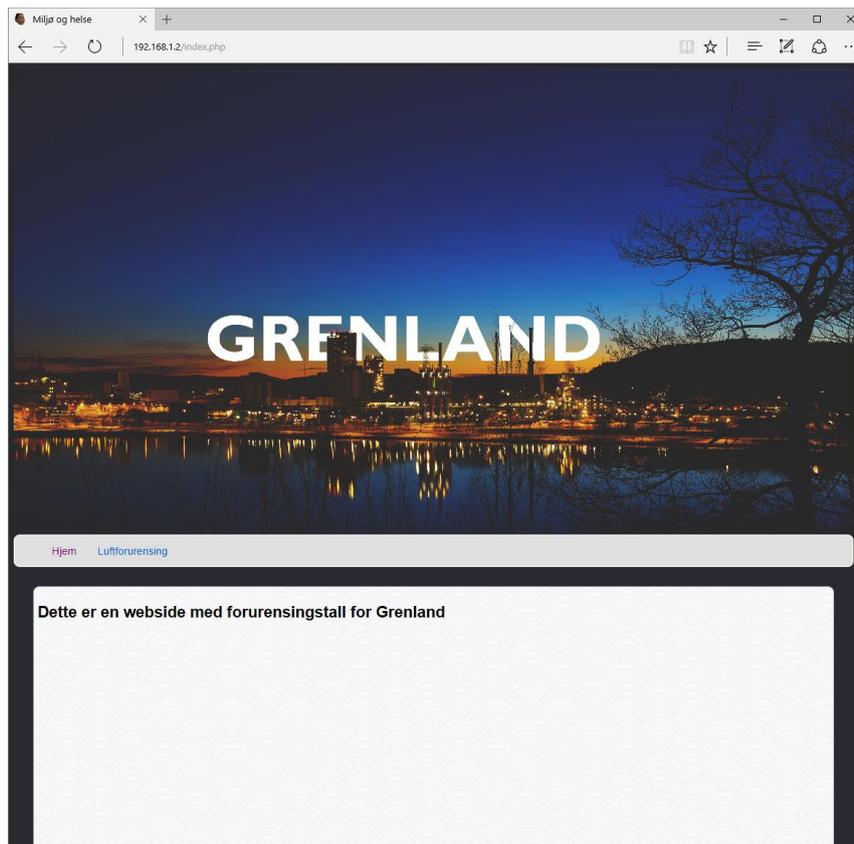


SCE4006 Project 2016

Development of a Database System for Environmental and Public Health Information



SIV-14-16

Course: SCE4006 Project, 2016

Title: Development of a database system for environmental and public health information

This report forms part of the basis for assessing the student's performance in the course.

Project group: SIV-14-16

Availability: <Open>

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(supervisor signature)

Summary:

The background for this project was demand for a system to hold climate/environmental data that would act as a factual basis.

There were two options to solve this project, either create a web portal with links to the external sources or create a database to store data and a website to display the data. By comparing these two solutions with the task description and system requirements, database solution is most appropriate. It gives the most control over the information/data to be displayed and stored, while with portal solution, the quality assurance and control over the data lies in the hands of the external source.

It was chosen to focus on air quality data. Importing measurement data into the database was successful and website has been developed.

The University College of Southeast Norway takes no responsibility for the results and conclusions in this student report.

Preface

We are master students from the University of South East Norway and this project is an obligatory subject for the master program in Industrial IT and Automation. The project is conducted during the third semester, and is group-based. The external partners of this project are Tel-Tek, Porsgrunn municipality and Telemark Hospital-Department of Occupational Medicine. The target groups are people with knowledge in database, web technologies, some environmental information and a little of public health.

The project is composed of two students but the workload was originally planned for 4-5 students. Due to this, the project is delegated in equivalence of two students. Thus, boundaries and limitations are discussed in meetings as a starting point of the website development. These boundaries and limitations are to focus on the available measurement station which is the measurements in local air pollution. The minutes of meetings can be seen in Appendix B. The measurement station is controlled and monitored by Porsgrunn municipality in the department of Medical and Environmental Health (legetjenester og miljørettet helsevern) by two measuring network operators (målenettoperatører). We would like to thank Børge Iversen for the measurement data from the measuring stations both in Porsgrunn and Skien. The prioritized pollutants for this project are particle matter (PM10 and PM2.5) and nitrogen dioxide (NO₂).

We would like to thank our supervisors, Nils-Olav and Hans-Petter Halvorsen and all our external partners for the opportunity to participate on this project. Special mention to Jon Hovland and Tonje Warholm Thomassen from Tel-Tek for helping us with the information gathering of the system for our database model. Petter Ellefsen and Ottar Berg from Porsgrunn municipality for helping us to deciding the prioritized pollutants to be shown in the website. Anne Kristin Fell and Martin Veel Svedsen for the fact box on these pollutants and Cathrine Nedberg for the monitoring report for Grenland fjords.

Porsgrunn, 25. November 2016

Lucille Ang

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1 Introduction

Norway is a member of the United Nations Framework Convention on Climate Change (UNFCCC). UNFCCC is an international environmental treaty and their objective is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system [1]. The convention has no binding limit on the emissions of each member (country). Instead, a treaty or protocols negotiates the binding limits of the greenhouse gases.

Greenhouse gases are elements (gases) that react with the elements in the atmosphere developing heat and makes the earth warmer. In Norway, the only institute that measures greenhouse gases continuously in the atmosphere is the Norsk Institutt for Luftforskning (NILU) or Norwegian Institute for Air Research [2]. The most important greenhouse gas is carbon dioxide CO₂ because it is emitted and made by human activities. Other greenhouse gases are methane, CH₄, Nitrous oxide, N₂O, fluorinated gases and halocarbons such as Chlorofluorocarbon, CFC and Hydrochlorofluorocarbons, HCFC [2].

The emission of greenhouse gases is a worldwide problem and it is very challenging to set boundaries and to monitor these gases because most of these gases are from human activities and some have reactions to the environment immediately once it is released. In Norway, the main authority that monitors the environment is called Miljødirektoratet or Norwegian Environmental Agency. The environmental protection authority not only supervises the greenhouse gases but also contributes to improve the air quality in local areas.

“The air quality in Norway has been improved since the 1990s.” [3] according to the Norwegian Environmental Agency. The air pollutants that is emitted most are particle matter (PM10 and PM2.5) and nitrogen dioxide (NO₂). Other air quality pollutants that contributes in poor local air quality are Sulphur dioxide (SO₂), ground-level ozone (O₃), carbon monoxide (CO), polycyclic aromatic hydrocarbons (PAH) and benzene. The dominant source of these pollutants is road traffic and other sources are industrial and long-range transport from other neighboring countries [3].

Air pollution have health effects and environmental reactions on the atmosphere. Some of these health effects are asthma, respiratory problems and cardiovascular disease and the age group that is most affected by these are children, elderly and pregnant women. The environmental effects of air pollution from the neighboring continents affects Norway with acid rain. An acid rain can lead to acidification of water courses [3].

In the past years, industrial companies were being monitored and controlled to the known hazardous pollutants such as mercury (Hg), dioxins in the fjords and Polychlorinated Biphenyl (PCB). But in today's modern lifestyle, everyday products contain hazardous chemicals that affects the environment. Examples of these everyday products are hair conditioner, mobile telephones and spray-on waterproofing. Some of these pollutants are

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brominated flame retardants and perfluorinated chemicals (PFCs). The whole list can be seen in the website of miljøstatus.no [4].

This chapter will discuss the background of this project, objectives, overview of information in the system, list of similar systems, prioritized pollutants and report structure.

1.1 Background

Norway consist a total of 19 counties. An area in Telamark county represents a geographical region called Grenland and this is composed of Porsgrunn, Skien, Bamble and Siljan.

Due to climate changes and global warming, Norway must implement actions to reduce the consequence of these changes. Thus, each municipality must implement and monitor the pollutant in their respective places. The following are referred to the task description of the project written by our supervisor and is shown in Appendix A. The ideal focus for this project is the Grenland area. But as a starting point and some limitations that are mentioned in the preface, the project will only focus in the Porsgrunn municipality.

In the city of Porsgrunn, the dominating businesses are process industries. Example of these industries are Yara, Ineos, Noretyl AS, Norcem and Eramet. Having an industrial city, it is needed to monitor and inform the public the environmental pollution that these companies are emitting to the air. In addition to the air pollution from these companies, increasing number of cars which leads to traffic can also cause environmental pollution in air.

Thus, collection of information is very important for this project. After gathering the data, a factual basis will be established from the current situation to the effects of the planned actions. With this information, people with environmental and heath background can help each other with their knowledge to provide implementation of actions and politicians can decide what are the right policy of choices.

1.2 Objectives

The following objectives are referred to the project description in Appendix A. The focus of the project will be to develop a database with a flexible structure. The tasks of the project are:

- a) Overview of the type information that should be part of such a system,
- b) Evaluating technologies for databases and WEB, both license and open-source solutions,
- c) Modelling of the database,
- d) Populate the database with some basic data,
- e) Consider the availability of the database information,
- f) Develop a prototype of a WEB based module.

1.3 Similar Systems

There are many systems that are similar to this project but most of them are intended for all the municipalities of Norway. In this project, the system will focus on the city of Porsgrunn and must be flexible to add more municipalities.

The most similar system for the local air pollution is www.luftkvalitet.info. The homepage of this website can be seen in Figure 1.1. The main source for the measurements is the local road traffic. The different colors represent the quality of air in the municipality. This website informs people what the air quality is for the day. Yearly reports can also be accessed in the website. These reports are written to review the yearly measurements for each station such as how many days did the measurement reach more than the required level and how much improvement on that year.

This website is developed and managed by Norwegian Institute for Air Research (NILU), on the behalf of the Norwegian Environment Agency (Miljødirektoratet) and the Public Roads Administration (Statens Vegvesen). NILU is also responsible for quality assurance of the measurement data and scientific contents of the website [5]. The available data for all the measurement stations in Porsgrunn is from 2009-2015.



Figure 1.1 The homepage of the luftkvalitet.info and the quality of air being monitored from all regions of Norway.

There is another system for the local industries that emits gases in air which is www.norskutslipp.no. This website also gives information to all the municipalities in

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Norway and they made an option on the lower left side of the website for choosing which county and municipality.



Figure 1.2 The option for choosing the county and municipality in the website norskutslipp.no.

By choosing Telemark as the county and Porsgrunn as the municipality, the list of industries can be seen with the given pollutant from the section “Landbasert industri” or in English land-based industries. Table 1.1. shows a summary that includes all the pollutants from the list of Tel-Tek and this will be also included in the future works. The names of the industries are sorted in alphabetical order.

Table 1.1 Companies and their emissions from norskutslipp.no.

Pollutants	Industries	Available Data
Sulfur Dioxide (SO ₂)	Eramet Norway, Norcem Brevik, RHI Normag AS, Ulefos jernværk AS, Vistin Pharma, Yara Norge	2002-2015
Nitrogen Oxides (NO _x)	Eramet Norway, Ineos AS, Inovyn Norge AS, Norcem brevik, Noretyl AS, Norske skog union, RHI Normag AS, Yara Norge	2002-2015
Carbon Dioxide (CO ₂)	Eramet Norway, Ineos AS, Inovyn Norge AS, Noretyl AS, Norcem Brevik, Renor Brevik, RHI Normag AS, Ulefos jernværk AS, Vistin Pharma, Yara Norge	2002-2015

1 Introduction

Methane (CH ₄)	Eramet Norway AS, Ineos AS, Inovyn Norge AS, Noretyl AS, Norske Skog Union, Yara Norge	2002-2015
Nitrous Oxide (N ₂ O)	Eramet Norway AS, Ineos AS, Inovyn Norge AS, Vistin Pharma, Yara Norge	2002-2015
Sulfur Hexafluoride (SF ₆)	Herøya industripark-omsmelteanlegget, Ineos AS, Inovyn Norge, Noretyl AS	2002-2015
Dioxins	Inovyn Norge, Norcem Brevik, Renor Brevik, RHI Normag AS	2002-2015
Polychlorinated Biphenyl (PCB)	Renor Brevik, Stena recycling filial Skien fragmentering og ee-avfall	2002-2015
Mercury (Hg)	Eramet Norway AS, Norcem Brevik, Stena recycling filial Skien fragmentering og ee-avfall	2002-2015

Another system for air pollution is www.ssb.no and this is shown in Figure 1.3

<https://www.ssb.no/statistikkbanken/SelectVarVal/Define.asp?MainTable=UtslippKlimaAktR&KortNavnWeb=klimgasser&PLanguage=0&checked=true>

Utslipp til luft, kommunetall

Lag egne tabeller og figurer

1 Velg tabell som inneholder de variablene du ønsker 2 Velg verdier fra ulike variabler 3 Se din skreddersydde tabell, eksporter eller lagre

Tabell: 08615: Utslipp til luft. Klimagasser, etter kilde (K) (avslutta serie)

Min tabell | Velg via søk | Velg via grupper | Informasjon | [Hvordan velge variabler og verdier?](#) | [Logg inn](#)

Statistikkvariabel 1 av 2

Utslipp til luft (1 000 tonn CO₂-ekvivalenter) - Enhet: 1 000 tonn CO₂-ekvivalenter
 Utslipp til luft (CO₂ i 1000 tonn, CH₄, N₂O og fluorholdige gasser i tonn) - Enhet: mengde

Region 0 av 440 | Kilde (aktivitet) 0 av 24 | Komponent: 0 av 5

Kommuner

0101 ... Halden
 0104 ... Moss
 0105 ... Sarpsborg
 0106 ... Fredrikstad
 0111 ... Hvaler
 0118 ... Aremark

Alle kilder
 Olje- og gassutvinning - stasjonær forbrenning
 Industri og bergverk - stasjonær forbrenning
 Energiforsyning - stasjonær forbrenning
 Andre næringer - stasjonær forbrenning
 Husholdninger, forbrenning i boliger

Klimagasser i alt
 Karbondioksid (CO₂)
 Metan (CH₄)
 Lystgass (N₂O)
 Fluorgasser

År 1 av 6

2009
 2008
 2005
 2000
 1995
 1991

Du har inntil videre valgt maks 1 celler. Klikk på 'Vis tabell' for å se tabellen.

