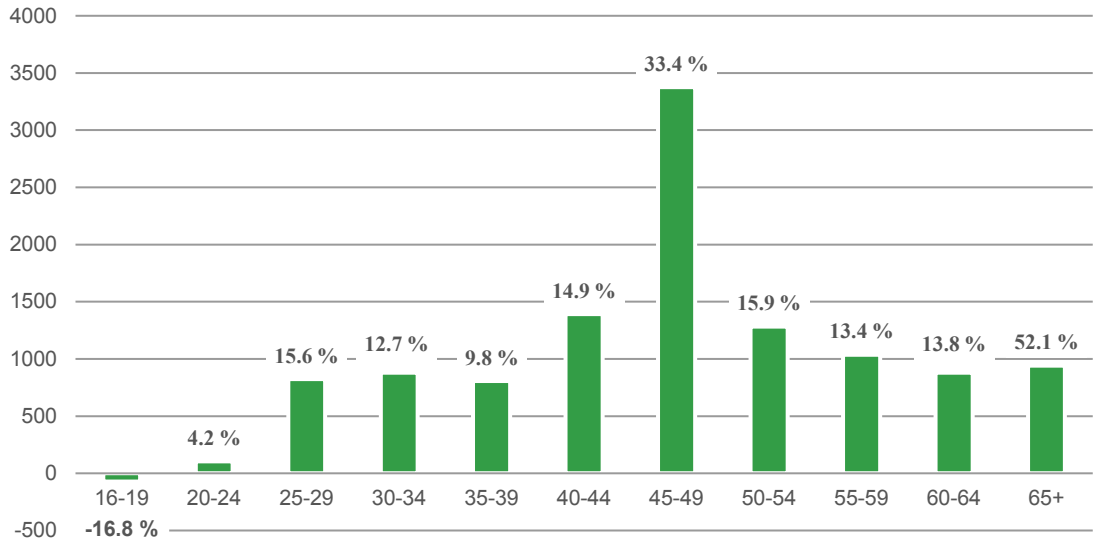


Figure 26 shows the change, both absolute as well as relative numbers, in the number of employees per age interval from year 2007 up to and including year 2013. The largest relative increase was among employees in the age interval 65+ with 52.1 percent, which can be compared with the chemical industry where the same age interval accounted for the largest relative increase by 67 percent. However, in terms of the number of employees the biggest increase is found in the age interval 45-49 years. The only age interval, in which the proportion of employees has decreased, both in relative and absolute numbers, is the interval 16-19 years.

Figure 27 Average Age for the Energy Industry, Year 2007 and 2013

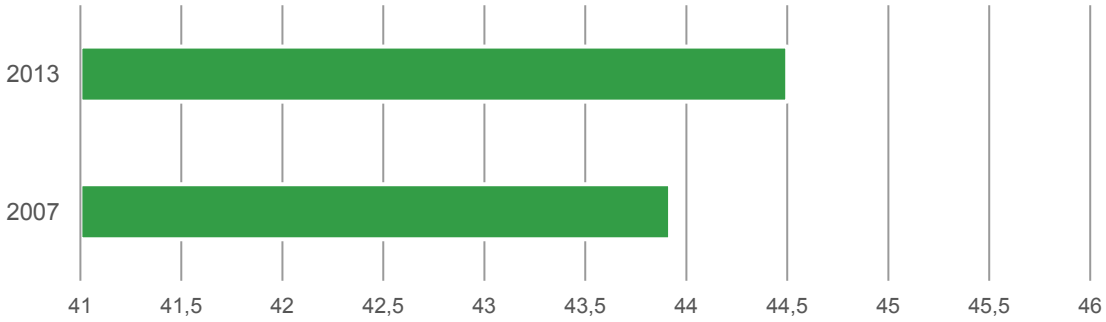
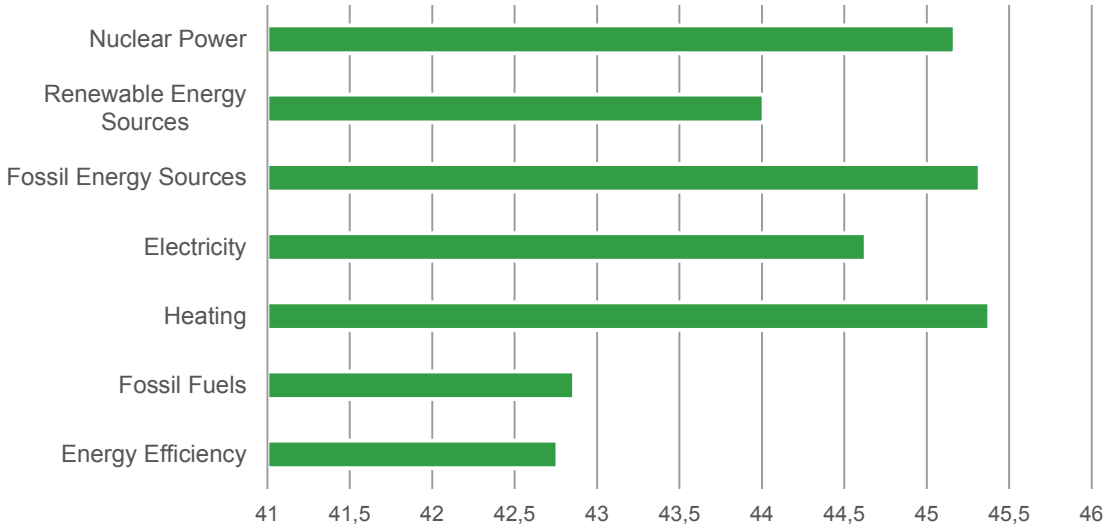


Figure 27 shows that in the year 2013 the average age of an employee in the Energy Industry was 44.5 years, which is an increase by 0.6 year compared to the average age in the year 2007 which was 43.9 years.[15]

[15] This can be compared to the average age in the chemical industry, which in the year 2013 was 44.4 years according to an analysis of the chemical industry VA 2016:04.

Figure 28 Average Age for Employees per Business Segment in the Energy Industry, Year 2013



The average age of employees per business segment in the Energy Industry is shown in Figure 28. As can be seen in the figure, the average age is similar within most business segments. Within three of the business segments - Nuclear power, Fossil fuels, and Heating - the average age exceeds 45 years. Two of the business segments, Renewable Energy Sources and Electricity, are also close to each other with an average age of 44 years and 44.6 years, respectively. Two business segments stand out with a lower average age than the other segments, Fossil Fuels and Energy Efficiency, with an average age of 42.9 years and 42.8 years, respectively.

3.2 Education

Figure 29 Level of Education of Employees in the Energy Industry, Year 2007, 2010, and 2013

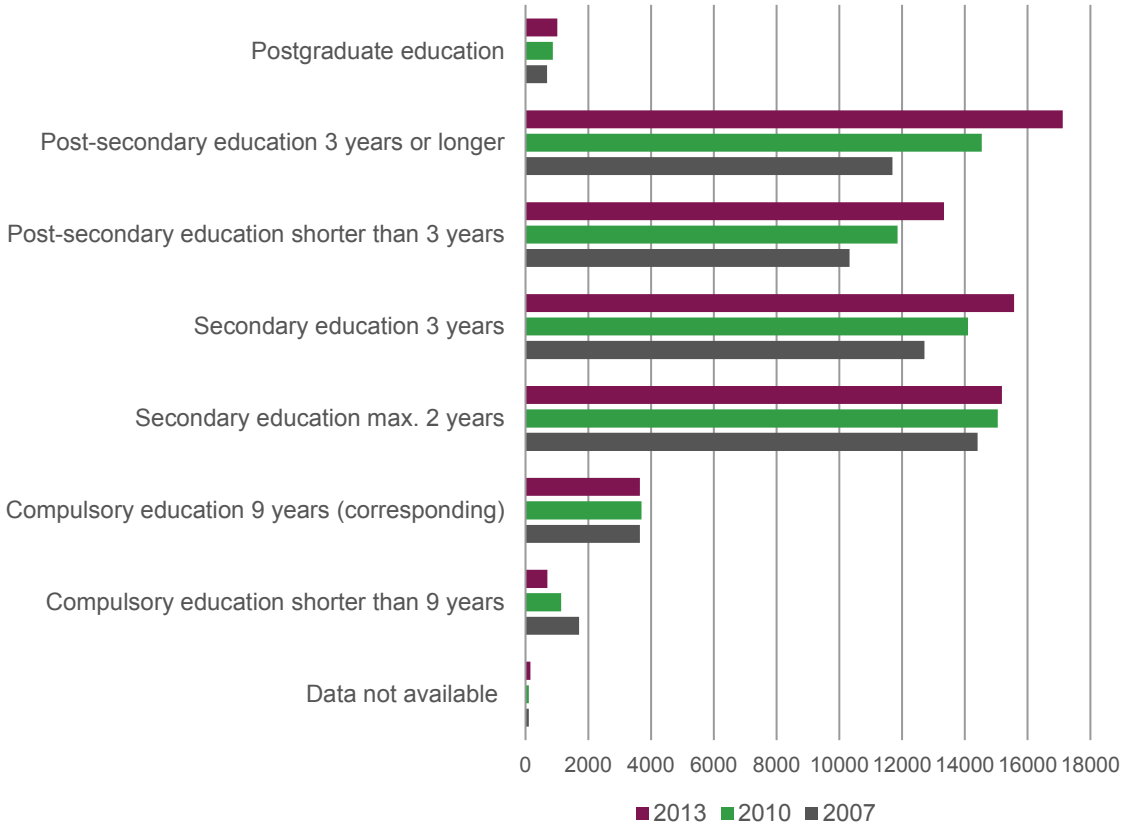
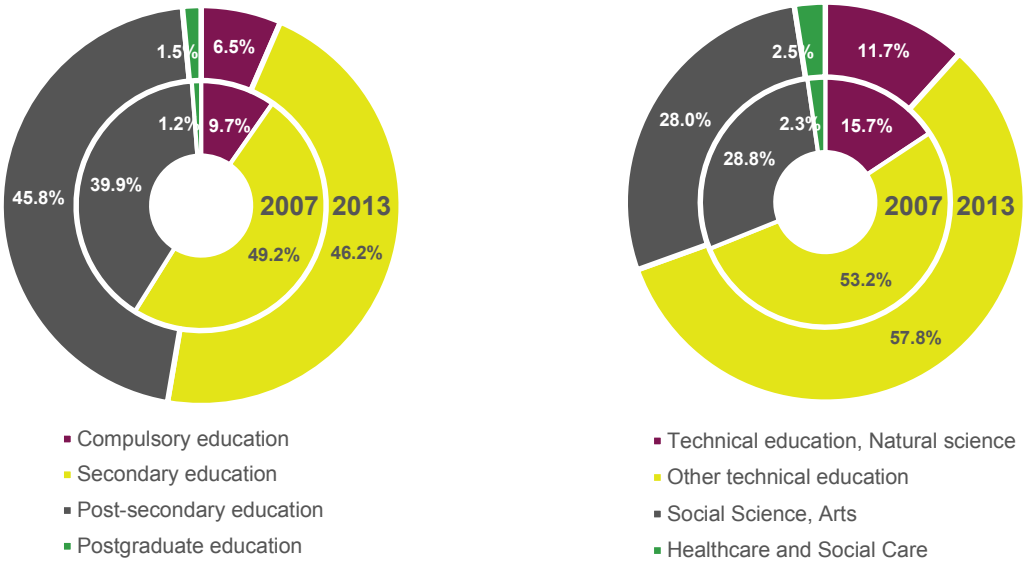


Figure 29 shows the different education levels that employees in the Energy Industry had during the years 2007, 2010, and 2013. It is worth noting that all education levels have increased proportionately from 2007 to 2013, with the exception of the two lower levels of education, Compulsory education 9 years and Compulsory education shorter than 9 years, which instead have decreased.

The largest increase was in Post-secondary education 3 years or longer, and within this category one finds, e.g., Master of Science in Engineering and Bachelor of Science.

Figure 30 Structures Regarding Education Level Within the Energy Industry, Year 2007 and 2013

Education Levels **Secondary Education**



In 2013, 45.8 percent of the employees in the Energy Industry had post-secondary education as their highest completed education, which means that they have graduated from vocational college, college, or university. That is an increase by 5.9 percentage points compared to the same category in 2007. This is illustrated in the circle to the left in Figure 30. 1.5 per cent of workers in the industry had postgraduate education in 2013, and compared to 2007 this percentage has increased slightly. As for employees who have lower secondary or upper secondary education as their highest completed education, a decrease can be seen in both categories. In 2013, 46.2 percent of the employees had secondary education as their highest completed education, which can be compared to 49.2 percent in 2007, i.e., a decrease by 3 percentage points.