[Vis tabell >>](#)

I noen tilfeller finnes det eldre tall i statistikkens arkiv [Gå til alle publiseringer av statistikken](#)

Figure 1.3 The database of the Statistisk Sentralbyrå (SSB) or Statistics Norway for the emission to the air in accordance to the respective municipality.

1 Introduction

Statistisk Sentralbyrå (SSB) has the overall responsibility for official statistics in Norway [6]. Figure 1.3 shows the system for this website and the pollutants that can be seen in this database are global pollutants emitted in air. Municipalities can be chosen with their respective global pollutants. These data can be included together with the information of gas emissions from the industries in www.norskutslipp.no.

Another system that is very similar to this project is www.emisoft.com. Emisoft team is expert in environmental data management & reporting software [7]. They are responsible for environmental monitoring and recognized for environmental data management software for collection, calculation and management of environmental data and reporting environmental performance. The hierarchy of the mechanics for their management software is shown in Figure 1.4. The following steps are collection of data, processing of data and analysis & report.

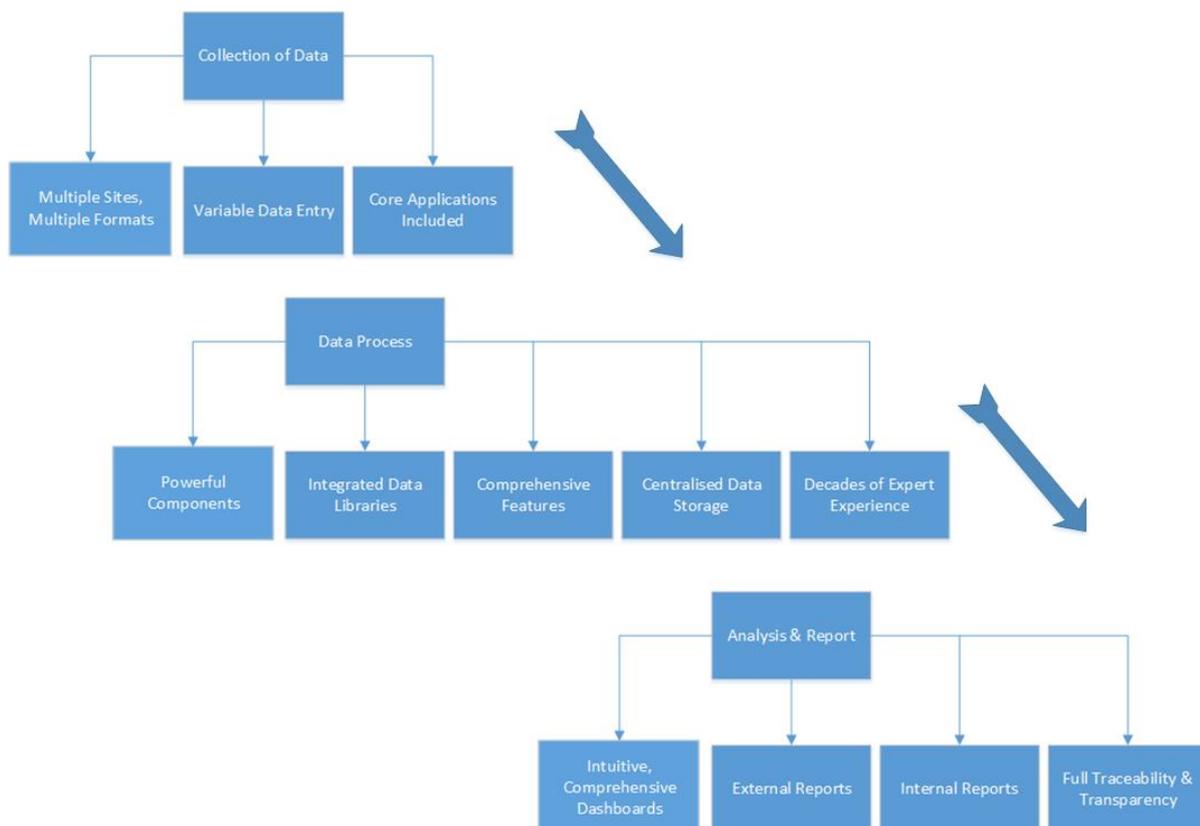


Figure 1.4 Overview of the mechanics for the management of Emisoft. [8]

1.4 Report Structure

This report starts by introducing the background and some of the similar systems/website for these pollutants. Chapter 2 discusses the measurement stations in Porsgrunn, overview of information, discussing the health effects and environmental effects of these pollutants. Chapter 3 discusses the decision on choosing the technologies used in the project. Chapter 4 & 5 shows the result and discussion of the final product, respectively. Chapter 6 will be the conclusion of the project. Lastly, the recommended future works for this project is presented as the last chapter.

2 System Description

In this chapter, the following will be discussed: a short summary of the system description, data of the measurement stations, overview of information, the prioritized pollutants, and the requirement specifications for the system.

The system will have three main purposes. 1) Sykehuset Telemark HF wants to use this to find connections between environmental/climate emissions and diseases. 2) Porsgrunn municipality wants to use the collected data to see the current situation and as a base line for future references. 3) Public information to the people who live in Porsgrunn/Grenland.

Since this project focuses on air quality, thus data from the local measurement stations are gathered. There is a total of 5 measurement stations located in Grenland area, Hakuenes, Lensmannsdalen, Øyekast, Furulund and Sverresgate. A map with location for each station is shown in Figure 2.1.

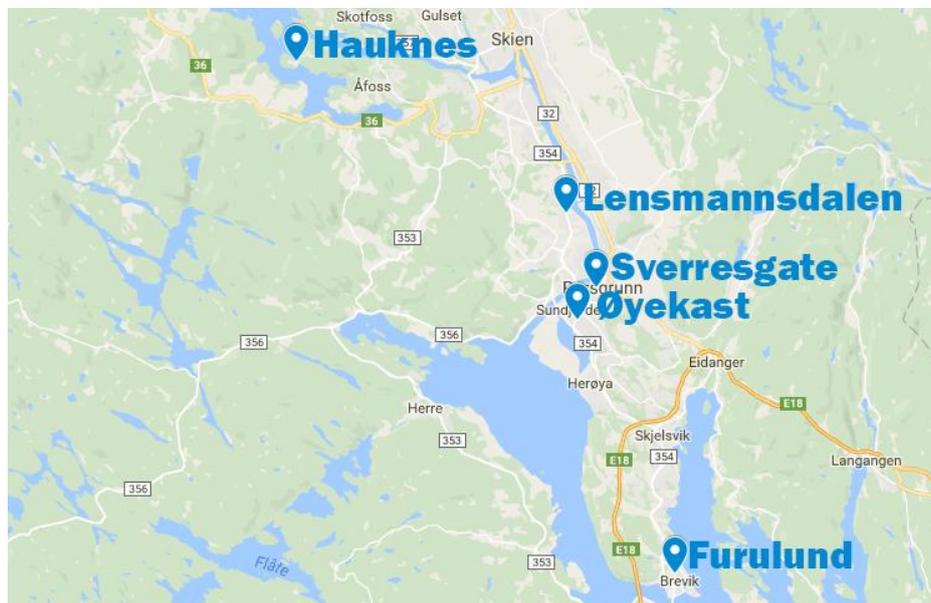


Figure 2.1 Map showing the locations of the five measurement stations

Each station measures different types of pollutants and this is handled by measurement operators in Porsgrunn municipality. The measurement data is saved in an .xls file and these data is manually transferred into the database system.

The .xls file contains data from each pollutant being measured from each measurement station. An example of this file can be found in the Appendix C. The file contains the name of the measurement station, timestamp and value of the pollutant.

2.1 Measurement Stations

The main reference for the information of the measurement stations is the website www.luftkvalitet.info. In the Grenland area, the overview of the five measurement stations is shown in Table 2.1. Two of the measurement stations are in Skien and three of these are in Porsgrunn. The following pollutant for each measurement station is also shown in the table. The exact places of these measurement stations are given by the operator in Porsgrunn municipality thus the coordinates are acquired. The coordinate is needed for mapping these measurement stations in the website.

Table 2.1 Overview of the measurement stations in Porsgrunn. [9] [10][11][12][13]

Measuring Station	Municipality	Pollutants	Longitude	Latitude
Haukenes	Skien	NO _x , O ₃	9.48708966	59.20243518
Lensmannsdalen	Skien	NO _x , PM ₁₀ , PM _{2.5}	9.635742	59.159296
Sverresgate	Porsgrunn	NO _x , PM ₁₀	9.652195	59.138162
Øyekast	Porsgrunn	NO _x , PM ₁₀ , PM _{2.5}	9.642207	59.129194
Furulund	Porsgrunn	NO _x , PM ₁₀ , PM _{2.5} , SO ₂	9.69563115	59.05730396

2.2 Overview of Information

The list of the suggested pollutants is given by Tel-Tek and these are categorized by local pollutants in air, global pollutants, old pollutants and the new environmental pollutants.

There was an article written in the Varden newspaper about the effects of exhausts emissions from traffics and chimneys that can affect to the local air pollution in Porsgrunn [14]. Thus, the local air pollution is the prioritized category as explained in the preface. This was done in the meetings with our external partners and the minutes of these meetings can be seen in Appendix B. The other categories will be discussed in future works. Table 2.2 shows the definition of the pollutants and their corresponding reaction into the atmosphere.

2 System Description

Table 2.2 Description of the air pollutants. [15][16][17]

Pollutants	Description	Reaction
Particulate Matter 10 (PM ₁₀)	Dust particles smaller than 10µm and can be called coarse particle. These particles are the effects of the mechanical break-up of larger solid particles.	
Particulate Matter 2.5 (PM _{2.5})	Dust particles smaller than 2.5µm and can be called fine particles. These particles are largely formed from gases.	These particles are mostly in gas form and these can interact with the gases in the atmosphere called secondary particles.
Nitrogen Oxides (NO _x)	A group gases which are nitrogen monoxide, NO and nitrogen dioxide, NO ₂ .	Contributes to the formation of ozone and particulate matter.
Sulfur Dioxide (SO ₂)	Formed by oxidation of sulphur (S), mainly through combustion of fuels containing S.	Contributes to the formation of secondary sulphate particles in the atmosphere.
Ozone (O ₃)	A reactive gas that exist both near the ground and in the stratosphere. Mostly, it is formed in the atmosphere from chain reaction of other gases.	Reactions with NO _x , carbon monoxide (CO) and methane (CH ₄) in the atmosphere.

2.3 Prioritized Pollutants

The prioritized pollutants are pollutants in air pollution. Table 2.3 shows the following overview of the prioritized pollutants including sources, health effects and environmental effects. The dominating pollutants that is emitted to the atmosphere are particulate matter (PM10 and PM2.5) and nitrogen dioxide (NO₂) thus one of these pollutants must be included in the website and it will be particle matter.

2 System Description

Table 2.3 Overview of the prioritized pollutant with their sources, health effects and environmental effects. [15][18][19]

Pollutants	Sources	Health Effects	Environmental Effects
PM ₁₀	<ul style="list-style-type: none"> ➤ Road traffic ➤ Tire wear ➤ Fuelwood ➤ Transboundary air pollution 	<ul style="list-style-type: none"> ▪ Can cause or aggravate cardiovascular and lung diseases ▪ Heart attacks and arrhythmias. ▪ Can affect the central nervous system and the reproductive system, ▪ Can cause cancer. ▪ One outcome of exposure can be premature death. 	<ul style="list-style-type: none"> ○ Acts as a greenhouse gas, mainly cooling the earth's climate, although in some cases it can lead to warming. ○ PM in the atmosphere can also alter rainfall patterns, and affect the surface albedo properties of snow (the extent to which the snow reflects light).
PM _{2.5}	<ul style="list-style-type: none"> ➤ Industrial exhaust emissions ➤ Important natural sources: sea salt and natural re-suspended dust. 	<ul style="list-style-type: none"> ▪ NO₂ is associated with adverse effects on health: it can affect the liver, lung, spleen and blood. It can also aggravate lung diseases leading to respiratory symptoms and increased susceptibility to respiratory infection. 	<ul style="list-style-type: none"> ○ Contributes to acid deposition but also to eutrophication of soil and water.
NO _x	<ul style="list-style-type: none"> ➤ Exhaust emissions ➤ Road traffic ➤ Marine traffic ➤ Transboundary pollution ➤ Diesel vehicles 	<ul style="list-style-type: none"> ▪ Aggravates asthma and can reduce lung function and inflame the respiratory tract. ▪ Can cause headache, general discomfort and anxiety. 	<ul style="list-style-type: none"> ○ Contributes to acid deposition causing damage to forests, and ecosystems in rivers and lakes.
SO ₂	<ul style="list-style-type: none"> ➤ Oil and coal. ➤ Important source: Electricity generation sector. 		

2 System Description

Ozone	▶ Forms in the atmosphere from a chain of chemical reactions following emissions of certain precursor gases: NO _x , carbon monoxide (CO) and NMVOCs and methane (CH ₄).	▪ Elevated levels of ozone can cause respiratory health problems, including decreased lung function, aggravation of asthma, and other lung diseases. ▪ Can also lead to premature mortality.	○ Ozone is also a greenhouse gas contributing to warming of the atmosphere.
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2.4 Requirement Specification

The system should be able to save measurements of air pollutants given in the prioritized list and this can be seen in Appendix D. The system also needs this data to be saved in a database with a flexible structure. It also should consist of a Web based export module for displaying the information/data.

The purpose of the system is to give an overview/ status of greenhouse gases and pollutants in the Greenland Area. The information/data in the database needs to be available online, easy accessible with quality assured data and will be open to the public and to be of use to the politicians and industries in Greenland. The system will also contain health related information regarding the pollutants to be displayed.

It will show the current situation and development over time. The information to be shown should be displayed as numbers and not as a report /document. The database will serve as a factual basis for future research.

These are the functional requirements specified for the system:

- Save measurements of air pollutants
- Display air quality data from database on website
- Show current situation
- Show development over time
- Show data as value/chart, not as a report

These are the non-functional requirements specified for the system:

- Database with flexible structure
- Have a website for displaying the data in database
- Available online
- Data needs to be quality assured
- Data needs to open to the public
- Contain health related information

3 Methods

In this chapter, the following will be discussed: an overview of the web solutions and the decisions on the chosen technologies in both database and website.

To view the environmental/pollution information, it was a requirement that a web solution is to be developed. Since there are already existing other web solutions for displaying the information, thus two solutions can be chosen from.

The first option is creating a web portal. By choosing a web portal, it is easy to create the web page and there is no need to create a database. The downside of creating a web portal is that it is dependent that the data is available on an external website. In addition, a web portal has no control over external data, no or little validation of the data, not possible to store data and hard to navigate to find desired data.

The second option is to create a database and create a web solution to display the information saved in the database. This solution ensures full control over the data displayed, easier to navigate and find desired data, option to add new data and full quality assurance of data in database. This is illustrated in Figure 3.1.

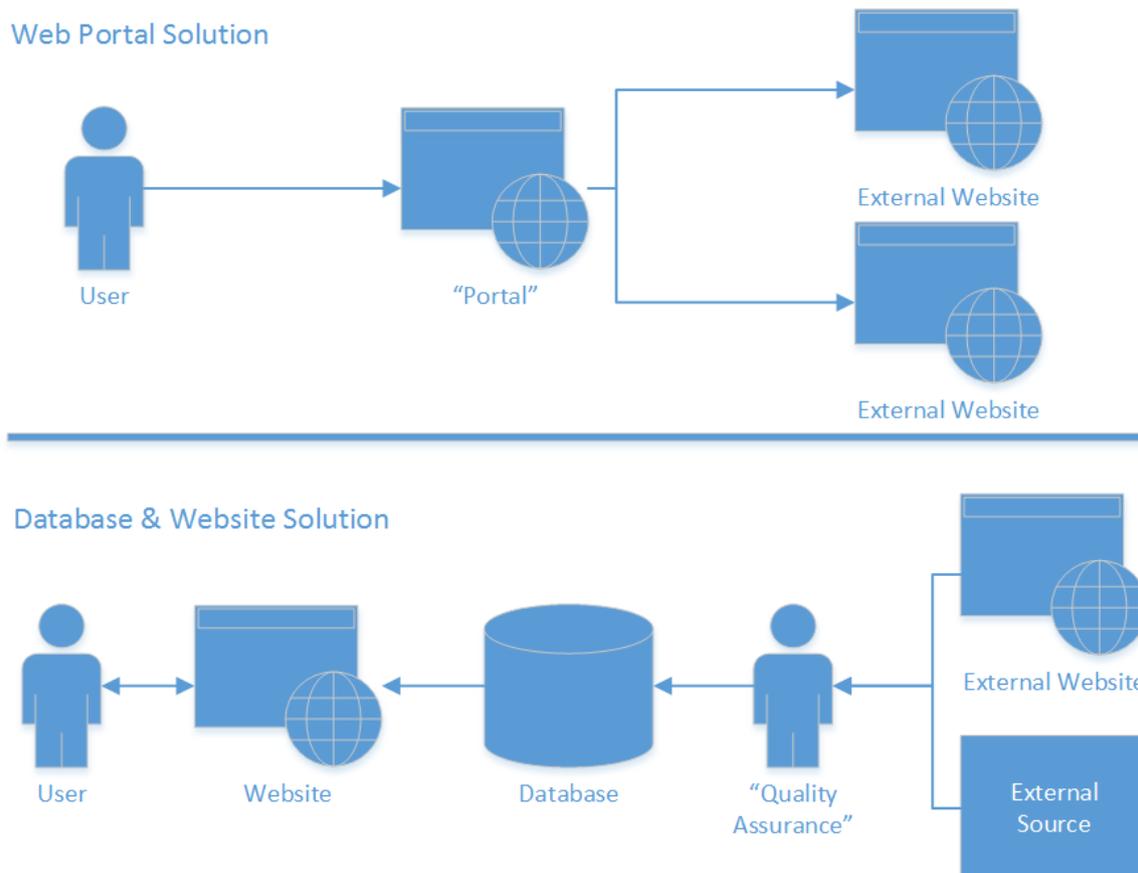


Figure 3.1 Overview of Web Portal Solution and Database & Website Solution.

All data is not available on the internet and therefore the second solution is better suited for this project.

3.1 Database

The data from the different sources needed to be stored in a database. There are two types of databases that was evaluated for this project, relational databases known as SQL database and NoSQL referring to non-SQL database.

Table 3.1 Comparison of SQL and NoSQL. [20]

	NoSQL	SQL
Model	Non-relational	Relational
	Stores data in JSON documents, key/value pairs, wide column stores, or graphs. JSON stands for JavaScript Object Notation and is a lightweight data-interchange format.	Stores data in a table
Data	Offers flexibility as not every record needs to store the same properties	Great for solutions where every record has the same properties
	New properties can be added on the fly	Adding a new property may require altering schemas or backfilling data
	Relationships are often captured by denormalizing data and presenting it in a single record	Relationships are often captured in a using joins to resolve references across tables
	Good for semi-structured data	Good for structure data
Schema	Dynamic or flexible schemas	Strict schema
	Database is schema-agnostic and the schema is dictated by the application. This allows for agility and highly iterative development	Structure and data types are fixed in advance. To store information about a new data item, the entire database must be altered, during which time the database must be taken offline.
Examples	MongoDB	MySQL, MariaDB, Microsoft SQL Server, Oracle Database

3 Methods

Development Model	Open-source	Mix of open-source (e.g. MariaDB, MySQL) and closed source (e.g. Oracle Database, Microsoft SQL Server)
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By comparing the two database technologies, SQL database was chosen. This is because the data in this project are structured and Microsoft SQL Server is the database technology taught in school and the developer has experience with the database type.

A database can be stored in different ways, either hosted by in a local computer or in the cloud. For simplicity, a SQL server was implemented on a local machine.

3.2 Website

It was a requirement to develop a website. A reason is because it is accessible for everyone and platform independent. To develop an application for this system, one version for each platform would have been needed to make the data accessible for everyone. The way a website works is illustrated in Figure 3.2. A user uses a client to send a request for a service on a web server. This communication normally goes over a computer network and after the server receives the request, it sends a response in return [21]. For the client and server to communicate, they need to use the same application layer protocol stating the rules and language used for communication.

On the World Wide Web (WWW), Hypertext Transfer Protocol (HTTP) is the main protocol used for communication between client and server [22]. The response from the server after receiving a request can be a HTML document or other content such as images and video.

A Hypertext Markup Language (HTML) document is loaded into a web browser and is used to display the website. What content the web browser shows and how it is displayed is defined using different web technologies.

HTML is used for formatting the content of the website. Cascade Style Sheet (CSS) is used to format the style of the content in the website. JavaScript is used to make the website interactive and PHP is used to make the website dynamic. HTML, CSS and JavaScript are executed on the client side, in the web browser of the client machine. PHP is a so called sever side language and PHP scripts are executed on the server. By combining these technologies, a dynamic interactive website can be created. To develop the web solution in this project, the following technologies was selected.

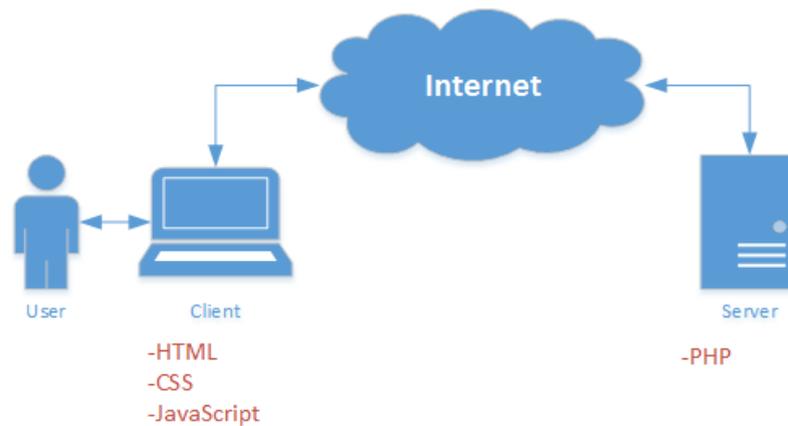


Figure 3.2 Client-Server model with web technologies

- HTML

HTML is the standard markup language used in web pages. HTML uses elements that is used to create the parts of the website such as the headings and body [23]. An example of an HTML code is shown below. The top section of the code is for declaring the HTML document. `<h1>` declares start of the heading 1 tag followed by the content and ended by the end tag (`</h1>`). The result of executing the code is shown in Figure 3.3.

```
<!DOCTYPE html>
<html>
  <head>
    <title>Hello World</title>
  </head>
  <body>
    <h1>This is a Heading</h1>
    <p>This is a paragraph.</p>
  </body>
</html>
```

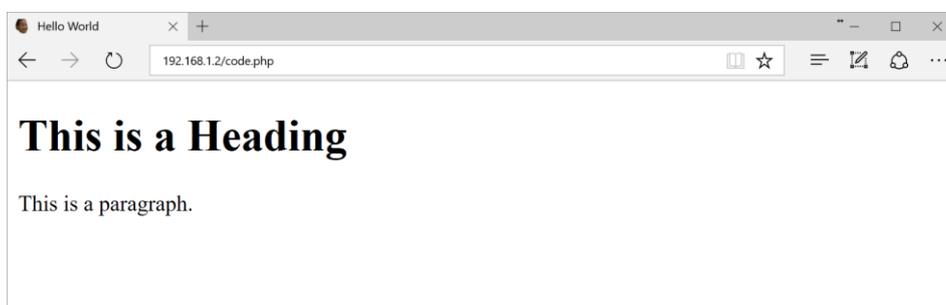


Figure 3.3 Screenshot of the result after running the HTML code.