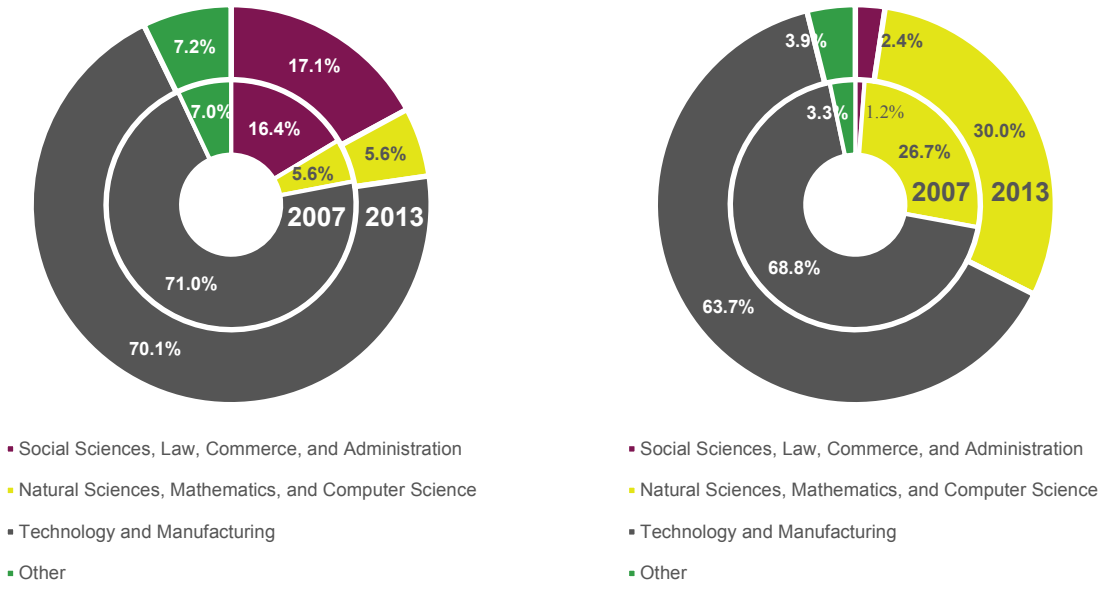
In the circle to the right in Figure 30, we note that among the employees who have secondary education as the highest completed education, the majority, 57.8 percent, had a technical specialisation within "other technical education"[16], 11.7 percent have specialised in technology and natural sciences[17], and 28.0 percent had specialised in social sciences or arts. Comparing to year 2007, one notes that the employees with specialization in "other technical education" increase by 4.6 percentage points compared to 2007, while the employees with technical and/or natural science education instead decrease by 4 percentage points in 2013 compared to 2007.

[16] Other technical education includes education in the following areas: Construction, computer science-electrical-energy, automotive, industry, Water-Heating-Sanitation and buildings, other technology and manufacturing, agriculture, and transportation.
[17] Technical and natural science education include the following education: Natural science education, vocational-oriented natural science, and technical college graduate.

It is especially interesting to note the actual increase for those with Secondary education 3 years or longer between 2007 and 2013. In total, that group increases by all of 5,428 persons, and the education level's numerical increase makes up all of 47.4 percent of the industry's growth during the period, based on SCB-data.

Figure 31 Structures Regarding Education Level Within the Energy Industry, Year 2007 and 2013

Post-secondary Education **Postgraduate Education**



In 2013, for the employees in the Energy Industry who had post-secondary education as their highest completed education, the left circle in Figure 31 shows that the vast majority, 70.1 percent, had an education specialised in technology and manufacturing, which is a decrease (-0.9 percentage points) compared to 2007. We also note that the distribution between the different education orientations is relatively constant compared to between the years 2007-2013. In 2013, 17.1 percent had an education in social sciences, law, commerce, or administration. 7.2 percent have an education orientation which is indicated here as ”other”[18].

Only 5.6 percent have a post-secondary education in natural sciences, mathematics, and computer science in 2013 (same percentage as in 2007). There is a distinct difference in comparison to how many employees in the Energy Industry that in 2013 had a postgraduate education where all of 30 percent have an education in natural sciences, mathematics, and computer science, which is illustrated in the right circle in Figure 31. Here we see an increase by 3.3 percentage points compared to 2007. However, the majority of employees with postgraduate education, 63.7 percent, also have education in technology and manufacturing,

[18] The category 'other' refers to education with the following orientation both for post-secondary education and education at postgraduate level: Pedagogy and teacher training, humanities and arts, agriculture and forestry, veterinary care, health care, social care, and services.

which in itself is a decrease by 5.1 percentage points compared to 2007. It is worth noting that there is a significantly lower percentage, 2.4 percent of employees with postgraduate studies, who have education in social sciences, law, commerce, or administration compared to the percentage with post-secondary education in the same specialisation (17.1 percent). We also note that this percentage has increased by 1.2 percentage points compared to 2007.

The majority of employees with postgraduate education have various Master of Science degree programs as basis, however, it is worth noting that there also are a few researchers/scientists in the Energy Industry who have education in areas such as health care, services, as well as pedagogy and teacher training.

3.3 Occupation Structure

Table 5 Top 10 Occupations All Employed in the Energy Industry, 2013

	OCCUPATION	NUMBER 2013	PERCENTAGE 2013
1	Engineers and technicians	13,158	19.7%
2	Master of Science in Engineering, architects, etc.	7,641	11.5%
3	Finance and sales associate professionals, etc.	3,856	5.8%
4	Electricians, telecommunications and electronics equipment mechanics and fitters, etc.	3,350	5.0%
5	Fitters	3,044	4.6%
6	Business economists, marketers, and civil servants	2,743	4.1%
7	Specialist managers	2,452	3.7%
8	Building craftsmen	1,779	2.7%
9	Other machine operators and fitters	1,770	2.7%
10	Computer specialists	1,590	2.4%

There is a wide variety of occupations represented in the Energy Industry and Table 7 shows what the top ten most common occupations are in the Energy Industry in 2013, distributed across all employees in the industry, regardless of education level or gender. The absolute vast majority of employees in the Energy Industry in 2013 were engineers and technicians, and then we find Master of Science in Engineering, architects, etc. In third place we find finance and sales associate professionals, etc. In fourth place we find electrical installers, telecom and electronics repair personnel, etc.

Similar tables are found in chapter 3.4, distributed across the most common occupations per employee men and women, respectively.

Figure 32 Number (X-axis) and Percentage of Master of Science in Engineering, Architects, etc., based on County

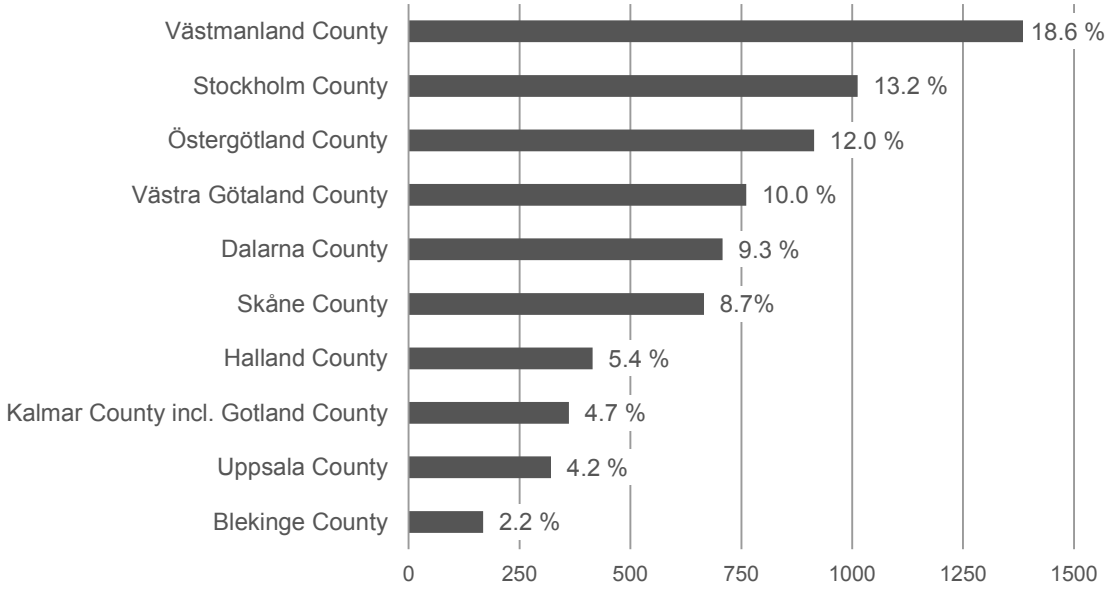


Figure 32 shows the counties with the highest percentage of Master of Science in Engineering in the Energy Industry. Västmanland County is at the top with 18.6 percent, thereafter comes Stockholm County with 13.2 percent, and Östergötland County with 12.0 percent. 88.3 percent of persons in the industry with Master of Science in Engineering are found in the 10 counties in Figure 32. The fact that these counties have large shares of Master of Science in Engineering can be understood from, among other things, the presence of headquarters of Groups, presence of important workplaces of foreign-owned system and component manufacturers, as well as counties with large nuclear power plants.

3.4 Gender Structure

Figure 33 Number of Employees per Age Interval in 2013 Distributed Across Men and

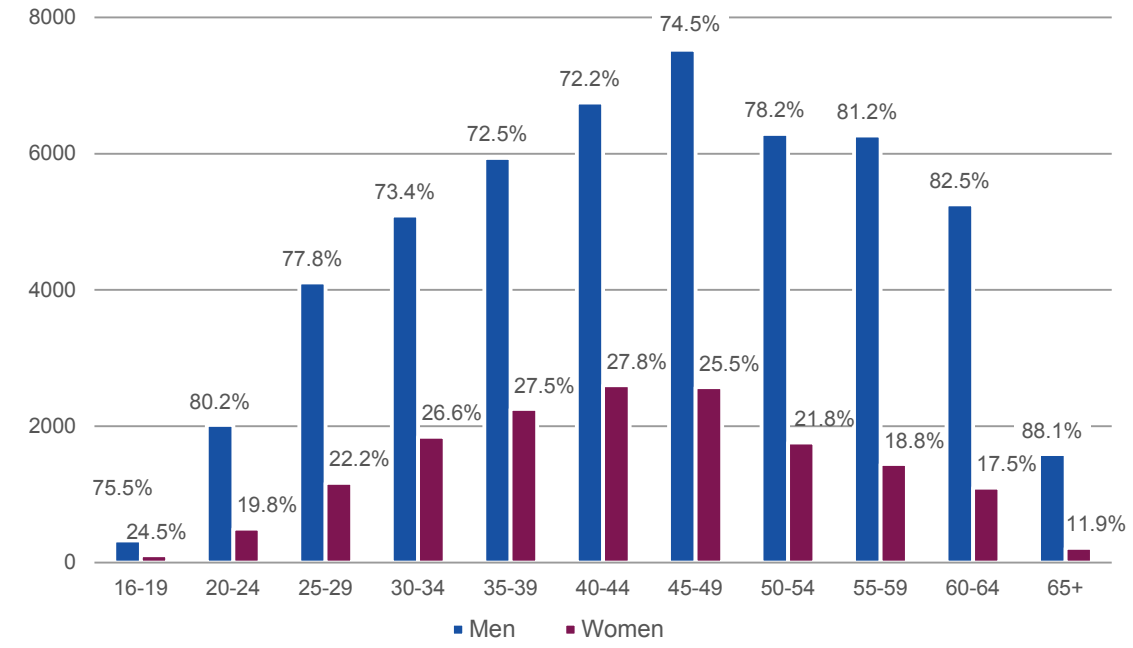


Figure 33 shows the number of employees in the Energy Industry in 2013 per age intervals distributed across men and women. As the figure shows, men make up the highest number of employees in all age intervals in relation to the number of women employed in the same interval. The figure also shows that the curve for the proportion of men and women generally follow each other in the different age intervals, meaning that in the age interval where the number of men increases, so does the number of women. However, there is a discrepancy here as most male workers are found in the age interval 45-49 years, while most female employees are found in the age interval 40-44 years.