- **CSS**

CSS is a style sheet language used to describe the layout of a document written in a markup language. A CSS rule-set contains a selector and a declaration block. In this solution, CSS is used to set the layout of the website and change the layout based on the device used to view the site. An example of a CSS code is shown below. Body, h1, p are selectors and these points to HTML elements based on the name. The declaration part includes a CSS property name and a value. The result of applying the CSS to the HTML example is shown in Figure 3.4.

```
body {  
    background-color: lightblue;  
}  
h1 {  
    color: white;  
    text-align: center;  
}  
p {  
    font-family: verdana;  
    font-size: 20px;  
}
```



Figure 3.4 Screenshot of the CSS applied to the HTML example.

- **PHP**

PHP (“PHP: Hypertext Preprocessor”) is a server-side scripting language. This means that the PHP code is executed on the server. This generates HTML that then gets sent back to the client. For this solution, PHP is mainly used to get the data stored in the database [24]. There exist several server scripting languages such as ASP, Ruby and Python, but PHP was selected based on the group’s experience. An example of a PHP code is shown below. This code uses a built-in PHP function called “echo” to output HTML code for adding a header and a paragraph. The result of executing the code is shown in Figure 3.5.

```
<!DOCTYPE html>  
<html>  
    <body>
```

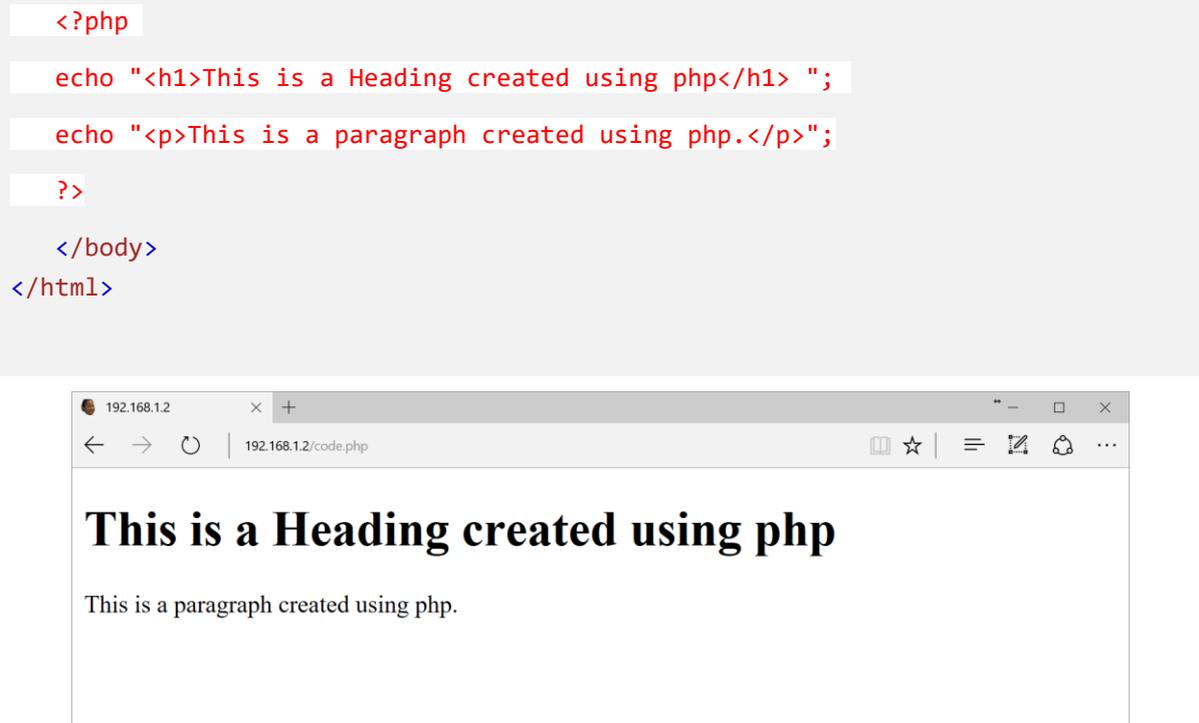


Figure 3.5 Screenshot of the result after running the PHP code.

- **JavaScript**

JavaScript is a web programming language and is used to create interactive websites. JavaScript is used in this solution to create the graph on the website using the charting library, Highcharts [25]. An example of a JavaScript code is shown below. In the code below, the JavaScript HTML method `getElementById()` is used to change the value of paragraph demo when the button is clicked. The result of executing this code is shown in Figure 3.6.

3 Methods

```
<!DOCTYPE html>
<html>
  <body>

  <button type="button"
  onclick="document.getElementById('demo').innerHTML = Date()">
  This button is created using JavaScript</button>

  <p id="demo"></p>

  </body>
</html>
```

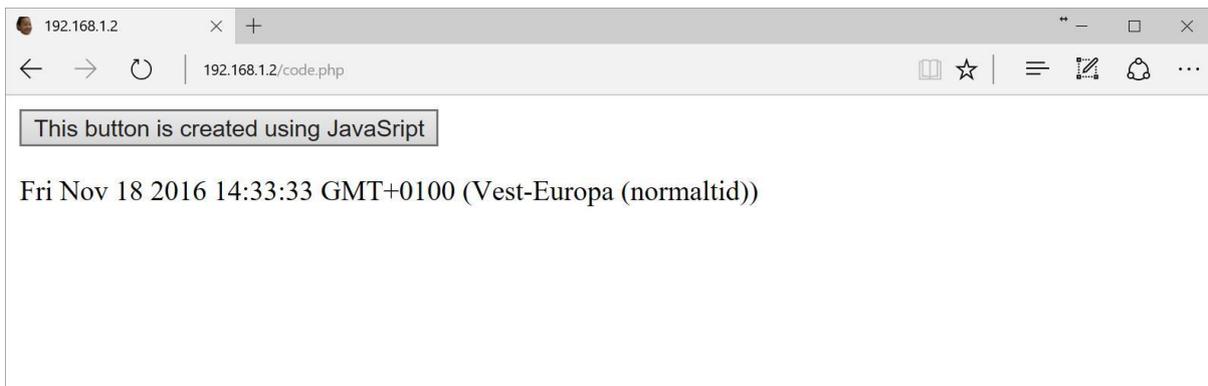


Figure 3.6 Screenshot of the result after running the JavaScript code.

4 Results

In this chapter, the following will be discussed: overview of the system and implementation of the database model and the website.

Figure 4.1 shows the structure of the system. The data is collected as described in Chapter 2. The excel file from the measurement technician is imported into the database with a Database Management System (DBMS) which is Microsoft SQL Server. After importing the excel file, the data collected is retrieved from the database and displayed on the website.

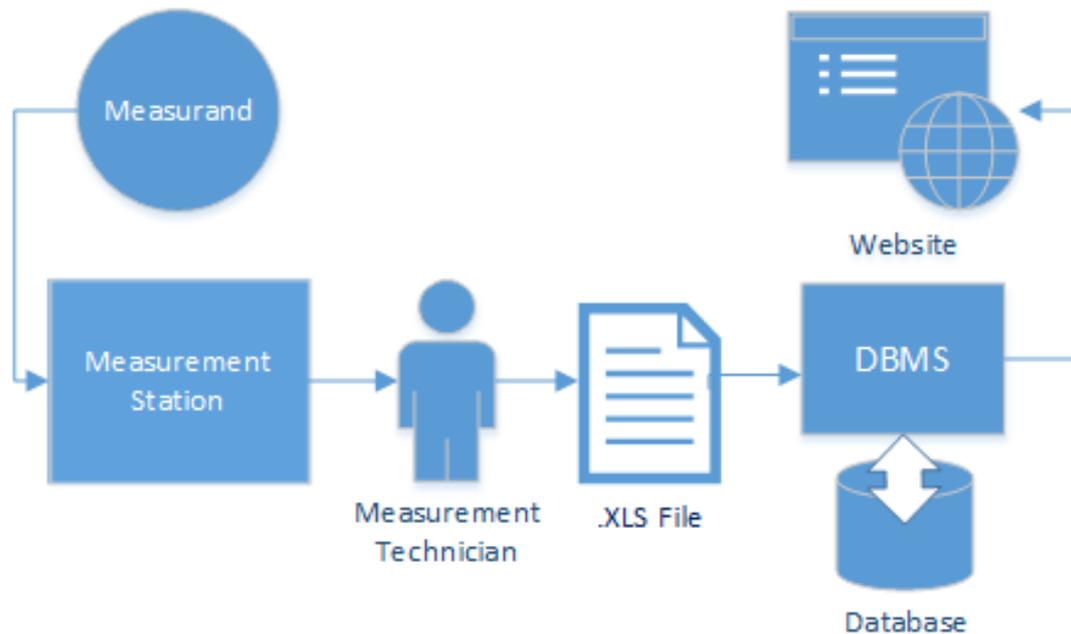


Figure 4.1 Overview of the system.

4.1 Database

The database is designed and implemented using SQL described in Chapter 3. The model was developed using the data modeling tool Erwin.¹ Figure 4.2 shows the steps in creating the database model. The first step for designing the database was identifying the entities. Based on the requirement specification and the measurement data, the entities were selected. After finding the entities, the relationships between the entities and cardinality of each relationship was determined. After identifying the relationships, the attributes were determined. Then, a unique identifier for each entity was determined to use as a primary key. An attribute with the name of the entity and combined with “id” was created for each entity to serve as the primary key. After defining the attributes data type and normalizing the data model, the following E/R model is shown in Figure 4.3.

¹ <http://erwin.com/>

4 Results

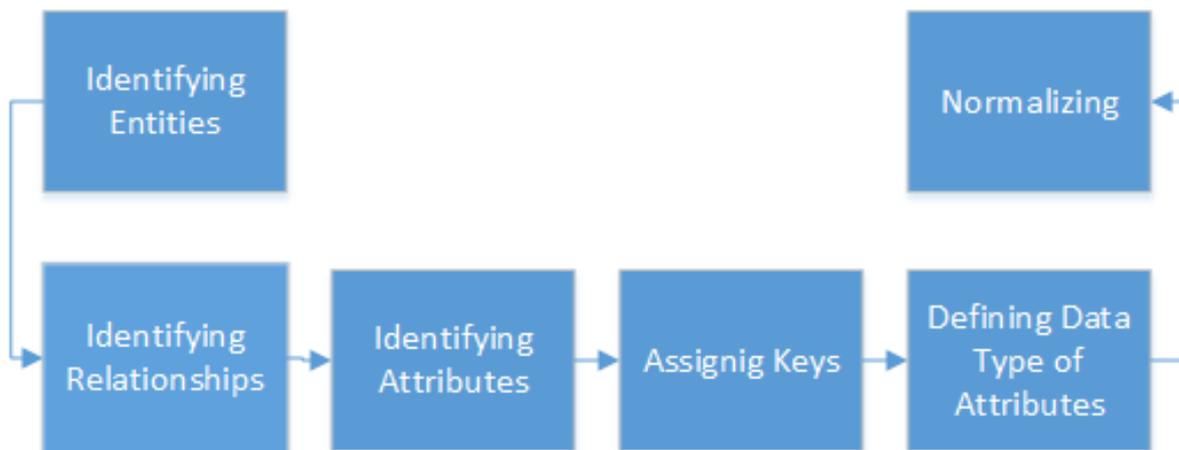


Figure 4.2 Structure of creating a Database model. [26]

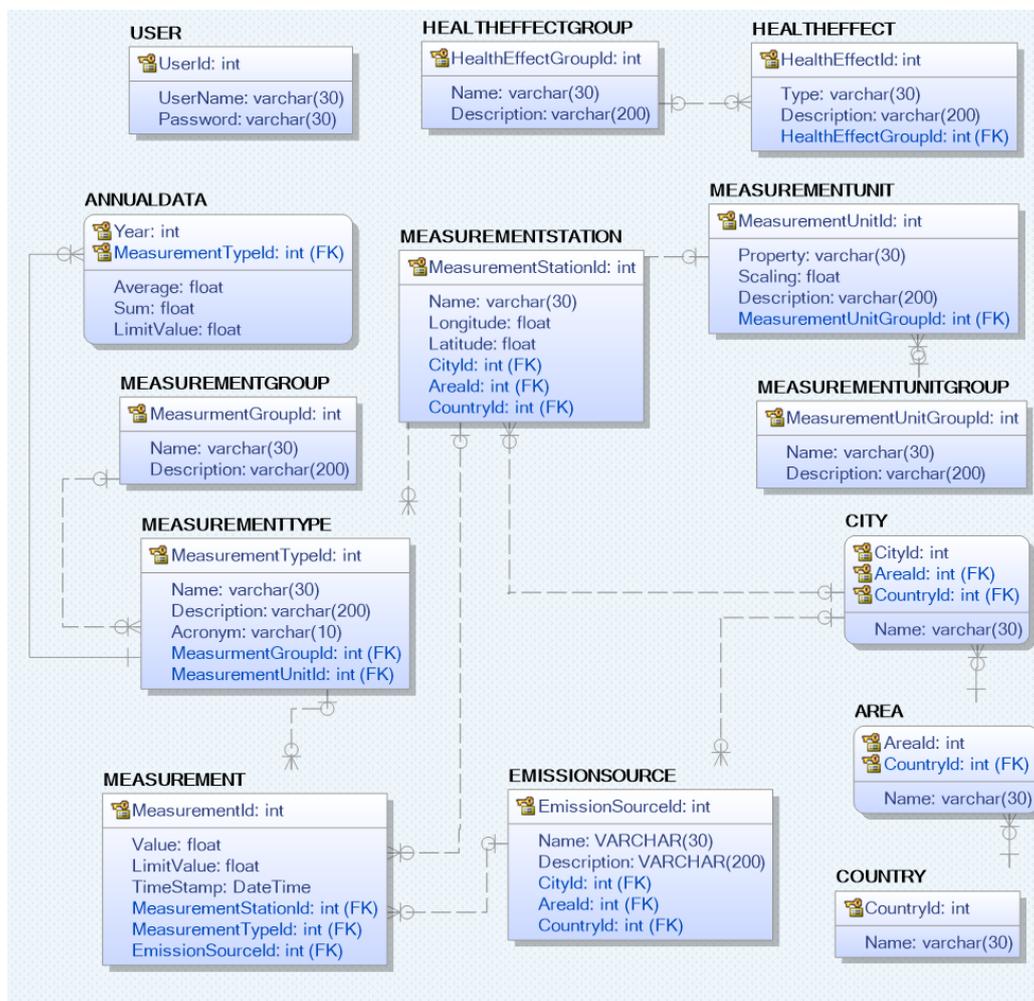


Figure 4.3 Screenshot of the physical E/R model developed.

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The USER entity serves as an independent table with all the information of the user that can change/access the website. HEALTHGROUP and HEALTHEFFECT entities describe the health information of the pollutants. COUNTRY, AREA and CITY contains the location of the database and they form a dependent relationship because some cities can have the same name within different areas. In this case, Norway is the location. The MEASUREMENTUNITGROUP and MEASUREMENTUNIT describes which group does the measurement unit belong and what the measurement unit is, respectively. MEASUREMENTTYPE and MEASUREMENTGROUP describes what kind of pollutants for this case but it can be other types and which group does these types belong. MEASUREMENTSTATION is the location of the measurement station of the measurement type. This is useful for mapping the location of the measurement station into the website. MEASUREMENT contains the value and limit value of the measurement type with its respective measurement station and emission source. EMISSIONSOURCE describes the source of the measurement such as industries and municipalities. Lastly, ANNUALDATA is a table that mainly get the average value from the MEASUREMENT table and this is dependent to the MEASUREMENTTYPE table because it is needed to know which measurement type in that certain average.

After finishing the model in ERWIN, a SQL script for creating the database modeled was generated using the forward engineering action in ERWIN. The script generated can be found in Appendix F. To implement the database, the script was executed in Microsoft SQL Server. This created a functional version of the database with all the entities, attributes, keys and relationships. The next step was to run a script that filled up the database with the necessary information. This information is needed when adding new measurement data. This script can be found in Appendix G.

The method that is used to import an excel spreadsheet into Microsoft SQL Server is the built-in function bulk insert. To import the excel file, it is needed to be converted in a Comma Separated Values (.csv) file. A .csv file stores the data in plain text and separate the values with comma. As stated in in Chapter 2, the data is transferred manually and therefore the data for these Ids; MeasurementStationId, MeasurementTypeId, EmissionSourceId and LimitValue is manually inserted to excel. Then, the excel file is converted into .csv. The script for the bulk insert function is shown below and this imports the data into the import file database.

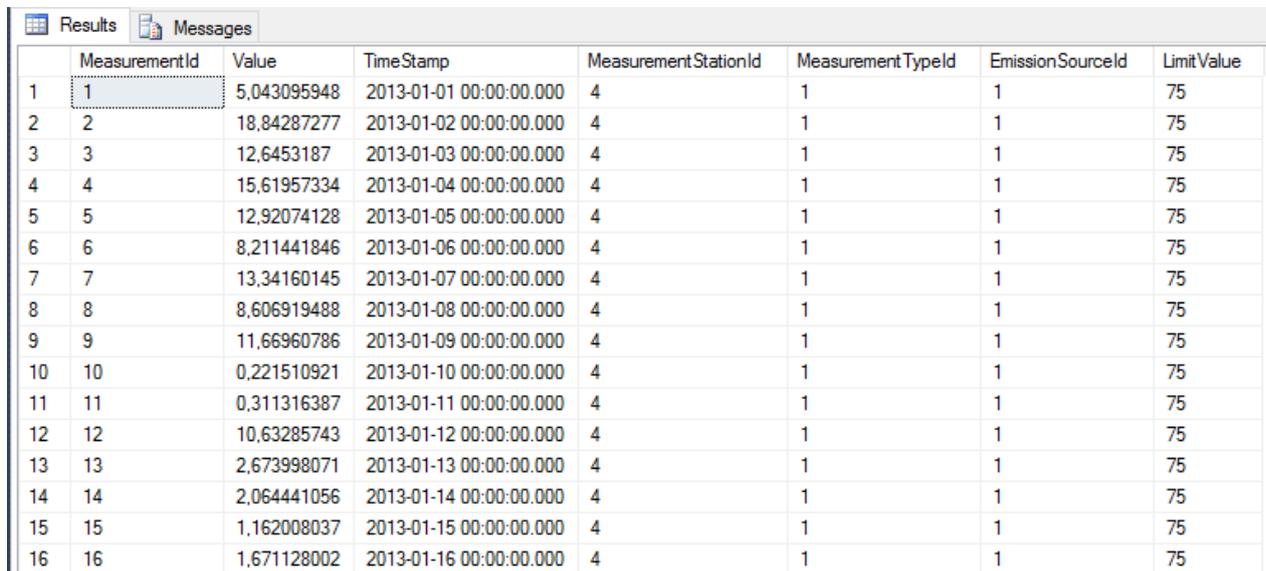
```
BULK INSERT IMPORTFILES.dbo.HAUKENESN02
FROM 'C:\Bear\SCE\3rd Year\Project 2016\Project\Data\HaukenesN02.csv'
WITH
(
    FIELDTERMINATOR = ';',
    ROWTERMINATOR = '\n',
    FIRSTROW = 2
)
```

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Then, to transfer data from import file database into the MEASUREMENT table the script below was executed.

```
INSERT INTO EHTESTDB2.dbo.MEASUREMENT
(
    [Value],
    [TimeStamp],
    [MeasurementStationId],
    [MeasurementTypeId],
    [EmissionSourceId],
    [LimitValue]
)
SELECT [Value], [Date], [StationId], [TypeId], [EmissionSourceId], [LimitValue] from
IMPORTFILES.dbo.HAUKENESNO2
```

After running the script, Figure 4.4 was obtained. The figure shows the measurement data found in the MEASUREMENT table.



The screenshot shows the SQL Server Enterprise Manager interface with the 'Results' tab active. It displays a table with 8 columns: MeasurementId, Value, TimeStamp, MeasurementStationId, MeasurementTypeId, EmissionSourceId, and LimitValue. The table contains 16 rows of data, with the first row highlighted. The data represents measurements taken daily from January 1st to January 16th, 2013, at station 4, with a constant limit value of 75.

	MeasurementId	Value	TimeStamp	MeasurementStationId	MeasurementTypeId	EmissionSourceId	LimitValue
1	1	5,043095948	2013-01-01 00:00:00.000	4	1	1	75
2	2	18,84287277	2013-01-02 00:00:00.000	4	1	1	75
3	3	12,6453187	2013-01-03 00:00:00.000	4	1	1	75
4	4	15,61957334	2013-01-04 00:00:00.000	4	1	1	75
5	5	12,92074128	2013-01-05 00:00:00.000	4	1	1	75
6	6	8,211441846	2013-01-06 00:00:00.000	4	1	1	75
7	7	13,34160145	2013-01-07 00:00:00.000	4	1	1	75
8	8	8,606919488	2013-01-08 00:00:00.000	4	1	1	75
9	9	11,66960786	2013-01-09 00:00:00.000	4	1	1	75
10	10	0,221510921	2013-01-10 00:00:00.000	4	1	1	75
11	11	0,311316387	2013-01-11 00:00:00.000	4	1	1	75
12	12	10,63285743	2013-01-12 00:00:00.000	4	1	1	75
13	13	2,673998071	2013-01-13 00:00:00.000	4	1	1	75
14	14	2,064441056	2013-01-14 00:00:00.000	4	1	1	75
15	15	1,162008037	2013-01-15 00:00:00.000	4	1	1	75
16	16	1,671128002	2013-01-16 00:00:00.000	4	1	1	75

Figure 4.4 Screenshot of the excel file successfully imported.

4.2 Website

The website was developed and implemented using the technologies described in Chapter 3. In addition, for development of the website, the web deployment tool, Adobe Dreamweaver was used. Adobe Dreamweaver is application developed by Adobe systems as a web development tool. It has syntax highlighting for multiple languages, code completion, real time syntax checking and live preview of website [27]. For hosting the site, WampServer was installed and used on a personal computer. WampServer is a web deployment environment for Windows. The environment consists Apache2 which is a webserver, PHP for running php code, MySQL database and PhpMyAdmin used managing databases [28]. In this project, WampServer was used mainly for hosting on the website on the web server and running php codes.

In Figure 4.5, the structure of the webpage is shown. The code for the website can be found in Appendix I. Index.php is the main page and also the first page displayed when accessing the website. A screenshot of this page is shown in Figure 4.6. The image displayed is put inside a HTML div class tag with name “image-container”. For formatting the style and placement of the image, properties for “image-container” was set in the CSS file main.css. main.css is used as a common CSS file for the whole website. Next the navigation bar implemented in this page by including nav.php. The navigation bar is created using HTML, CSS and JavaScript. By hovering over the column called “Luftkvalitet” the list of the page for each substance is shown. The remaining part of the page is created using HTML and CSS.

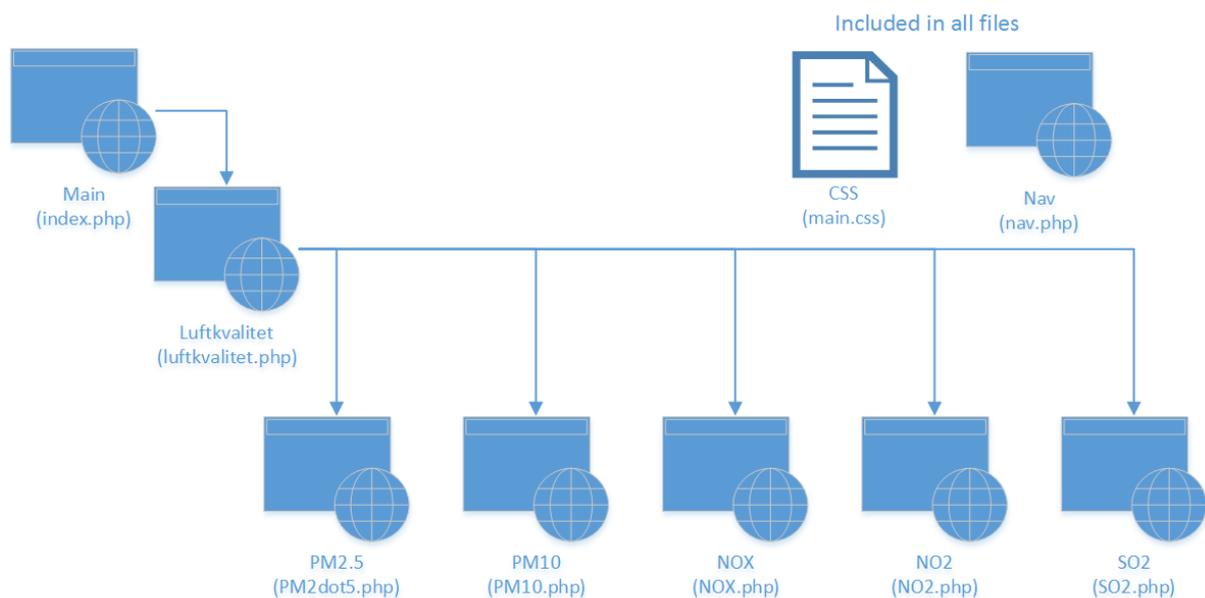


Figure 4.5 Structure of the website developed. Main, Nav, CSS and PM10 is the only documents developed in the current solution