Figure 34 Number of Employees per Age Interval in 2007 Distributed Across Men and Women

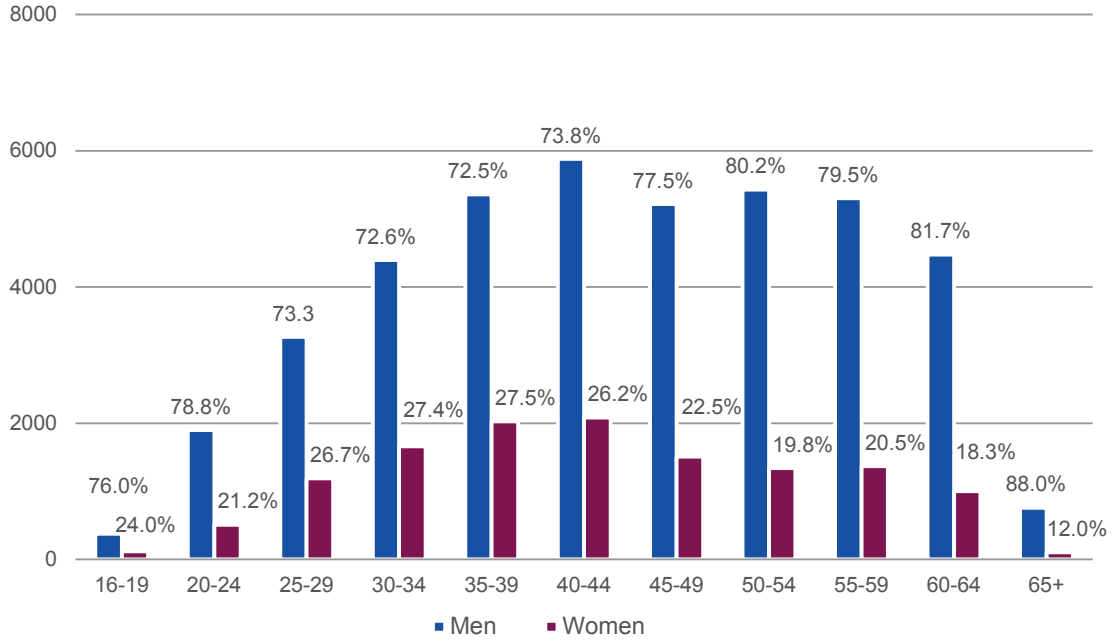
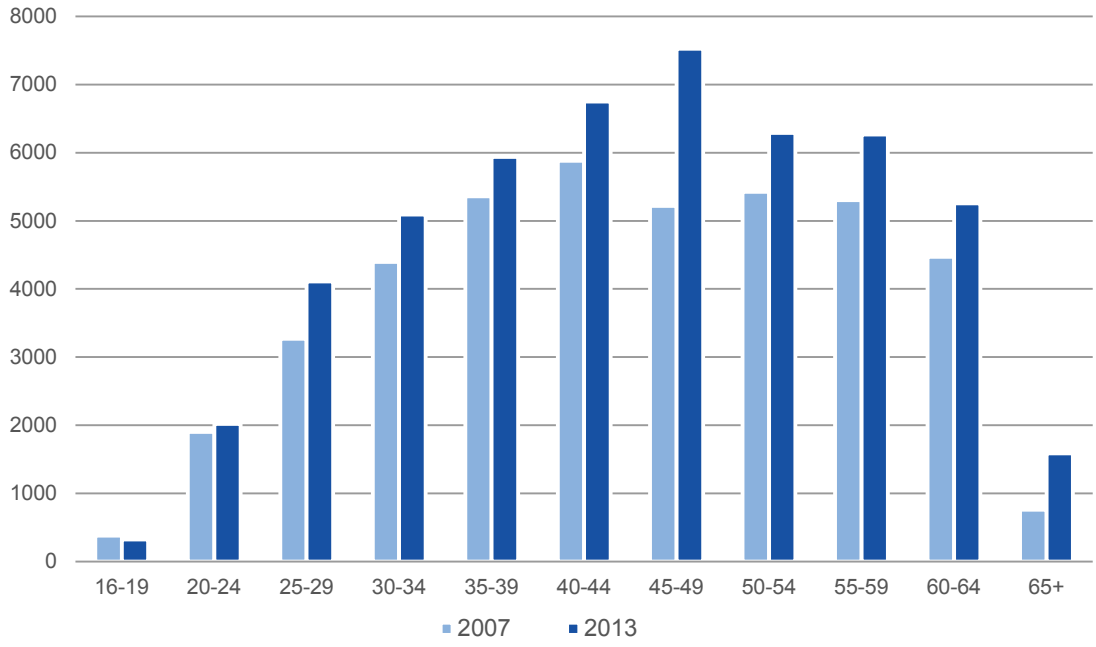


Figure 34 shows what the distribution was like per age interval in the Energy Industry in 2007 for men and women. In 2007, both the highest number of employed men and women were found in the age interval 40-44 years, and compared to 2013, the highest number of women employees remain in this range. However, for the number of employed men there has been a shift since most of them are found in the somewhat older age interval 45-49 years.

Figure 35 Number of Employed Men per Age Interval, Year 2007 and 2013



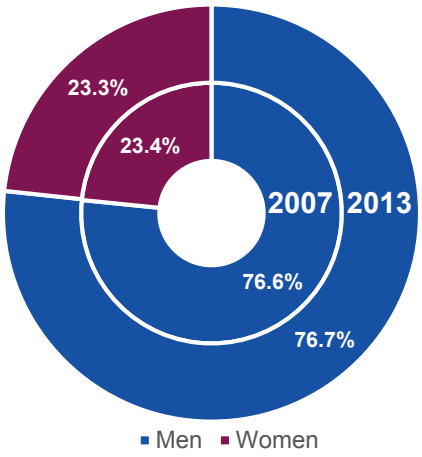
When comparing 2007 and 2013, it can be stated that the number of employed men has increased in all age interval, with one exception, the age interval 16-19 years, where the number of male employees has decreased, see Figure 35. The largest increase in terms of employed men has taken place in the age interval 45-49 years, where there are approx. 2,300 more men in 2013 compared to 2007.

Figure 36 Number of Employed Women per Age Interval, Year 2007 and 2013

The number of women employed in the Energy Industry has also increased in almost all age intervals from 2007 to 2013, with the exception of three categories, age interval 16-19 years, 20-24 years, and 25-29 years. Here the number of employed women decreased slightly while the industry as a whole has grown, see Figure 36. One conclusion that can be drawn is that the Energy Industry has not been able to attract young women to work in the industry during this time period. A desire for the industry could be to recruit young women in this age interval, primarily the latter of the two where, e.g., women who recently graduated could be found. We do not see any such trend in the material but quite the opposite, instead the number of women employed in these two age intervals has decreased slightly. The largest increases for the number of employed women are found in the age intervals 40-44 years and 45-49 years, where the latter represents a significant increase by approx. 1,060 women in 2013 compared to 2007.

Figure 37 Number of Employed Men and Women, Year 2007 and 2013

All Employees



Mangers At All Levels

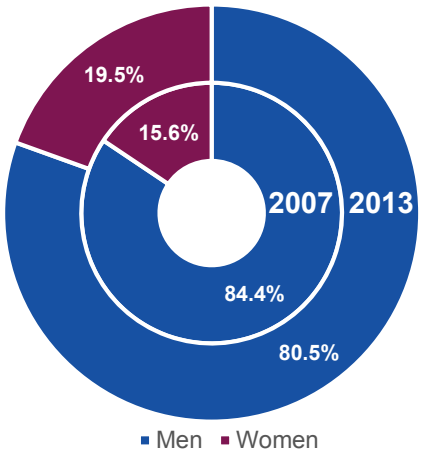
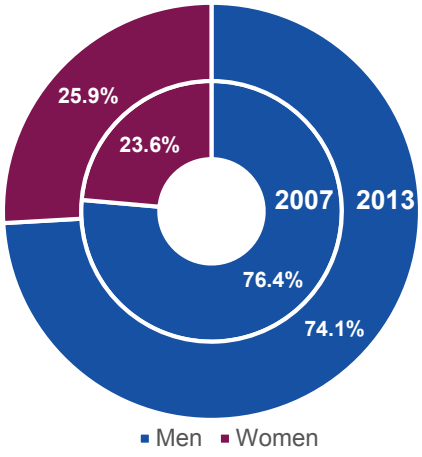


Figure 38 Number of Employed Men and Women, Year 2007 and 2013

Post-secondary education incl. researchers/scientists



Master of Science in Engineering, engineers and technicians

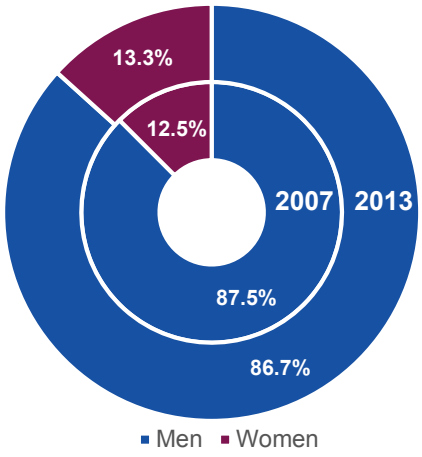


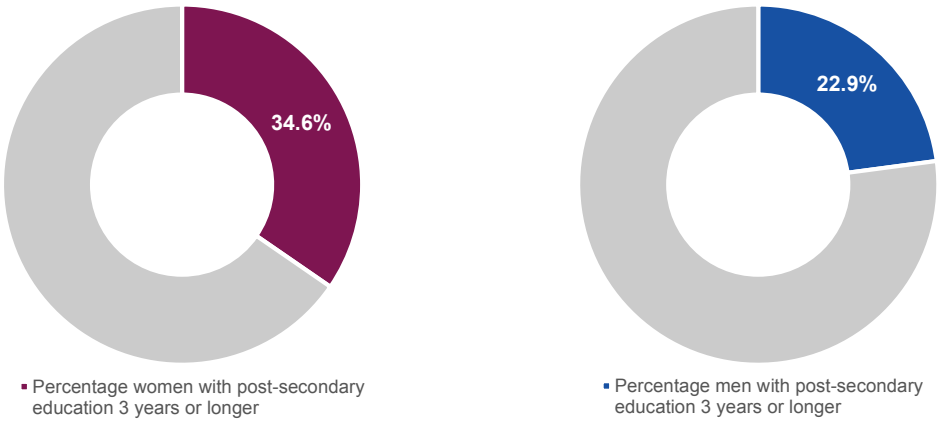
Figure 37 and 38 give an overview of the percentage of employees in 2013 and 2007 in the Energy Industry distributed across men and women based on four different parameters in the four different circles. The circle to the left in Figure 37 illustrates the percentage of men and women based on all employees, which shows that in 2013 the distribution was 76.7 percent men and 23.3 percent women. Notably, the percentage of men and women in the industry, considering all employees, is almost identical in comparison to what the distribution looked like in 2007 compared to 2013. Despite various efforts, the percentage of women has not increased in the industry, rather the opposite, it has decreased by 0.1 percentage points.

The circle to the right in Figure 37 illustrates the percentage of men and women as related to managers at all levels in 2013 and 2007, which shows that 80.5 percent of managers are men and 19.5 percent of managers are women. It is worth noting here that the proportion of female managers has increased by 3.9 percentage points in 2013 compared to 2007.

The circle to the left in Figure 38 shows that with regards to the employees in the Energy Industry who have post-secondary education, including researchers/scientists, 74.1 percent are men and 25.9 percent are women. Here as well, one can note an increase (2.3 percentage points) in the proportion of women when comparing 2013 and 2007.

The circle to the right in Figure 38 shows that among employees who are Master of Science in Engineering, engineers and technicians, 86.7 percent are men and 13.3 percent are women. Here one can note a small increase (0.8 percent) in the proportion of women in 2013 as compared to the proportion of women in 2007. In comparison with the proportion of female Master of Science in Engineering, engineers and technicians in the chemical industry, there the proportion is much greater, 45 percent,[19] as compared to 13.3 percent in the Energy Industry.

Figure 39 Percentage Men and Women With Postgraduate Education 3 Years or Longer



Based on the percentage of women in the left circle in Figure 38 (25.9 percent), if we look at the percentage of these women who have *longer* education, that is, post-secondary education 3 years or longer, we see that the percentage is 34.6 percent, which is illustrated in the left circle in Figure 39. If we look at the percentage of men who have post-secondary education 3 years or longer, we see that the percentage is lower, 22.9 percent, see the right circle in Figure 39.

Note that important occupational roles such as Production and operations managers, Managing Directors, chief executives and others, electricians, telecommunications and electronics

[19] http://www.vinnova.se/en/Publications-and-events/Publications/Products/Chemical-Industry-Companies-in-Sweden1/

equipment mechanics and fitters, machine operators, metal and mineral processing, and the large volume in the occupational code Engineers and technicians, are well below the industry's total percentage of women which is 23.3 percent.