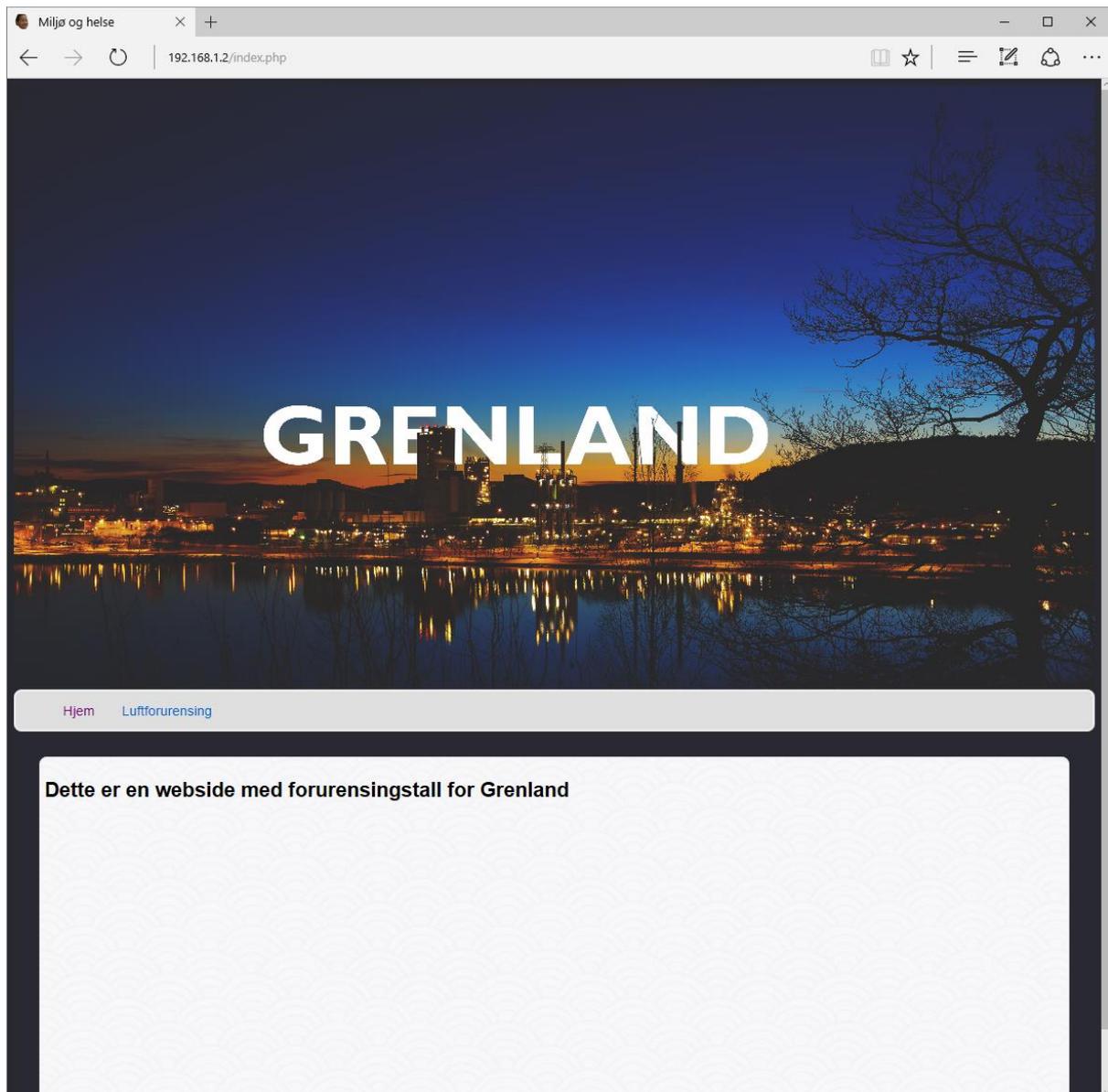


Figure 4.6 Screenshot of the home page for the website.

By clicking on PM10 in the dropdown menu when hovering over the navigation bar, the browser is redirected to `pm10.php`. Figure 4.7 shows a screenshot of the PM10 page. The top of this page includes the same navigation bar as main page. Underneath the navigation bar is a facts box defined inside a HTML article tag region. The header text inside this area is defined using the tag `<h1>` and `<h3>`. The facts inside this region is stored in the database and displayed using PHP. Underneath the facts box is another article region. Inside this second region a google map is shown. This was implemented by using a `<iframe>` tag and code found on Google Maps API [29].

4 Results

Beneath the map there is a <div id> tag named “graph1” defined. In this section a graph is drawn with data from database. To draw the chart Highcharts was used. To draw the data located in the database, PHP was used inside the Highcharts code to get the data from the database.

It is possible to navigate back to the main page from PM10 by clicking on “Hjem” in the navigation bar.

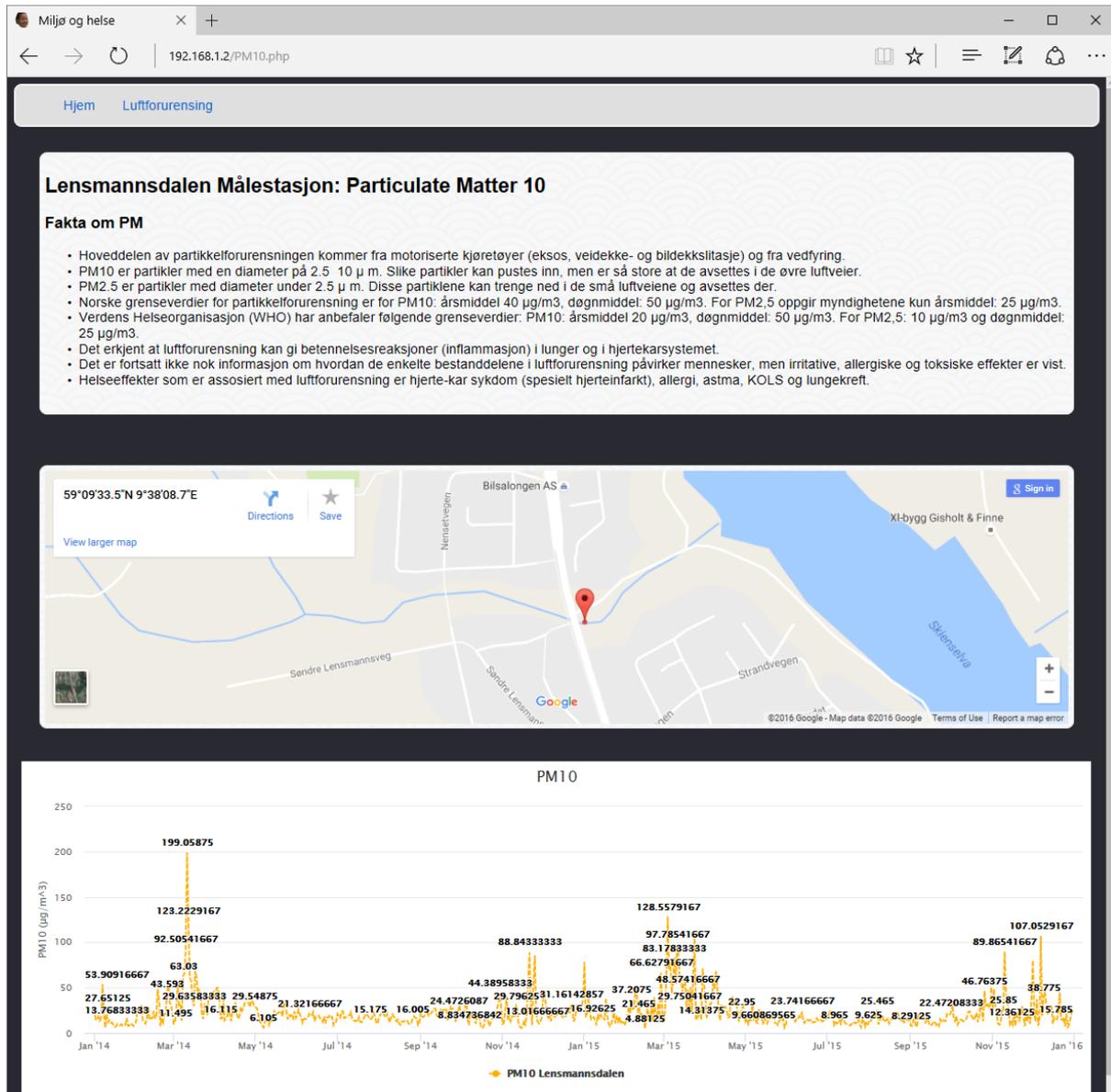


Figure 4.7 Screenshot of PM10 information page

5 Discussion

The result is based on the requirement specification in Chapter 2.4. The choice of the pollutant was done in accordance to the list decided in the meeting. This can be seen in Appendix D. It was decided that the most important of these air pollutants is Particle Matter (PM10). The data of PM10 from the Lensmannsdalen measurement station was chosen to be displayed first in the website.

The database is designed with a flexible structure therefore other environmental pollutants from the list can be stored into the database in the future. It is also possible to add measurement stations and measurement data from these stations.

The web solution can retrieve data successfully from the database and display it. This was achieved in testing by hosting on a local computer but it needs a permanent server to have the data available online. This also applies for the Microsoft SQL database. The current populate data of the database is from 2013 to 2015 and this is needed to be updated for 2016 to show the current status.

According to the last minutes of meeting in Appendix B, it was wished that there will be an information box on the page for each pollutant and this is an extension of the system. The information in these boxes had to come from a qualified source. Therefore, Sykehuset Telemark HF was appointed to provide the information. In the current version, only one information box has been implemented to serve as an example and this is shown in Figure 4.7. But in the future, Sykehuset Telemark HF can provide information box for the other pollutants.

From Chapter 2.4, the functional and non-functional requirements was listed. The measurement data from the measurement station is being monitored by Norsk Institutt for luftforskning (NILU) and they do the quality assurance for the data. The result in the database showed that the database model manages to save the measurement data of the air pollutants into the Database Management System (DBMS) and from the DBMS the data was transferred into the website. The website has been developed and tested using these requirements thus, the air quality data was displayed on the website. The data in the website shows the values in a chart and the information box from the Sykehuset Telemark HF. The graph shows how the pollutant changes with time. The chart shows measurement data from 2013 – 2015 as a starting point but information of current situation in 2016 can be included in the future. The database is flexible thus, other environmental pollutants can be added on the website.

When adding more data from other measurement stations, the same method can be used thus this solution gives more control and more maintainable. The two similar systems, norskutslipp.no and ssb.no have information for environmental pollutants and the data for these systems can also be imported into the database and displayed on the website. More details will be discussed in Future Works.

6 Conclusion

The database model was created according to the requirement specification and measurement data. The model was implemented into Microsoft SQL Server using SQL script generated by ERwin. Importing measurement data into the database was successful and this shows that it can handle different kinds of data when it is structured in the same way.

The measurement data from the measurement station is an excel file. Then, each station is separated in several excel files with their corresponding pollutants. Each pollutant in a measurement station file is converted to a Comma Separated Values (.csv) to be able to export from excel into the Database Management System (DBMS) which in this case is Microsoft SQL Server. When transferring data from the database, the language used is PHP. To display the chart, the language used is JavaScript.

To make the data accessible online, a website was developed. The website was able to retrieve data from the database and display it in a chart on the website.

One challenge has been transferring of data from the original measurement file into the database. More details can be seen in Future Works.

7 Future Works

- **Automatic data import**

The method that was used in this project was manually filling out the excel file with the necessary information to be imported into Microsoft SQL Server. This method is time consuming and it is recommended to have a system that is independent to human error because the data being gathered from the measurement station is quite plenty and this can lead to errors on the way if they are exported manually. Thus, an automatic data import is recommended for the system.

Several techniques for importing an excel spread sheet into Microsoft SQL Server databases mentioned in [30] are

- SQL Server Data Transformation Services (DTS)
- Microsoft SQL Server 2005 Integration Services (SSIS)
- SQL Server linked servers
- SQL Server distributed queries
- ActiveX Data Objects (ADO) and the Microsoft OLE DB Provider for SQL Server
- ADO and the Microsoft OLE DB Provider for Jet 4.0

It is also possible to create an automatic data importer in C#.

- **Make function for exporting selected data**

It is great to have an export function in the website so that everyone who are interested for a copy of the data, a document such as an excel file, .csv, etc. can be exported. These data can be used in research & development for industries and the hospital. Thus, creating an export function is recommended for the system.

- **User Log in**

In the database, it has been created a user table. This can in the future be used to enable for user log in. This can be used as a safety barrier if it is needed in a future expansion of the system.

- **Rest API**

Rest API can be implemented to prohibit direct connection between clients and the database. Rest API uses a web service that clients can send requests to using HTTP protocol. Then the web service gets the wanted and returns it to the client that sent the request. This adds extra security to the system and can protect against hackers.

- **Including the limit value of the pollutants in the graphs**

Table 7.1 **Feil! Fant ikke referansekinden.** shows the limit values for each of the air pollutants according to the law data in Norway for air pollution. Since the website will be annually updated, it is recommended to insert the average limit to the graph together with the overall average of the measurement data.

Table 7.1 shows the limit values of each air pollutant [31]

Component	Averaging Period	Limit Value	The number of permitted exceedances of the limit value
Particulate Matter 10 (PM₁₀)			
1. Daily limit for protection of human health	1 day (fixed)	50 µg/m ³	The limit value must not exceed more than 30 times per calendar year.
2. Yearly limit for protection of human health	Calendar year	25 µg/m ³	
Particulate Matter 2.5 (PM_{2.5})			
Yearly limit for protection of human health	Calendar year	15 µg/m ³	
Nitrogen Oxides (NO_x) and Nitrogen Dioxide (NO₂)			
1. Yearly limit for protection of human health	Calendar year	40 µg/m ³ NO ₂	
2. Limit for the protection of vegetation	Calendar year	30 µg/m ³ NO _x	
Sulfur Dioxide (SO₂)			

7 Future Works

1. Daily limit for protection of human health	1 day (fixed)	125 $\mu\text{g}/\text{m}^3$	The limit value must not exceed more than 3 times per calendar year.
2. Limit for protection of the ecosystem	Calendar year and in the winter period (1/10–31/3)	20 $\mu\text{g}/\text{m}^3$	

- **Include data from other measurement stations into the website**

After completing the first measurement station for the air pollutant, Particle Matter, the next step will be to include all the data of the other measurement stations with the same air pollutant. Thus, all measurement data from all the measurement station of a certain pollutant will be viewed in a single page. This will be the format of all the other air pollutants.

- **Get more data from different sources.**

The current system has focus on air pollutants, and it is recommended to look for data for the different categories in the original list from Tel-Tek. These data can be added into the database because the database was designed to hold different types of data. The database is design to hold various types of measurements as long as the data is structured in a certain way. The data needs to contain what is measured, where is measured, when it was measured and the value measured.

- **More information of emission data from the industries.**

Here is a list of industries in Porsgrunn based on the website norskutslipp.no. It is also recommended to get the amount of Particle Matter (PM) emitted from these industries. But there are available air pollutants which are SO_2 and NO_x . Data for the global pollutants can be seen in the website and it is shown in Table 1.1.

Table 7.2 List and descriptions of all the industries in Porsgrunn [32]

Industries	Description
Addcon Nordic	Manufacturer of other organic chemical raw materials

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Bilfinger Industrial Services Norway AS, Ildfast	Reparation of machines.
Diplom-Is	Manufacturer of ice cream.
Elkem Solar Herøya	Manufacturer of other inorganic chemicals.
Eramet Norway AS	Manufacturer of ferroalloys.
Herøya Industripark- Omsmelteanlegget	Manufacturer of primary aluminum.
Herøya Industripark AS	Rental or leased real estate.
Inovyn Norge AS, PVC fabriken	Manufacturer of basisplast.
KS Vestsiden Eiendom (Porsgrunn Mekaniske Verksted AS)	Rental or leased real estate.
Norcem Brevik	Manufacturer of cement.
Norsk Gjenvinning	Sorting and processing of waste for recycling.
Porsgrunn Bad A.S	Wholesale of construction materials.
Porsgrunds Porselensfabrik A.S, Avd Husholdningsporselen	Manufacturer of ceramic household and ornaments.
Renor Brevik	Treatment and disposal of hazardous waste
RHI Normag AS	Manufacturer of other inorganic chemicals.
SiC Processing	Sorting and processing of waste for recycling.
Tine Meieriet Sør	Manufacturer of dairy products.
Yara Norge AS demoanlegg ammoniumnitrat løsning	Manufacturer of fertilizers, nitrogen compounds and soil (vekstjord).
Yara Norge AS demonstrasjonsanlegg Ammoniumnitrat	Manufacturer of fertilizers, nitrogen compounds and soil (vekstjord).

7 Future Works

Yara Norge	Manufacturer of fertilizers, nitrogen compounds and soil (vekstjord).
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http://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf [Access 17.10.2016]
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Appendix A Project Description



SCE4006 Project

Title: Development of a database system for environmental and public health information

TUC supervisors: Nils-Olav Skeie and Hans-Petter Halvorsen

External partners: Tel-Tek, Telemark Hospital - Department of Occupational Medicine, and Porsgrunn municipality.

Task background:

Like other municipalities in Norway Porsgrunn municipality must implement actions to reduce the influence of climate and environmental factors. One of these actions is collecting climate and environmental information to establish the factual basis (base line), both in terms of the current situation and the effects of the planned actions. The Porsgrunn municipality wants an overview / status of greenhouse gases and pollutants in the Grenland area and wants this information to be available online.

A factual basis will have two main functions:

- Provide a factual basis for policy choices and implementation of actions,
- Information for residents in the municipality.

A factual basis will form the basis for annual updates / accounting of greenhouse gases and pollutants. Such an overview will serve several purposes like:

- Describe the current situation, and changes and trends over time,
- Highlighting the results of measures to reduce emissions of greenhouse gases and pollutants local / regional / national items organized by industry,
- Be open, easily accessible and high-quality information to the population and decision makers,
- Being a starting point for the choice of measures for decision makers,
- Be a foundation that can provide base for new industry, research and development.

Task description:

The main part of the project will be to develop a database with a flexible structure. The tasks of the project will be:

1. Overview of the type of information that should be part of such a system,
2. Evaluate technologies for databases and WEB, both licence and open-source solutions,
3. Modelling of the database,
4. Populate the database with some basic data,
5. Consider the availability of the database information,
6. Develop a prototype of a WEB based module.

Student category:

Combination of one EET student and three to four IIA students.

Practical arrangements:

Cooperation with Tel-Tek and Telemark Hospital for the information into the system.

Signatures:

Supervisor (date and signature): *Nils Jansen* 26 Sep 16

Students (date and signature): *Juulie Ay*

Students (date and signature): *Alvina Thy G. Persch*

Appendix B Minutes to Meeting

University College of Southeast Norway

Faculty of technology

Group SIV-14-16

Development of a database system for environmental and public health information

Porsgrunn 23.09.2016

To: Nils-Olav Skeie, Hans-Petter Halvorsen, Jon Hovland, Tonje Warholm Thomassen, Anne Kristin M. Fell, Lucille Ang.

PROJECT MEETING MINUTES NO.1

Present:

Nils-Olav Skeie, Jon Hovland, Tonje Warholm Thomassen, Anne Kristin M. Fell, Lucille Ang, Alexander Zhang Gjerseth.

Absent:

Hans-Petter Halvorsen

Duration of meeting: 09.00-09.35

Item 01/16 Preliminary items

1. Notice of meeting (call-in) was approved
2. Agenda was approved
3. Any other business
 - a. Arrange meeting with Porsgrunn Kommune
 - b. Date for next formal meeting
 - c. Date for final presentation

Item 02/16 Status/information items

1. Status report

Lucille presented the work done for last two weeks. Went through the information list and discussed the list. The list was prioritized and the first main focus will be air quality. The list needs approval from Porsgrunn Kommune. The focus should not only be on Porsgrunn, but the whole geographical region known as Grenland. It was suggested also to collect data about number of cars driving in Grenland.
2. The project schedule was approved.

Item 03/16 Approval and prioritizing of information

This was done in item 02/16 under status report.

Item 04/16 Evaluate Technology

Alexander informed briefly about the technology chosen for this project.

tem 05/16 Election of chair and secretary for next meeting

Alexander was chosen as chair and Lucille Ang was chosen as secretary.

Item 06/16 Any other business

- a. A meeting with Porsgrunn Kommune needs to be arranged.
- b. The date for the next formal meeting is set to 21. Of October at 09.00.
- c. Lucille and Alexander needs to talk with Inger Kristiansen to book a room for the presentation.

Secretary: Alexander Zhang Gjerseth

MØTEREFERAT

DATO: 04.10.2016

TID: 09.00-10.30

STED: Tel-Tek

TILSTEDE: Ottar Berg, Petter Ellefsen, Nils-Olav Skeie, Lucille Ang, Alexander Zhang Gjerseth, Jon Hovland, Hans Aksel Haugen, Tonje Warholm Thomassen

REFERENT: TWT

TEMA: Prioritering av klima/miljøfaktorer i studentprosjektet «development of a database system for environmental and public health information» (Årsregnskap klimagasser og miljøgifter)

Pkt.	Agenda	Ansvar
	<p>Agenda for møtet: Diskusjon rundt prioritering av input til studentprosjektet ved HSN. AOB</p> <p>Ottar startet med å fortelle litt om bakgrunnen, hensikten og målene med prosjektet.</p> <p>Det er ønskelig at databasen skal vise «kyniske, kalde tall», ikke som en rapport med synsing og tiltak etc. Databasen skal vise utviklingen over tid. Den skal være nyttig for ulike aktører; politikere, industrien, allmenheten.</p> <p>Databasen bør kunne være en fin basis for videre forskning.</p> <p>Viktig at databasen kan utvides i fremtiden. Det er ønskelig at den skal oppdateres i lang tid (50 år er nevnt)</p> <p>Ønskelig at det skilles mellom bil, industri osv når tallene legges inn.</p> <p>Luftforurensning (luftkvalitet.info) Hvor forurenset luften er, vises ved bruk av varslingsklasser med fargekoder (grønn: Lite forurensning, oransje: moderat,</p>	

	<p>rød: høy, lilla: svært høy). Lage oversikt over hvor mange dager per år som kommer inn under de ulike fargekodene.</p> <p>Grenseverdiene for de ulike fargene skal settes ned pga undervurdering av farene. Dette må det legges til rette for i databasen.</p> <p>Måleusikkerhetene må gjøres rede for/kommenteres på nettsiden.</p> <p>Norconsult har skrevet en rapport på vegne av folkehelseinstituttet. Her står det at vedfyring er en ubetydelig forurensningskilde. Ottar sender rapporten til Jon.</p> <p>Prioriteten på dette stadiet blir kildene som påvirker luftkvaliteten i Grenland. Andre interessante områder (som mikroplast, hormonhermere etc) kan det bli aktuelt å utvide databasen med på et senere tidspunkt, men per nå har man ingen målinger på dette.</p> <p>Det er ønskelig med et estimat på hva det vil koste å holde databasen oppdatert fra år til år. Det må da skilles på normalt vedlikehold og dersom databasen skal utvides eller andre områder skal forskes på.</p> <p>Neste møte: 21.10.2016. I tillegg til de vanlige deltakerne inviteres da også Petter, Ottar, Anne Kristin (YMA), Cathrine Nedberg (Porsgrunn kommune) og Preben Hjallum (ViG).</p> <p>13.12.2016, kl 8.15-09.00: Presentasjon av ferdig modell/database på HSN.</p>	<p>Ottar</p> <p>Tel-Tek</p> <p>Lucille/Alexander</p>
--	---	--

Porsgrunn, 24.11.2016

Referent: Tonje Warholm Thomassen

University College of Southeast Norway

Faculty of Technology

Group SIV-14-16,

Development of a database system for environmental and public health information

Porsgrunn 21.10.16

To: Nils-Olav Skeie, Hans-Petter Halvorsen, Jon Hovland, Tonje Warholm Thomassen, Petter Ellefsen, Ann Kristin Møller Fell, Martin Veel Svendsen, Cathrine Nedberg, Ottar Berg, Preben Hjallum, Lucille Ang, Alexander Zhang Gjerset,th

PROJECT MEETING MINUTES NO.2

Present:

Nils-Olav Skeie, Jon Hovland, Tonje Warholm Thomassen, Petter Ellefsen, Ann Kristin Møller Fell, Martin Veel Svendsen, Cathrine Nedberg, Lucille Ang, Alexander Zhang Gjerset,th

Absent: Hans-Petter Halvorsen, Ottar Berg, Preben Hjallum

Duration of meeting: 09:00 – 09:30

Secretary of the meeting: Lucille Ang

Item 08/16 Preliminary items

4. The notice of meeting (call-in) was approved.
5. The agenda was approved.
6. There was no other business.

Item 09/16 Overview of chosen data

The data being focus for the web development is the air quality from Porsgrunn Municipality. For future projects, the pollutants from the companies will be explored and the whereabouts of those measurement stations.