Individual occupational codes with a small percentage of women:

- Production and operations managers has 13.3 percent women (calculated for 1,559 persons in the occupational code)
- Electricians, telecommunications and electronics equipment mechanics and fitters has 3.1 percent women (calculated for 3,350 persons in the occupational code)
- Engineers and technicians has 14.2 percent women (calculated for 13,158 persons in the occupational code)[20]
- Machine operators, metal and mineral processing has 11.2 percent women (calculated for 1,428 persons in the occupational code)
- Managing Directors, chief executives, etc., has 5.8 percent women (calculated for 396 persons in the occupational code)

On the other hand, there are other occupational codes with a higher percentage of women than the industry's average. Those occupational codes relate to administration, finance, and sales.

Administratively oriented occupational codes with a greater percentage of women:

- Accountancy and accounts assistants has 91.6 percent women (calculated for 776 persons in the occupational code)
- Business economists, marketers, and civil servants has 47.4 percent women (calculated for 2,743 persons in the occupational code)
- Client information workers has 81.1 percent women (calculated for 1190 persons in the occupational code)
- Finance and sales associate professionals, etc., has 26.6 percent women (calculated for 3,856 persons in the occupational code)
- Other office clerks has 73.9 percent women (calculated for 1253 persons in the occupational code)

Management positions are often used as numbers to talk about gender equality. In total the Energy Industry has 19.5 percent women as managers, regardless of management level. The material from Statistics Sweden (SCB) consists of six different levels of management, of which the four most common are listed below.

Occupational codes with different management levels[21]:

- Managers of small enterprises and units has 15.9 percent women (calculated for 825 persons in the occupational code)

[20] A difference occurs here in relation to the right circle in Figure 38 (Master of Science in Engineering, engineers, and technicians) since that figure is a combination of two different occupational codes.
[21] The occupation Codes "Senior officials in interest group" and "Senior officials and politicians" have too few employees reported for it to be relevant to report. See Appendix for the whole list.

- Specialist managers has 26.8 percent women (calculated for 2,452 persons in the occupational code)
- Production and operations managers has 13.3 percent women (calculated for 1,559 persons in the occupational code)
- Managing Director, chief executives, etc., has 5.8 percent women (calculated for 396 persons in the occupational code)

In the report's Appendix, there are figures and percentages for all of the 89 occupational codes used in the Energy Industry.

Table 6 Top 10 Occupations, Men in the Energy Industry, Year 2013

	OCCUPATION	NUMBER 2013	PERCENTAGE 2013
1	Engineers and technicians	11,291	22.0%
2	Master of Science in Engineering, architects, etc.	6,329	12.4%
3	Electricians, telecommunications and electronics equipment mechanics and fitters, etc.	3,247	6.3%
4	Finance and sales associate professionals, etc.	2,830	5.5%
5	Fitters	2,341	4.6%
6	Specialist managers	1,795	3.5%
7	Building craftsmen	1,718	3.4%
8	Other machine operators and fitters	1,486	2.9%
9	Business economists, marketers, and civil servants	1,442	2.8%
10	Production and operations managers	1,351	2.6%

Table 8 shows the top 10 most common occupations among men employed in the Energy Industry in 2013. Here it can be noted that the top five most common occupations for men in the industry in 2013, are exactly the same as the top five most common occupations for all employees in the industry (see Table 7).

Table 7 Top 10 Occupations, Women in the Energy Industry, Year 2013

	OCCUPATION	NUMBER 2013	PERCENTAGE 2013
1	Engineers and technicians	1,867	12.0%
2	Master of Science in Engineering, architects, etc.	1,312	8.4%
3	Business economists, marketers, and civil servants	1,301	8.3%
4	Accountants, administrative assistants, etc.	1,142	7.3%
5	Finance and sales associate professionals, etc.	1,026	6.6%
6	Client information workers	965	6.3%
7	Other office clerks	926	5.9%
8	Accountancy and accounts assistants	711	4.6%
9	Fitters	703	4.5%
10	Specialist managers	657	4.2%

Table 9 shows the top 10 most common occupations among women employed in the Energy Industry in 2013. Here it can be noted that the two most common occupations correspond to the

occupations that are listed both for all employees in the industry as well as for only male employees, that is, Engineers and technicians in first place, and Master of Science in Engineering, architects, etc. in second place. However, for third and fourth place among the most common occupations for female employees it can be noted that these are other occupations than for men, namely the following in third place: Business economists, marketers, and civil servants, and in forth place: Accountants, administrative assistants, etc. For specialist managers, this occupational category is found in fifth place among men, while it is found in 10th place among women. In place six to eight we find, among the most common occupations for women in the Energy Industry, completely different occupations than those included on the list of the most common occupations for all employees in the industry, namely Client information workers, Other office clerks, as well as Accountancy and accounts. The occupation Fitters is found in ninth place for female employees, while for male employees it is found in fifth place.

Figure 40 Distribution Men and Women Per Business Segment, Year 2013

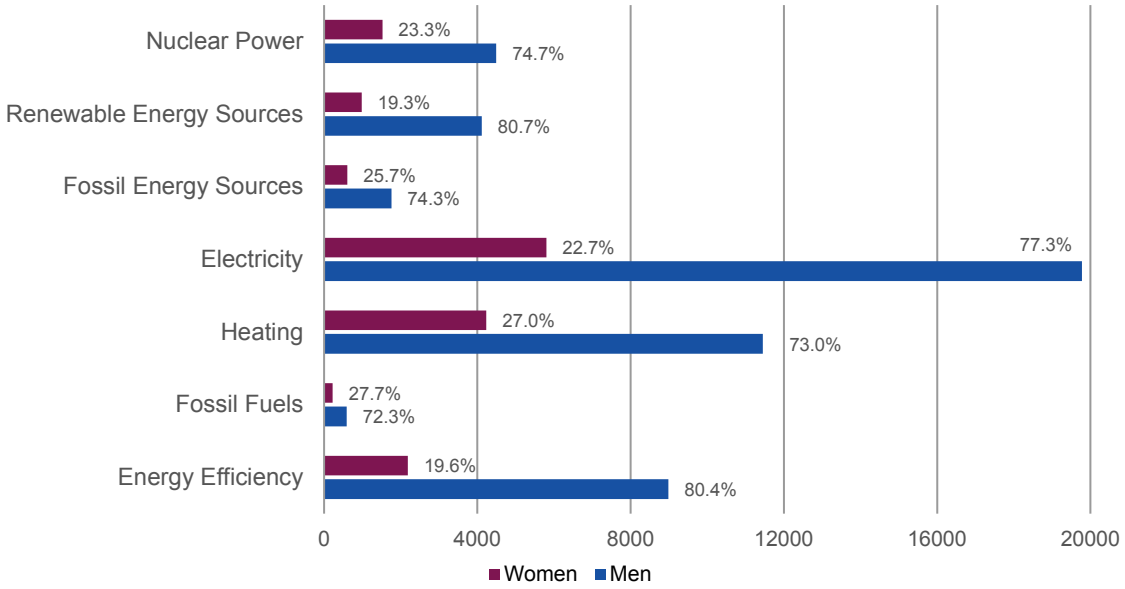


Figure 40 shows the distribution of men and women within the different business segments. Here it can be noted that the figure shows both percentage and number (x-axis) of men and women per segment. There is no segment in the Energy Industry that has a distribution in the range 40-60 percent, which means that in 2013 there is no business segment that can be considered equal according to the 40-60 principle.[22]

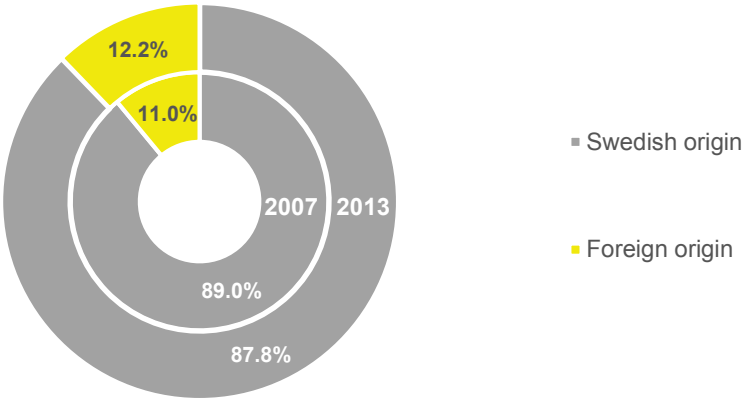
Every year the Energy Agency (Energimyndigheten) performs a follow-up of Sweden's energy-political goals and produces indicators. The energy indicators in 2015 have the theme Gender Equality. Based on the government's gender equality goals, the Energy Agency analyses four themes; Power and influence, Education and Research, Attitudes, and Energy use. This study

[22] This can be compared to the chemical industry, which has two segments that are considered equal according to the 40-60 percent principle, namely "pharmaceutical products" (53 percent women) and "chemical products" (approx. 45 percent women).

can supplement the Energy Agency's analysis. The content of this analysis ends up bordering between the theme of Power and Influence, and Education and Research in Energy Indicators 2015. The Energy Agency's study shows that there are nearly seven times as many female Managing Directors in 2014/2015 compared to 2008 (an increase from five to 33 female Managing Directors) at the more than 160 companies included in the study. This means that their analysed company population has approx. 20 percent female Managing Directors.

3.5 Origin

Figure 41 Percentage Employees according to



With regards to origin, employees are classified as either of Swedish or foreign origin.[23] Figure 41 shows the percentage of employees of foreign origin in the Energy Industry, which in 2013 was 12.2 percent. This can be compared to 2007 when the percentage of employees of foreign origin was 11.0 percent. This ought to be an interesting indicator for companies in the industry that work actively with both gender equality and diversity issues.

[23] Definition of Swedish and foreign origin according to SCB is described further in chapter 1.8.

Figure 42 Number of and Percentage of Employees according to Origin, Year 2013 - Education Level

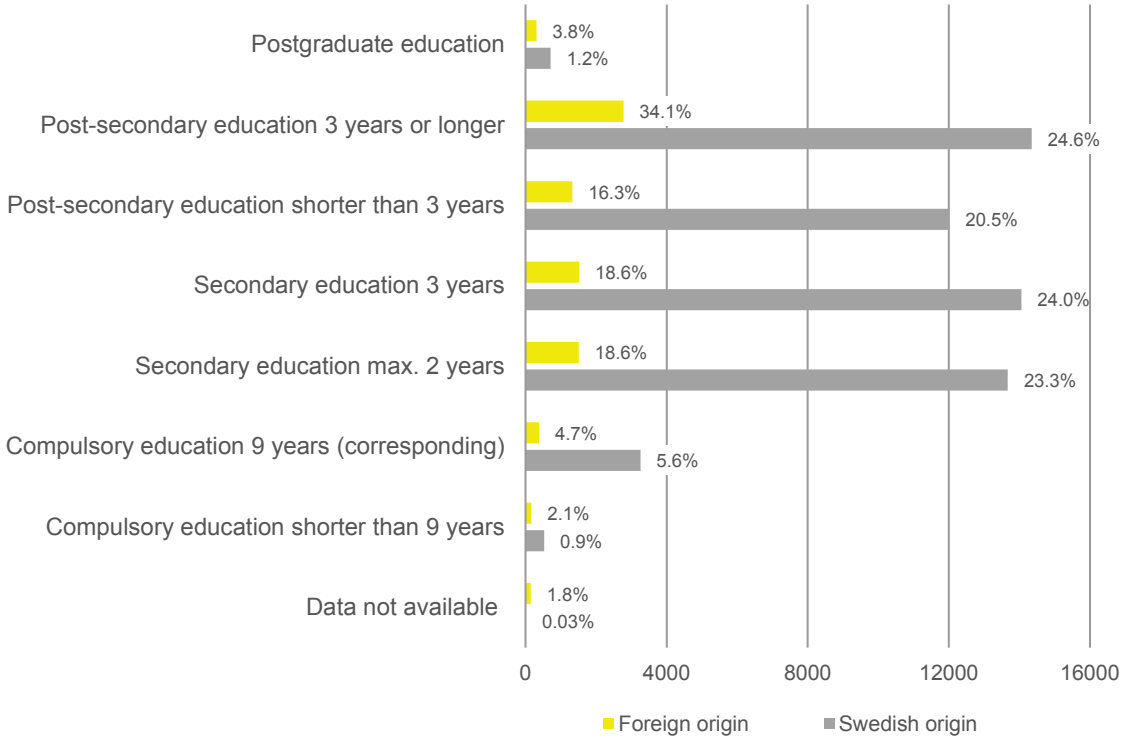


Figure 42 shows both the number of and percentage of employees in 2013 per education level according to origin, distributed across either Swedish or foreign origin. The greatest number of employees with foreign origin is found at the education level post-secondary education 3 years or longer.

Figure 43 Number of and Percentage of Employees according to Origin, Year 2013 - Business Segment

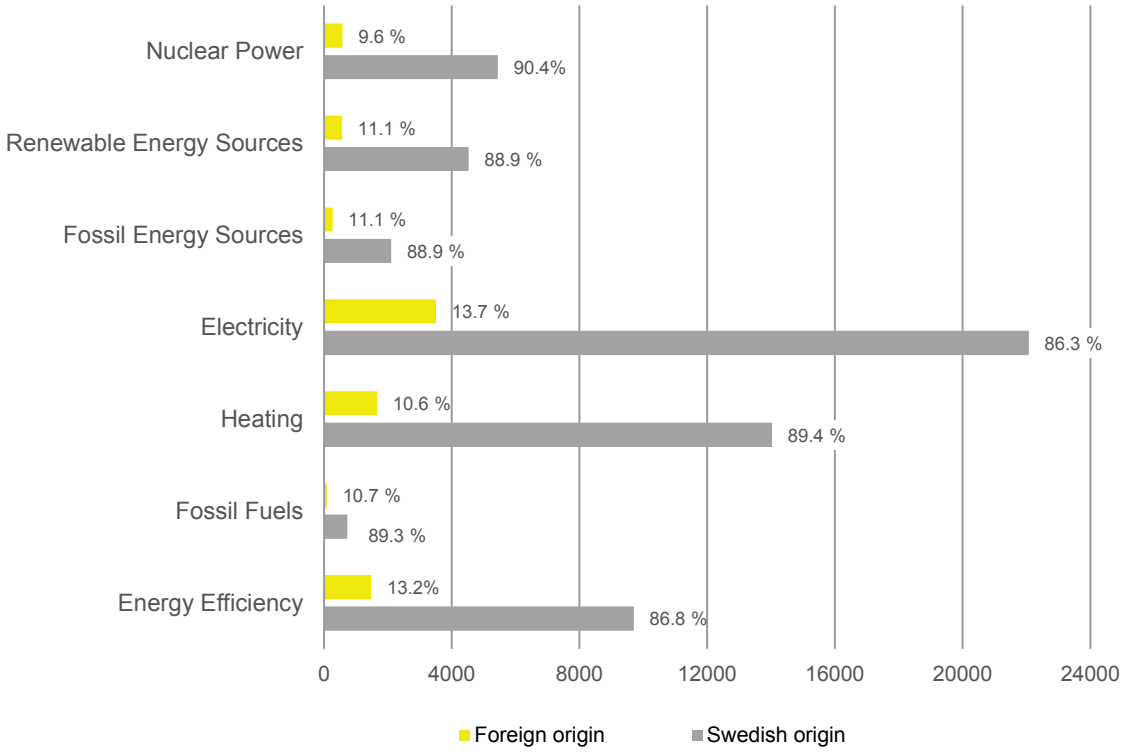


Figure 43 illustrates the percentage of employees with Swedish and foreign origin per business segment. The highest percentage with foreign origin is found in the business segment Electricity, at 13.7 percent. Other business segments are in the range between 9.6 percent to 13.2 percent regarding employees with foreign origin.

4 Research and Development

Energy remains a major area of research at universities, colleges, and institutes in Sweden. However, in line with previous analysis, there are still relatively few of the companies in this study with websites that clearly describe commitments, investments, and partnerships in R&D in the field. On the other hand, a few companies with roots in research cooperation and that may be perceived as spin-off companies from colleges and universities, often describe their history, background, and inclination for innovation. At several educational institutions there is a research environment in the energy sector with clear strategies for commercialising research and to be at the forefront of technology shifts. For example, at Uppsala University, the company Seabased is an example of a spin-off company with the purpose of commercialising their research results. Companies with a foreign Group often have references to major research programs linked to the parent company abroad. Municipal energy companies generally have good local commitment when they have geographic proximity to universities and colleges, and can invest significant amounts in research being conducted at these educational institutions. At a few companies, such as ABB (Corporate Research) and Vattenfall, there are larger internal research units. In its annual report, ABB states that the ABB Group worldwide spends about 1.5 billion USD on research and development, and one of the Group's largest research centres worldwide is ABB Corporate Research in Västerås.[24]

ABB Corporate Research has several hundred employees from 50 countries and cooperates with universities worldwide. ABB's research has a global perspective. Focus areas are digitization and the Internet of things, but also integration of non-controllable renewable energy. Another aspect that is important to a global company like ABB is energy efficiency throughout the entire chain - from production of electricity, to its use, and how efficiency improvements can be implemented throughout the chain to the end customers. A key issue is how ABB can help its clients move forward with increased automation in production lines. Globally, the matter of microgrids is very important in, for example, Africa and India. As one of the largest research units within ABB, Corporate Research needs to be two to 10 years ahead of the present and develop technologies for the future. Five years ago, ABB Corporate Research worked on several projects that now are being launched on the market, including robots, cables for high voltage (525 kV), and energy-efficient solutions for ships and mines.[25]

Within the framework of the EU's Seventh Framework Programme (FP7) research and development was conducted in the years 2007-2013, where a large part was research within energy, and in January 2014, the FP7's sequel, Horizon 2020, was started. A total of 1.7 billion Euro is estimated to have been allotted to the Swedish participants in FP7. In January 2016, the European Commission published the results of an evaluation of FP7 conducted by an

[24] http://new.abb.com/docs/default-source/investor-center-docs/annual-report/annual-report-2015/abb-group-annual-report-2015-english.pdf
[25] Interview materials in the authors' possession

independent expert group. The evaluation indicated that research funding in FP7 has increased the scientific excellence within the EU and has increased the competitiveness of European industry. In part, the report demonstrates that the research and innovation investments made within the project supports world-leading research as well as it improves the welfare of citizens, and also that it had a very positive impact on growth and jobs. It also states that FP7 has been very favourable for the participants in the private sector and for the large number of participants from small and medium-sized companies. Through FP7, one has also learned lessons and with these as basis, recommendations are now given to be included in the sequel Horizon 2020.[26] The current EU framework program for research and innovation, Horizon 2020, is the world's largest investment in the area with a total budget of approx. 80 billion Euro.[27]

In addition to the research and innovation projects financed by the EU, the Energy Agency distributes approx. 1.3 billion SEK per year to various programs in Sweden. According to the Energy Agency it is important to be able to achieve the goal of a sustainable energy system, that there is a well thought-out strategy for how research funds administered by the Energy Agency shall be distributed. The strategy work of the Energy Agency is called FOKUS and the agency's reports, including the report "Holistic approach is key" that presents the agency's strategy for research and innovation for the years 2017-2020, are the basis for the energy bills that are developed.[28] It is in the report mentioned above that the Energy Agency proposes to increase the current research funding from 1.3 billion SEK a year to 1.76 billion SEK per year from 2017, in order to further accelerate the development toward a sustainable energy system.[29]

State-owned Vattenfall Group has seen a change in focus of its research and development in later years. From the more traditional focus on development of generation and transmission, the element of services increases in the customer interface and to increased cost-efficiency in energy production. At current market prices for electricity, including futures prices several years ahead, Vattenfall sees increased difficulties for new production methods, such as wave power, to compete (in this context, wind power and solar power are considered conventional production methods). A typical example of more customer-oriented development is Vattenfall's involvement in the development of charging infrastructure and charging services for the electric hybrid-powered bus route 73 in Stockholm, which also is included in the FP7 programme Zeus.[30] The project is run in cooperation with SL, Volvo, Keolis, and Viktora Swedish ICT. Also, Vattenfall's product development projects "Smart electric car charging for the home," and "Smart church" are examples of development of services for end customers. "Smart electric car charging for the home" is a development project with automatic control of electric power loads in a home, to prevent fuses from blowing when charging electric vehicles. "Smart church" focuses on church administrators' need to keep track of the humidity, temperature, and energy consumption in their buildings.[31]

[26] http://europa.eu/rapid/press-release_MEMO-16-146_en.htm?locale=en
[27] http://www.vinnova.se/sv/EU-internationell-samverkan/Horisont-20201/Horisont-2020-EUs-ramprogram-for-FoI/
[28] http://www.energimyndigheten.se/forskning-och-innovation/fokus/
[29] Report: Holistic approach is the key - Strategy for research and innovation in the energy sector 2017-2020
[30] https://www.vattenfall.se/globalassets/foretag/miljo/att-kora-pa-el/projekt-zeeus.pdf
[31] Interview materials in the authors' possession

Vattenfall is also investing, within the framework of the project Knowledge and Innovation Communities ("KIC") InnoEnergy, a total of 70 million SEK in smart grids and energy storage for a period of seven years, with an option for a possible extension.[32] KIC InnoEnergy was started in 2010, and is originally an initiative from the European Institute of Innovation and Technology, EIT, a branch within the EU, based in Budapest. In Sweden, KIC InnoEnergy Sweden AB is a cooperation venture between the main parties KTH (Royal Institute of Technology in Stockholm), Uppsala University, ABB AB, Vattenfall AB.[33] In addition to these main parties there is a number of associated network partners, such as Elforsk, Ericsson, Fortum, Logica, Nova Center, Power Circle, Seabased, SP, Sting, STRI, and Svenska Kraftnät.

Colleges and universities in Sweden offer a range of research that is relevant for the Energy Industry. At Chalmers, Energy Area of Advance is one of eight areas and research is conducted in areas such as sustainable energy production, energy efficiency, and smart grids. Chalmers Energy Initiative (CEI) was carried out during the years 2010-2014, a strategic research program that linked research on the energy of the future with its system impact in three different areas. Among other things, it focused on upgrading biomass, on electric drive and control systems for electro-mobility, combination of energy sources, large-scale grid generation from renewable energy sources, and method development. CEI was funded by the government's special investment in strategically important research, a total of 230 million SEK for the period 2010-2014, and in addition, Chalmers' president gave additional support equivalent to 50 percent of the granted amount.[34] Chalmers states that the need for increased interaction and today's development means that industry and universities must come together and work closer, and they felt that there was the opportunity for this within CEI.[35] Issues that were run within CEI now continue within Energy Area of Advance at Chalmers. At The Royal Institute of Technology (KTH) as well, energy is one focus area of five, and "the energy platform" serves as a platform for interdisciplinary research. This means that energy research is ongoing at many of KTH's units. KTH states that the energy area has approx. 450 researchers/scientists, 48 research groups, and 15 research centres. [36] At the Lund University Faculty of Engineering, LTH (Lunds Tekniska Högskola, LTH) research is carried out primarily in the following areas regarding "energy sciences"; energy efficiency, internal combustion engines, power engineering, fluid mechanics, and heat transfer. During 2012-2017, E.ON and LTH cooperate in research for development of energy solutions with the lowest possible carbon footprint. Under the cooperation agreement, E.ON finances research by at least 5 million SEK per year over five years (2012-2017), and comprises mainly two areas; research on energy systems with the lowest possible carbon emissions and research on new products. At Mälardalen College (Mälardalens

[32] https://corporate.vattenfall.se/press-och-media/nyheter/import-nyheter/vattenfall-satsar-70-miljoner-pa-smarta-elnat1/?_t_id=1B2M2Y8AsgTpgAmY7PhCfg%3d%3d&_t_q=forskning&_t_tags=language%3asv%2csiteid%3af95a4f00-a0c6-415c-a29a-eb64244e4301&_t_ip=46.17.184.153&_t_hit.id=Kwd_Kestrel_Library_Epi_Types_Pages_NewsItemPageType/_b4a4283c-6245-4ac4-aa02-7bbb706b9b70_sv&_t_hit.pos=2
[33] http://www.abb.se/cawp/db0003db002698/6c3ca8940d40043ec1257bde00368b0a.aspx
[34] http://www.chalmers.se/SiteCollectionDocuments/Energi%20och%20milj%C3%B6/Elteknik/Nyheter/121128-Chalmers-CEI-HVDC-grid-Magasin.pdf
[35] http://www.chalmers.se/sv/styrkeomraden/energi/chalmersenergiinitiativ/Sidor/default.aspx
[36] https://www.kth.se/en/forskning/forskningsplattformar/energy

Högskola, MDH) there is a seven-year research profile "Energy for the Future - Future Energy", which was started in 2013. Here there are three focus areas of research; renewable energy with a focus on biomass and bioenergy, and solar energy; Energy efficiency and reduced emissions; smarter modelling for optimization, decision support, and control. In total, approx. 50 researchers/scientists and graduate students are involved in Future Energy, and the total project budget is 83 million SEK, financed by the Foundation for Knowledge (Stiftelsen för kunskaps- och kompetensutveckling), ABB, Mälarenergi, Vafab Miljö, Eskilstuna Strängnäs Energi och Miljö, Aspholmen Fastigheter, and MDH.[37] Linköping University (Linköpings Universitet, LiU) has several strategic partnerships with energy-related companies; including Tekniska verken in Linköping, SAAB, ABB, and VTI. Among other areas, Tekniska verken cooperates in the biogas area and industrial ecology. At Tekniska verken there is a biogas lab where employees also have one foot in the academic world, partnering with industrial postgraduate students. Within the research program for industrial ecology Tekniska verken funds a professorship, and supports research. Cooperation on IERP is worth 30 million SEK over ten years. Tekniska verken in Linköping has also patented a dozen or so innovations, and today they are spread through license agreements to different segments of the business community.[38]

Since 1993, Elforsk has been run by Swedenergy (Energiföretagen Sverige) and Svenska Kraftnät. Elforsk is now, since January 2015, a part of Energiforsk, which is a research and knowledge company that runs and coordinates energy research. Energiforsk is owned by Swedenergy (Energiföretagen Sverige), Svensk Fjärrvärme, Svenska kraftnät, Energigas Sverige, and Swedegas. Enerigforsk operates in the following areas; hydropower and nuclear power, power transmission with solar and wind power, heating, cooling, combined heat and power, and transportation and fuels.[39]

[37] http://www.mdh.se/forskning/inriktningar/framtidens-energi/kks-profil
[38] Telephone interview material in the authors' possession.
[39] http://www.energiforsk.se/info/om-energiforsk/

5 Business Segments

The Swedish Energy Industry has a clear division between *production & distribution* and *system & component.* The former group works close to the energy sources and distribute energy to customers, and here we find, e.g., public owners such as municipalities. The latter group is dedicated to producing systems and components, and are thus the enablers of extraction (supply) and distribution of energy, and mainly has a foreign Group.

In this chapter we follow the energy companies in each business segment; Nuclear power, Renewable energy sources, Fossil energy sources, Electricity, Heating, Fossil fuels, and Energy efficiency.

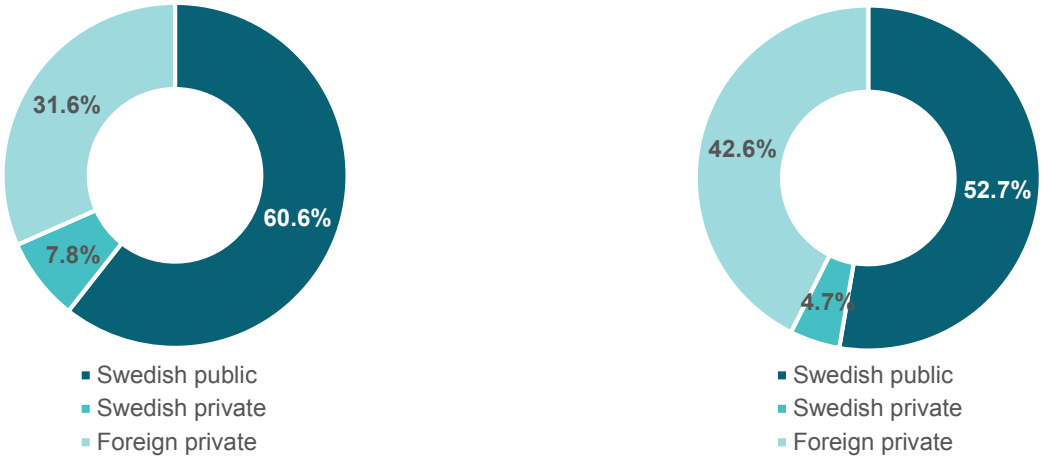
5.1 Nuclear Power

The nuclear power business segment has been divided into the subgroups *nuclear power* and *dedicated partners to nuclear power.* The first subgroup consists of companies that generate nuclear power, which includes the reactors that are operated in Sweden. As well, companies that own and manage facility and nuclear power assets are also included. The latter subgroup includes the companies that have most of their work focused on nuclear power operations.

Table 8 Nuclear Power Companies in Numbers

NUMBER OF COMPANIES	22
NUMBER OF EMPLOYEES	5,947
NET TURNOVER	34.4 Billion SEK
NUMBER OF LARGE COMPANIES (MORE THAN 250 EMPLOYEES)	7
NUMBER OF MEDIUM-SIZED COMPANIES (51-249 EMPLOYEES)	2
NUMBER OF SMALL COMPANIES (UP TO 50 EMPLOYEES)	13

Figure 44 Nuclear Power Companies' Ownership Profile, from the left: Percentage of Employees and Percentage of Net Turnover



A majority of those who work in the nuclear power companies are employees of Swedish public companies and those companies account for the majority of the net turnover in the industry segment. Close to a third of the employees of the nuclear power companies work in companies whose ownership profile is private foreign. It is worth noting that employees of these companies generate a turnover of 42.6 percent of the nuclear power companies' total net turnover, which is a lot compared to other owner profile groups.

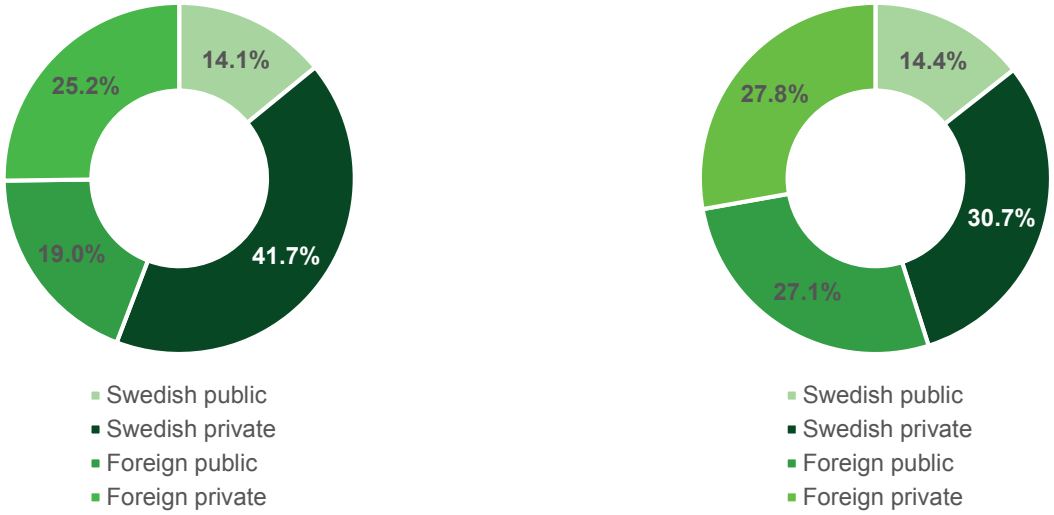
5.2 Renewable Energy Sources

The companies within the business segment Renewable energy sources are divided into four operational areas; *wind power, solar energy, hydropower,* and *bioenergy.* This includes companies that generate renewable energy, those that supply products, components, equipment, and services that enable the production of renewable energy and at the same time have a clear industry specialization in one of the renewable energy sources.

Table 9 Companies Within Renewable Energy Sources in Numbers

NUMBER OF COMPANIES	221
NUMBER OF EMPLOYEES	5,125
NET TURNOVER	39.4 Billion SEK
NUMBER OF LARGE COMPANIES (MORE THAN 250 EMPLOYEES)	3
NUMBER OF MEDIUM-SIZED COMPANIES (51-249 EMPLOYEES)	17
NUMBER OF SMALL COMPANIES (UP TO 50 EMPLOYEES)	201

Figure 45 Companies Within Renewable Energy Sources, Ownership Profile, from the left: Percentage of Employees and Percentage of Net Turnover



For companies within Renewable energy sources, most employees are found in Swedish private companies, 41.7 percent of those employed in the industry segment, and together these Swedish private companies account for 30.7 percent of the segment's turnover. The smallest ownership profile group with regards to percentage employees and turnover is Swedish public companies, 14.1 percent and 14.4 percent, respectively. This is different from the previous industry segment, Nuclear power, where the same ownership profile group had the highest percentage of employees and turnover.

5.3 Fossil Energy Sources

The business segment Fossil energy sources is divided into the subgroups *oil, coal,* and *gas*, and includes companies in Sweden that work within each operational area.

The first subgroup includes companies working with crude oil as well as those who are partners in production of oil and enable oil extraction. Companies that belong to the second subgroup work with coal, and are dedicated partners for coal extraction. In the last subgroup, gas, we find companies that extract and handle gas as an energy source.

Table 10 Companies Within Fossil Energy Sources

NUMBER OF COMPANIES	40
NUMBER OF EMPLOYEES	2,204
NET TURNOVER	114.7 Billion SEK
NUMBER OF LARGE COMPANIES (MORE THAN 250 EMPLOYEES)	2
NUMBER OF MEDIUM-SIZED COMPANIES (51-249 EMPLOYEES)	4
NUMBER OF SMALL COMPANIES (UP TO 50 EMPLOYEES)	34

Figure 46 Companies Within Fossil Energy Sources, Ownership Profile, from the left: Percentage of Employees and Percentage of Net Turnover

This segment only has privately owned companies. Figure 46 shows that almost all employees are in foreign or privately owned companies. There is only a small percentage of employees with Swedish and privately owned companies.

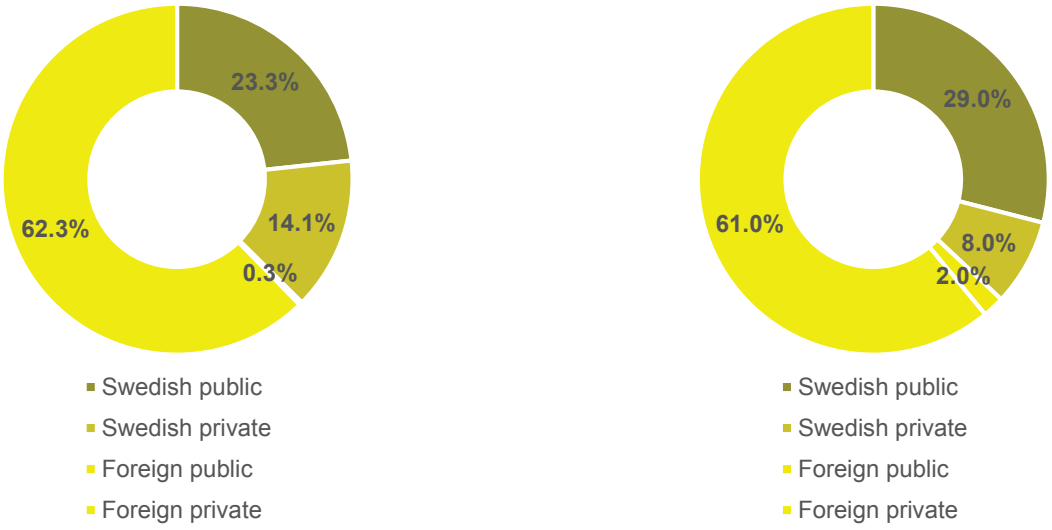
5.4 Electricity

The electricity companies are divided into operation areas *electricity distribution (power distribution)* and *electricity trading (power trading).* The first subgroup includes companies involved in power transmission and distribution. Here there is a wide range of mostly municipal energy companies, as well as large companies that have their roots in the electrification of Sweden. The subgroup also includes companies that work with a mix of the energy types hydro, solar, wind, and bio to enable production and distribution of electricity. The latter subgroup, electricity trading, includes companies involved in or enabling trading of electricity in Sweden.

Table 11 Electricity Companies in Numbers

NUMBER OF COMPANIES	289
NUMBER OF EMPLOYEES	25,586
NET TURNOVER	130.6 Billion SEK
NUMBER OF LARGE COMPANIES (MORE THAN 250 EMPLOYEES)	11
NUMBER OF MEDIUM-SIZED COMPANIES (51-249 EMPLOYEES)	43
NUMBER OF SMALL COMPANIES (UP TO 50 EMPLOYEES)	235

Figure 47 Electricity Companies' Ownership Profile, from the left: Percentage of Employees and Percentage of Net Turnover



The majority of employees work at foreign private companies and they are also responsible for most of the net turnover, 61.0 percent. Almost a quarter of the employees work at Swedish public companies, 23.3 percent, and the Swedish public companies account for 29.0 percent of net turnover in the business segment.

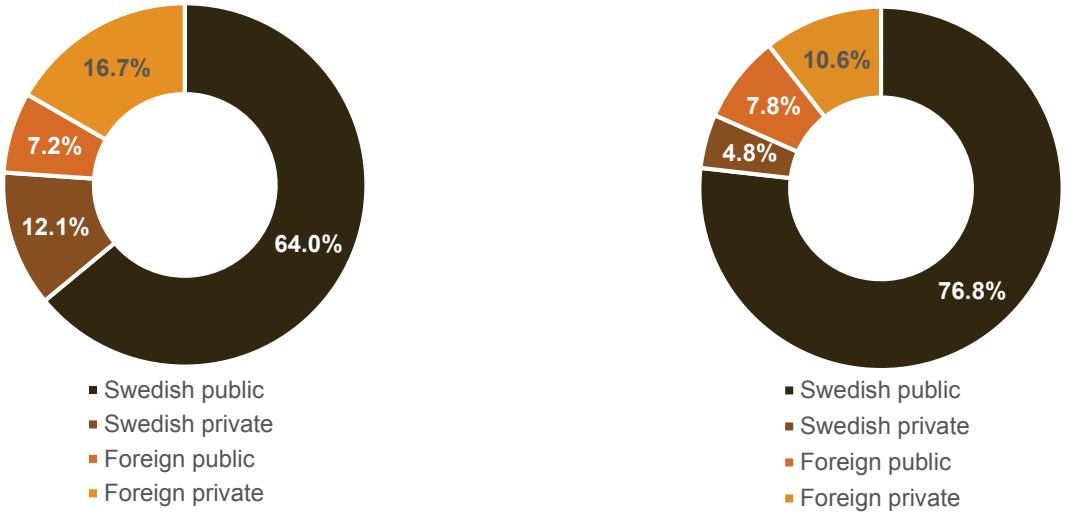
5.5 Heating

The business segment Heating includes companies that work with district heating, boilers, heat pumps, and supplementary heat production, such as geothermal heat. The segment consists of the subgroups *district heating* and *boilers and heat pumps*. The first sub-group includes mainly CHP-companies in Sweden, and in the latter we find companies that manufacture and sell boilers and heat pumps, as well as companies involved in supplementary heat production such as geothermal heat.

Table 12 Heating Companies in Numbers

NUMBER OF COMPANIES	222
NUMBER OF EMPLOYEES	15,766
NET TURNOVER	93.7 Billion SEK
NUMBER OF LARGE COMPANIES (MORE THAN 250 EMPLOYEES)	16
NUMBER OF MEDIUM-SIZED COMPANIES (51-249 EMPLOYEES)	53
NUMBER OF SMALL COMPANIES (UP TO 50 EMPLOYEES)	153

Figure 48 Heating Companies' Ownership Profile, from the left: Percentage of Employees and Percentage of Net Turnover



The majority of employees in the segment are found in Swedish public heating companies, 64.0 percent, and those companies also account for the largest percentage of the net turnover, 76.8 percent. If we look at the employees according to ownership profile, we see that the lowest percentage of employees are found in foreign public companies, 7.2 percent, and the Swedish private companies account for the lowest percentage of the net turnover, 4.8 percent.

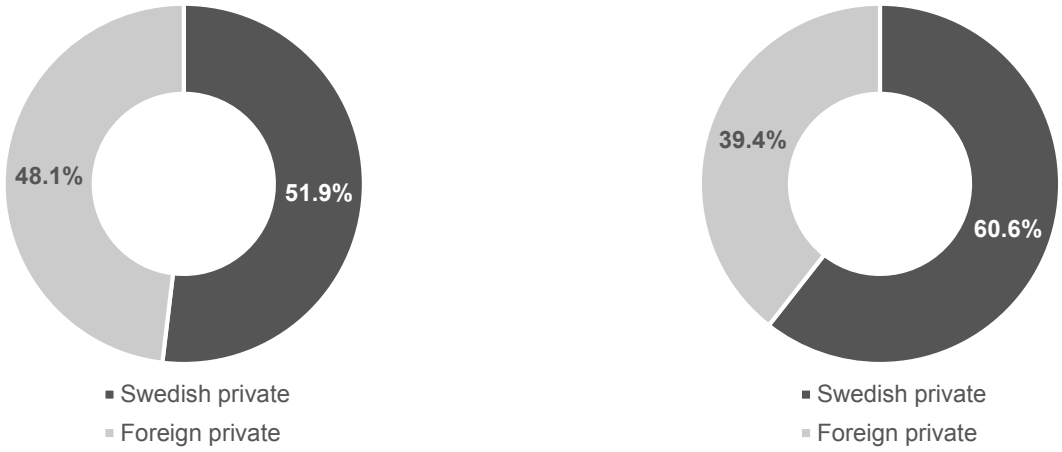
5.6 Fossil Fuels

The business segment Fossil Fuels includes companies that refine oil into fuels and work with the product to the end customer. The segment has two operational areas; *petrol (gasoline) and diesel* and *Compressed Natural Gas (CNG)*. The first subgroup includes companies that refine oil, distribute and sell petrol (gasoline) and diesel. The latter subgroup includes companies that are involved in distribution and sales of Compressed Natural Gas (CNG), as well as upgrading of biogas to fuel for vehicles.

Table 13 Companies Within Fossil Fuels in Numbers

NUMBER OF COMPANIES	30
NUMBER OF EMPLOYEES	973
NET TURNOVER	33.2 Billion SEK
NUMBER OF LARGE COMPANIES (MORE THAN 250 EMPLOYEES)	1
NUMBER OF MEDIUM-SIZED COMPANIES (51-249 EMPLOYEES)	3
NUMBER OF SMALL COMPANIES (UP TO 50 EMPLOYEES)	26

Figure 49 Companies Within Fossil Fuels, Ownership Profile, from the left: Percentage of Employees and Percentage of Net Turnover



This business segment only has privately owned companies. 51.9 percent of employees are with Swedish private companies and these companies account for 60.6 percent of the net turnover. Employees of foreign private companies account for 48.1 percent and these companies represent 39.4 percent of the net turnover in the business segment.

5.7 Energy Efficiency

Companies included in Energy efficiency are both consulting businesses that work with diversified energy efficiency solutions, as well as companies that have a clear focus on energy efficiency based on motor operation and control, regulation, and drive systems within industry and buildings, not least in the ventilation and automation sector.

The business segment has three subgroups: *energy efficiency in industry and buildings*, *energy efficiency in transportation,* and *other*. The first subgroup includes energy and technology consultants who have a primary focus on energy efficiency in automation and ventilation. The second subgroup includes companies that produce drive and control systems for transportation, where focus shifts from fossil fuels to the use of fossil-free energy. The last subgroup, Other, includes companies and consulting companies that work broadly with energy efficiency and that are not dedicated in any of the two subgroups above.

Table 14 Energy Efficiency Companies in Numbers

NUMBER OF COMPANIES	240
NUMBER OF EMPLOYEES	12,873
NET TURNOVER	29.9 Billion SEK
NUMBER OF LARGE COMPANIES (MORE THAN 250 EMPLOYEES)	12
NUMBER OF MEDIUM-SIZED COMPANIES (51-249 EMPLOYEES)	25
NUMBER OF SMALL COMPANIES (UP TO 50 EMPLOYEES)	203

Figure 50 Energy Efficiency Companies' Ownership Profile, from the left: Percentage of Employees and Percentage of Net Turnover

The majority of the employees are found in Swedish private companies, 50.4 percent, and these companies account for 41.5 percent of the net turnover of the energy efficiency companies. 49.5 percent of employees work in companies whose ownership profile are private foreign and these companies account for 58.0 percent of the net turnover in the business segment.

Appendix

Complete List of Occupations for Employees in the Energy Industry

The following is a complete list of the employees in the Energy Industry in 2013, at the companies included in this analysis based on data from Statistics Sweden (SCB). The occupations listed below are jobs, on the basis SSYK-codes, reported by the companies to the SCB and in which their employees work. The occupations are stated both as the total number of employees per occupational title, and thereafter as the percentage of men and women within each specific occupational title.

OCCUPATION	NUMBER OF EMPLOYEES 2013	PERCENTAGE MEN 2013	PERCENTAGE WOMEN 2013
ADMINISTRATORS IN INTEREST GROUPS	2	100	0
ADMINISTRATORS IN PUBLIC ADMINISTRATION	1	100	0
AGENTS AND TRADE BROKERS, ETC.	105	35.2	64.8
OTHER TEACHERS AND INSTRUCTORS	11	100	0
OTHER TEACHING PROFESSIONALS	31	87.1	12.9
ARCHIVISTS, LIBRARIANS, ETC.	16	31.3	68.7
MIDWIVES; NURSING PROFESSIONALS	5	100	0
LIBRARY ASSISTANTS, ETC.	8	75	25
BIOMEDICAL SCIENTISTS	5	80	20
ACCOUNTANCY AND ACCOUNTS ASSISTANTS	776	8.4	91.6
BUILDING AND CONSTRUCTION WORKERS	192	97.9	2.1
BUILDING CRAFTSMEN	1,779	96.6	3.4
MANAGERS OF SMALL COMPANIES AND UNITS	825	84.1	15.9
SPECIALIST MANAGERS	2,452	73.2	26.8
SENIOR OFFICIALS IN INTEREST GROUPS	1	100	0
MASTER OF SCIENCE IN ENGINEERING, ARCHITECTS, ETC.	7,641	82.8	17.2
COMPUTER SPECIALISTS	1,590	79.1	20.9
COMPUTER TECHNICIANS AND COMPUTER OPERATORS	797	82.6	17.4
BREEDERS AND ANIMAL CARETAKERS	4	75	25
TURNER, GLASS WORKS WORKERS, DECORATORS, ETC.	1	100	0
PRODUCTION AND OPERATIONS MANAGERS	1,559	86.7	13.3
OPERATION MACHINISTS, ETC.	1,272	96.1	3.9
ELECTRICIANS, TELECOMMUNICATIONS AND ELECTRONICS EQUIPMENT MECHANICS AND FITTERS, ETC.	3,350	96.9	3.1
TOOLMAKER, PRECISION ENGINEER, ETC.	89	87.6	12.4
FISHERMEN AND HUNTERS	6	100	0
VEHICLE DRIVERS	136	97.1	2.9

OCCUPATION	NUMBER OF EMPLOYEES 2013	PERCENTAGE MEN 2013	PERCENTAGE WOMEN 2013
PHOTOGRAPHERS; OPTICAL AND ELECTRONIC EQUIPMENT OPERATORS, ETC.	5	40	60
HAIRDRESSERS AND OTHER PERSONAL SERVICES	1	100	0
PHYSICISTS, CHEMISTS, ETC.	134	59.7	40.3
BUSINESS ECONOMISTS, MARKETERS, AND CIVIL SERVANTS	2,743	52.6	47.4
PRESCHOOL TEACHERS AND HELPERS	1	0	100
SALES, RETAIL, DEMONSTRATORS, ETC.	172	68	32
FOUNDRY WORKER, WELDER, SHEET METAL WORKER, ETC.	595	96.6	3.4
FREIGHT WORKERS AND COURIERS	32	71.9	28.1
LABOURER IN CONSTRUCTION	72	93.1	6.9
UPPER SECONDARY SCHOOL TEACHER, ETC.	2	100	0
HAND MANUFACTURING LABOURERS	185	77.8	22.2
HEALTH CARE SPECIALISTS	5	40	60
SENIOR OFFICIALS AND POLITICIANS	2	50	50
ENGINEERS AND TECHNICIANS	13,158	85.8	14.2
JOURNALISTS, ARTISTS, PERFORMING ARTISTS, ETC.	292	34.2	65.8
LAWYERS	124	47.6	52.4
CASHIERS, ETC.	111	6.3	93.7
OFFICE SECRETARIES, ETC.	356	7.6	92.4
CLIENT INFORMATION WORKERS	1,190	18.9	81.1
HELPERS IN RESTAURANTS	19	42.1	57.9
STOCK AND TRANSPORTATION CLERKS	706	72.7	27.3
AGRONOMY AND FORESTRY TECHNICIANS, ETC.	45	86.7	13.3
ORE PROCESSING OPERATORS, WELL DRILLERS, ETC.	5	100	0
MACHINERY MECHANICS AND FITTERS	952	97.2	2.8
MACHINE OPERATORS	269	95.5	4.5
MACHINE OPERATORS, PRINTING, PAPER PRODUCTS	2	50	50
MACHINE OPERATORS, RUBBER AND PLASTICS INDUSTRY	94	94.7	5.3
MACHINE OPERATORS, CHEMICAL-TECHNICAL INDUSTRY	84	96.4	3.6
MACHINE OPERATORS, METAL AND MINERAL PROCESSING	1,428	88.8	11.2
MACHINE OPERATORS, WOOD PRODUCTS INDUSTRY	14	100	0
MATHEMATICIAN AND STATISTICIAN	36	80.6	19.4
LABOURERS IN AGRICULTURE, HORTICULTURE, FORESTRY, AND FISHING	12	83.3	16.7
FITTERS	3,044	76.9	23.1
PAINTERS, CHIMNEY SWEEPS, ETC.	30	93.3	6.7
PILOTS, SHIP'S OFFICERS, ETC.	20	90	10

OCCUPATION	NUMBER OF EMPLOYEES 2013	PERCENTAGE MEN 2013	PERCENTAGE WOMEN 2013
PROCESS OPERATORS IN STEEL AND METAL PLANTS	67	94	16
PROCESS OPERATORS, BASIC CHEMICAL INDUSTRY	606	91.9	8.1
PROCESS OPERATORS, WOOD AND PAPER INDUSTRY	93	92.5	7.5
ACCOUNTANTS, ADMINISTRATIVE ASSISTANTS, ETC.	1,538	25.7	74.3
WASTE MANAGEMENT AND RECYCLING LABOURERS	204	90.2	19.8
TRAVEL HOSTS, ETC.	3	66.7	33.3
SOCIAL SCIENTISTS AND LINGUISTS	9	22.2	77.8
PHYSICAL THERAPISTS, DENTAL HYGIENISTS, ETC.	77	44.2	55.8
NURSES	6	16.7	83.3
FORESTER	3	100	0
BUTCHERS, BAKERS, CONFECTIONERS, ETC.	1	100	0
BLACKSMITHS, TOOLMAKERS, ETC.	212	92.5	7.5
SPECIALISTS IN BIOLOGY, AGRICULTURE AND FORESTRY, ETC.	31	45.2	54.8
SPECIAL EDUCATION TEACHER	1	100	0
HOUSEKEEPING AND RESTAURANT STAFF	14	7.1	92.9
CLEANERS, ETC.	56	8.9	91.1
SAFETY AND QUALITY INSPECTORS	294	83.7	12.3
SECURITY PERSONNEL	148	73.6	26.4
FINANCE AND SALES ASSOCIATE PROFESSIONALS, ETC.	3,856	73.4	26.6
ARTISTIC, ENTERTAINMENT AND SPORTS PROFESSIONALS, ETC.	12	16.7	83.3
MAGAZINE DISTRIBUTORS, CARETAKERS/JANITORS, ETC.	92	67.4	32.6
STALL AND MARKET VENDORS	1	100	0
MANAGING DIRECTORS, CHIEF EXECUTIVES, ETC.	396	94.2	5.8
PLANT/CROP GROWER IN AGRICULTURE AND HORTICULTURE	39	79.5	20.5
CROP GROWERS AND ANIMAL BREEDER, MIXED OPERATION	2	100	0
OTHER OFFICE CLERKS	1,253	26.1	73.9
OTHER MACHINE OPERATORS AND FITTERS	1,770	84	16
OTHER SERVICE WORKERS	51	60.8	39.2
DATA NOT AVAILABLE	7300	74.9	25.1

Vinnova´s publications

February 2017

See vinnova.se for more information

Vinnova Analysis

VA 2017:

01 The Energy Industry in Sweden continues to grow - *Analysis of companies in the energy industry 2007-2014 - business segments, age structures, gender equality and competence. (For Swedish version see VA 2016:05)*

VA 2016:

01 Vinnväxt - Ett innovativt program i takt med tiden

02 Årsbok 2015 - Svenskt deltagande i europeiska program för forskning & innovation

03 Effektanalys av Vinnväxt-programmet - *Analys av effekter och nytta*

04 Chemical Industry Companies in Sweden - *Update including data for competence analysis*

05 Energibranschen i Sverige fortsätter växa - *Analys av företag i energibranschen 2007-204 - branschdelar, åldersstrukturer, jämställdhet och kompetens. (For English version see VA 2017:01)*

06 Omvandling och fasta tillstånd – *Materialvetenskapens etablering vid svenska universitet*

07 Svensk konsultsektor i ny belysning - *Utvecklingstrender och dynamik*

VA 2015:

01 Årsbok 2014 - *Svenskt deltagande i europeiska program för forskning & innovation*

02 Samverkansuppgiften i ett historiskt och institutionellt perspektiv

03 Långsiktig utveckling av svenska lärosätens samverkan med det omgivande samhället - *Effekter av forsknings- och innovationsfinansiärers insatser*

04 Företag i Tåg- och järnvägsbranschen i Sverige - *2007-2013*

05 FoU-program för Små och Medelstora Företag - *Metodologiskt ramverk för effektanalyser*

06 Small and beautiful - *The ICT success of Finland & Sweden*

07 National Research and Innovation Councils as an Instrument of Innovation Governance - *Characteristics and challenges*

08 Kartläggning och behovsinventering av test- & demonstrationsinfrastruktur

VA 2014:

01 Resultat från 18 VINN Excellence Center redovisade 2012 - *Sammanställning av enkätresultaten. (For English version see VA 2014:02)*

02 Results from 18 VINN Excellence Centres reported in 2012 - *Compilation of the survey results. (For Swedish version see VA 2014:01)*

03 Global trends with local effects - *The Swedish Life Science Industry 1998-2012*

04 Årsbok 2013 - *Svenskt deltagande i europeiska program för forskning och innovation.*

05 Innovations and new technology - *what is the role of research? Implications for public policy. (For Swedish version see VA 2013:13)*

06 Hälsoekonomisk effektanalys - *av forskning inom programmet Innovationer för framtidens hälsa.*

07 Sino-Swedish Eco-Innovation Collaboration - *Towards a new pathway for shared green growth opportunity.*

08 Företag inom svensk massa- och pappersindustri - *2007-2012*

09 Universitets och högskolors samverkansmönster och dess effekter

VA 2013:

01 Chemical Industry Companies in Sweden

02 Metallindustrin i Sverige 2007 - 2011

03 Eco-innovative Measures in large Swedish Companies - *An inventory based on company reports*

04 Gamla möjligheter - *Tillväxten på den globala marknaden för hälso- och sjukvård till äldre*

05 Rörliga och kopplade - *Mobila produktionssystem integreras*

06 Företag inom miljötekniksektorn 2007-2011

07 Företag inom informations- och kommunikationsteknik i Sverige 2007 - 2011

08 Snabbare Cash - *Effektiv kontanthantering är en tillväxtmarknad*

09 Den svenska maritima näringen - *2007 - 2011*

10 Long Term Industrial Impacts of the Swedish Competence Centres

11 Summary - Long Term Industrial Impacts of the Swedish Competence Centres. *Brief version of VA 2013:10*

12 Företag inom svensk gruv- och mineralindustri 2007-2011

13 Innovationer och ny teknik - *Vilken roll spelar forskningen. (For English version see VA 2014:05)*

14 Företag i energibranschen i Sverige - *2007-2011*

15 Sveriges deltagande i sjunde ramprogrammet för forskning och teknisk utveckling (FP7) - *Lägesrapport 2007-2012*

16 FP7 and Horizon 2020

Vinnova Information VI 2017:

01 Forskning inom gruv- och mineralområdet - *En studie av styrkor och samverkan*

VI 2016:

01 Projektkatalog Utmaningsdriven innovation Steg 1-2015 - *Initieringsprojekt*

02 Projektkatalog Utmaningsdriven innovation Steg 2-2015 - *Samverkansprojekt*

03 Projektkatalog Utmaningsdriven innovation Steg 3-2015 - *Följdinvesteringsprojekt*

04 Årsredovisning 2015

05 FFI Årsrapport 2015 - *Samverkan för stark svensk fordonsindustri och miljöanpassade samt säkra transporter*

06 Innovation för ett attraktivare Sverige - Sammanfattning

07 Utmaningsdriven innovation - *Samhällsutmaningar som tillväxtmöjligheter (for English version see VI 2015:11)*

08 Vinnväxt - *A programme renewing and moving Sweden ahead*

VI 2015:

01 Insatser för innovationer inomHälsa

02 FFI Årsrapport 2014 - *Samverkan för stark svensk fordonsindustri och miljöanpassade samt säkra transporter*

03 Social innovation - Exempel

04 Social innovation

05 Årsredovisning 2014

06 Sweden needs FFI *(for Swedish version see VI 2015:10)*

07 Innovation för ett attraktivare Sverige - *Underlag till regeringens politik för forskning, innovation och högre utbildning 2017-2020 - Huvudrapport*

08 Förutsättningar för innovationspolitik i Sverige - *Underlag till regeringens politik för forskning, innovation och högre utbildning 2017-2027 - Analysrapport*

09 *Replaced by VI 2016:07*

10 Sverige behöver FFI *(for English version see VI 2015:06)*

11 Challenge-Driven Innovation - *Societal challenges as opportunities for growth (for Swedish version see VI 2016:07)*

Vinnova Report VR 2017:

01 Att skapa förutsättningar för innovation - *Erfarenheter från "Idéslussar i kommuner - förstudie 2015"*

VR 2016:

01 Third Evaluation of VINN Excellence Centres - *AFC, BiMaC Innovation, BIOMATCELL, CESC, CHASE, ECO2, Faste, FUNMAT, GHz, HELIX, Hero-m, iPack, Mobile Life, ProNova, SAMOT, SuMo & WINGQUIST*

02 Third Evaluation of Berzelii Centres - *Exselent, UPSC & Uppsala Berzelii*

03 NOVA - Verktyg och metoder för normkreativ innovation *(for English version see VR 2016:06)*

04 Forskning och utveckling för ökad jämställdhet - *Följeforskning om Vinnovas regeringsuppdrag avseende behovsmotiverad forskning för ökad jämställdhet 2013-2015*

05 This is about Change - *Ten years as an on-going evaluator of the Triple Steelix initiative (For Swedish version see VR 2015:05)*

06 NOVA – tools and methods for norm-creative innovation *(for Swedish version see VR 2016:03)*

07 Flaggskeppsfabriken - *Styrkor i svensk produktion*

08 Flaggskeppsmetodiken - *En arbetsmetod för industriellt erfarenhetsutbyte*

09 Evaluating the Role of HEIs´ Interaction with Surrounding Society - *Development Pilot in Sweden 2013-2016*

10 Utvärdering strategiska innovationsprogram - *Första utvärderingen av Processindustriell IT och automation, Produktion 2030, Gruv- och metallutvinning, Lättvikt och Metalliska material*

11 Shaping the Future now - Good Start! *International evaluation of Geo Life Region, Smart Housing Småland and The Paper Province 2.0*

VR 2015:

01 Bumpy flying at high altitude? - *International evaluation of Smart Textiles, The Biorefinery of the Future and Peak Innovation*

02 From green forest to green commodity chemicals - *Evaluating the potential for large-scale production in Sweden for three value chains*

03 Innovationstävlingar i Sverige - *insikter och lärdomar*

04 Future Smart Industry - *perspektiv på industriomvandling*

05 Det handlar om förändring - *Tio år som följeforskare i Triple Steelix (For English version see VR 2016:05)*

06 Evaluation of the Programme Multidisciplinary BIO - *The strategic Japanese-Swedish cooperation programme 2005 - 2014*

07 Nätverksstyrning av transportinnovation

08 Ersättningssystem för innovation i vård och omsorg – *En studie av åtta projekt som utvecklar nya ersättningsmodeller*

VR 2014:

01 Vägar till välfärdsinnovation - *Hur ersättningsmodeller och impact bonds kan stimulera nytänkande och innovation i offentlig verksamhet*

02 Jämställdhet på köpet? - *Marknadsfeminism, innovation och normkritik*

03 Googlemodellen - *Företagsledning för kontinuerlig innovation i en föränderlig värld*

04 Öppna data 2014 - *Nulägesanalys*

05 Institute Excellence Centres - IEC *-En utvärdering av programmet*

06 The many Faces of Implementation

07 Slututvärdering Innovationsslussar inom hälso- och sjukvården

Production: Vinnova´s Communication Division
February 2017

Vinnova - strengthening Sweden´s innovativeness

Post: Vinnova, SE-101 58 Stockholm, Sweden Office: Mäster Samuelsgatan 56
+46 8 473 30 00 vinnova@vinnova.se vinnova.se