Item 10/16 Presentation of database model

For the database model, the table for the health effects will be written by the health specialist from the hospital and fun facts about those pollutants.

Item 11/16 Presentation of prototype of Web module

The chart will have the same pollutant with different measurement station. More information can be added in the website.

Item 12/16 Any other business

Start with the particle matter 10 and particle matter 2.5 in the website. Sources of the different pollutants can also be included in the database.

Secretary: Lucille Ang

Appendix D Prioritized list of the pollutants

Type	Beskrivelse	Kategori	Referanser	Kilder	Ar	Sammenheng	Miljø- og helseeffekter	Prioritering
PM10	Partiklene på støv mindre enn 10µm	Lokal tema luft		Vei-trafikk Dekk-sitasje, Vedfyring, Industri og Langtransportert luftforurensning, industri eksosutslipp		Svevestøv i uteluft (andre land), sykkelighet, dødelighet i befolkningen	Luftveislidelser, Hjerter- og karsykdommer, Kreft	1
PM2.5	Partiklene på støv mindre enn 2.5µm	Lokal tema luft						1
NOx	NO + NO2 = Nox som dannes med høy temperatur	Lokal tema luft	luftkvalitet.info miljøstatus.no miljødirektoratet.no	Eksosutslipp, vei-trafikk, skiptrafikk, industri, langtransportert forurensning, dieselmotorer	2009-2015	NO har reaksjon i bakkenær ozon som tiffører NO2 som er helseskadelig	Astma, bronkitt, lungefunksjon og dødelighet	1
SO2	Dannes ved forbrenning av stoffer som inneholder svovel – i hovedsak olje og kull	Lokal tema luft		Olje og kull, kraftverk		Sur Nedbør	Luftveislidelser, Hjerter- og karsykdommer, Kreft	1
Ozon	En reaktiv gass som finnes både nær bakken og i stratosfæren	Lokal tema luft		Langtransportert forurensning		Bakkenær ozon, Sur nedbør	Miljøproblem: Vegetasjon Luftveislidelser, Hjerter- og karsykdommer, Kreft	1
CO2	Det viktigste menneskeskapte bidraget til klimaendringer	Globale tema	SSB, Miljøstatus.no	Olje- og gassvirksomhet, transport og industri.	1991, 1995, 2000, 2005, 2008, 2009	CO2 bidrar mest til endring av drivhuseffekten av alle klimagasser	Klimaendringer	2
Lystgass, N2O	Den tredje viktigste naturlige klimagassen i Norge	Globale tema	SSB	Prosessutslipp, Industri, Olje og gass, Husholdninger, Vei-trafikk	1991, 1995, 2000, 2005, 2008, 2010			2
Metan, CH4		Globale tema	SSB					2
SF6	Et menneskeskapt kjemikalie, ikke reaktiv, fargeløs og luktfri, ikke brennbar, en av tyngste stoff	Globale tema	Miljøstatus.no	Strømforsyning, industri	2002-2015		Stor mengde kan redusere oksygenkonsentrasjonen i luften, Skade hjerte hos mennesker, Klimaendringer	3
Dioksiner i fjorden	komplekse kjemiske stoffer som inneholder klor, tungt nedbrytbare kjemiske stoffer	Gamle synder	Miljødirektoratet.no Norskutslipp.no	Avfallsforbrenning, ved jern- og stålbehandling samt fra kraftverk og kjøretøy	2002-2015		En stor dose dioksin kan påvirke hjertet, immunforsvaret, leveren, huden og fostre og kan være kreftfremkallende.	3
Kvikksølv	De farligste miljøgiftene vi kjenner til, og utgjør en trussel for miljøet og menneskers helse.	Gamle synder	Miljødirektoratet.no	Olje- og gassvirksomhet og metallurgisk industri	2002-2015		Alvorlig skade på nerve-, fordøyelses- og immunsystemet, samt på lunger, nyrer, hud og øyne.	3
Polyklorerte bifenyler (PCB)	Et syntetisk fremstilt stoff, to aromatiske ringer som kan ha 1-10 kloratomer koblet til seg	Gamle synder	Norskutslipp.no miljøstatus.no	Gamle produkter og materialer	1995-2013 (ikke selve Porsgrunn)		Svekket immunforsvar, øker mottakelighet for infeksjoner og sykdommer, skade nervesystemet, kreft	3

Appendix E Fact box from Sykehuset Telemark HF

Faktaboks partikkelforurensning

- Hoveddelen av partikkelforurensningen kommer fra motoriserte kjøretøyer (eksos, veidekke- og bildekkslitasje) og fra vedfyring.
- PM₁₀ er partikler med en diameter på 2.5 – 10 µ m. Slike partikler kan pustes inn, men er så store at de avsettes i de øvre luftveier.
- PM_{2.5} er partikler med diameter under 2.5 µ m. Disse partiklene kan trenge ned i de små luftveiene og avsettes der.
- Norske grenseverdier for partikkelforurensning er for PM₁₀: årsmiddel 40 µg/m³, døgnmiddel: 50 µg/m³. For PM_{2.5} oppgir myndighetene kun årsmiddel: 25 µg/m³.
- Verdens Helseorganisasjon (WHO) har anbefaler følgende grenseverdier: PM₁₀: årsmiddel 20 µg/m³, døgnmiddel: 50 µg/m³. For PM_{2.5}: 10 µg/m³ og døgnmiddel: 25 µg/m³.
- Det er kjent at luftforurensning kan gi betennelsesreaksjoner (inflammasjon) i lunger og i hjertekarsystemet.
- Det er fortsatt ikke nok informasjon om hvordan de enkelte bestanddelene i luftforurensning påvirker mennesker, men irritative, allergiske og toksiske effekter er vist.
- Helseeffekter som er assosiert med luftforurensning er hjerte-kar sykdom (spesielt hjerteinfarkt), allergi, astma, KOLS og lungekreft.
- Grupper som er spesielt sårbare er barn, eldre og personer med hjerte-kar eller lungesykdom.

Appendix F Script from the Data Modeller ERwin.

```

USE MASTER
GO
CREATE DATABASE EHTESTDB1
GO
USE EHTESTDB1
GO

CREATE TABLE [USER]
(
    [UserId]                int NOT NULL IDENTITY ,
    [UserName]              varchar(30) NULL ,
    [Password]              varchar(30) NULL ,
    CONSTRAINT [XPKUSER] PRIMARY KEY CLUSTERED ([UserId] ASC)
)
go

CREATE TABLE [COUNTRY]
(
    [CountryId]             int NOT NULL IDENTITY ,
    [Name]                  varchar(30) NULL UNIQUE,
    CONSTRAINT [XPKCOUNTRY] PRIMARY KEY CLUSTERED ([CountryId] ASC)
)
go

CREATE TABLE [AREA]
(
    [AreaId]                int NOT NULL IDENTITY ,
    [Name]                  varchar(30) NULL UNIQUE,
    [CountryId]             int NOT NULL ,
    CONSTRAINT [XPKAREA] PRIMARY KEY CLUSTERED ([AreaId] ASC,[CountryId] ASC),
    CONSTRAINT [R_2] FOREIGN KEY ([CountryId]) REFERENCES [COUNTRY]([CountryId])
        ON DELETE NO ACTION
        ON UPDATE NO ACTION
)
go

CREATE TABLE [CITY]
(
    [CityId]                int NOT NULL IDENTITY ,
    [Name]                  varchar(30) NULL ,
    [AreaId]                int NOT NULL ,
    [CountryId]             int NOT NULL ,
    CONSTRAINT [XPKCITY] PRIMARY KEY CLUSTERED ([CityId] ASC,[AreaId]
ASC,[CountryId] ASC),

```

```

        CONSTRAINT [R_3] FOREIGN KEY ([AreaId],[CountryId]) REFERENCES
[AREA]([AreaId],[CountryId])
        ON DELETE NO ACTION
        ON UPDATE NO ACTION
    )
go

CREATE TABLE [MEASUREMENTSTATION]
(
    [MeasurementStationId] int NOT NULL IDENTITY ,
    [Name] varchar(30) NULL ,
    [Longitude] float NULL ,
    [Latitude] float NULL ,
    [CityId] int NULL ,
    [AreaId] int NULL ,
    [CountryId] int NULL ,
    CONSTRAINT [XPKMEASUREMENTSTATION] PRIMARY KEY CLUSTERED
([MeasurementStationId] ASC),
    CONSTRAINT [R_21] FOREIGN KEY ([CityId],[AreaId],[CountryId]) REFERENCES
[CITY]([CityId],[AreaId],[CountryId])
        ON DELETE NO ACTION
        ON UPDATE NO ACTION
)
go

CREATE TABLE [MEASUREMENTGROUP]
(
    [MeasurementGroupId] int NOT NULL IDENTITY ,
    [Name] varchar(30) NULL ,
    [Description] varchar(200) NULL ,
    CONSTRAINT [XPKMEASUREMENTGROUP] PRIMARY KEY CLUSTERED ([MeasurementGroupId]
ASC)
)
go

CREATE TABLE [MEASUREMENTUNITGROUP]
(
    [MeasurementUnitGroupId] int NOT NULL IDENTITY ,
    [Name] varchar(30) NULL ,
    [Description] varchar(200) NULL ,
    CONSTRAINT [XPKMEASUREMENTUNITGROUP] PRIMARY KEY CLUSTERED
([MeasurementUnitGroupId] ASC)
)
go

CREATE TABLE [MEASUREMENTUNIT]
(
    [MeasurementUnitId] int NOT NULL IDENTITY ,

```

```

[Property]          varchar(30) NULL ,
[Scaling]           float NULL ,
[Description]       varchar(200) NULL ,
[MeasurementUnitGroupId] int NULL ,
CONSTRAINT [XPKMEASUREMENTUNIT] PRIMARY KEY CLUSTERED ([MeasurementUnitId]
ASC),
CONSTRAINT [R_20] FOREIGN KEY ([MeasurementUnitGroupId]) REFERENCES
[MEASUREMENTUNITGROUP]([MeasurementUnitGroupId])
ON DELETE NO ACTION
ON UPDATE NO ACTION
)
go

```

```

CREATE TABLE [MEASUREMENTTYPE]
(
[MeasurementTypeId] int NOT NULL IDENTITY ,
[Name]              varchar(30) NULL ,
[Description]       varchar(200) NULL ,
[Acronym]           varchar(10) NULL ,
[MeasurmentGroupId] int NULL ,
[MeasurementUnitId] int NULL ,
CONSTRAINT [XPKMEASUREMENTTYPE] PRIMARY KEY CLUSTERED ([MeasurementTypeId]
ASC),
CONSTRAINT [R_17] FOREIGN KEY ([MeasurmentGroupId]) REFERENCES
[MEASURMENTGROUP]([MeasurmentGroupId])
ON DELETE NO ACTION
ON UPDATE NO ACTION,
CONSTRAINT [R_19] FOREIGN KEY ([MeasurementUnitId]) REFERENCES
[MEASUREMENTUNIT]([MeasurementUnitId])
ON DELETE NO ACTION
ON UPDATE NO ACTION
)
go

```

```

CREATE TABLE [EMISSIONSOURCE]
(
[EmissionSourceId] int NOT NULL ,
[Name]              VARCHAR(30) NULL UNIQUE,
[Description]       VARCHAR(200) NULL ,
[CityId]            int NULL ,
[AreaId]            int NULL ,
[CountryId]         int NULL ,
CONSTRAINT [XPKEMISSIONSOURCE] PRIMARY KEY CLUSTERED ([EmissionSourceId]
ASC),
CONSTRAINT [R_22] FOREIGN KEY ([CityId],[AreaId],[CountryId]) REFERENCES
[CITY]([CityId],[AreaId],[CountryId])
ON DELETE NO ACTION
ON UPDATE NO ACTION
)

```

```

)
go

CREATE TABLE [MEASUREMENT]
(
    [MeasurementId]      int NOT NULL IDENTITY ,
    [Value]              float NULL ,
    [TimeStamp]          DateTime NULL ,
    [MeasurementStationId] int NULL ,
    [MeasurementTypeId] int NULL ,
    [EmissionSourceId]  int NULL ,
    [LimitValue]        float NULL ,
    CONSTRAINT [XPKMEASUREMENT] PRIMARY KEY CLUSTERED ([MeasurementId] ASC),
    CONSTRAINT [R_15] FOREIGN KEY ([MeasurementStationId]) REFERENCES
[MEASUREMENTSTATION]([MeasurementStationId])
        ON DELETE NO ACTION
        ON UPDATE NO ACTION,
    CONSTRAINT [R_16] FOREIGN KEY ([MeasurementTypeId]) REFERENCES
[MEASUREMENTTYPE]([MeasurementTypeId])
        ON DELETE NO ACTION
        ON UPDATE NO ACTION,
    CONSTRAINT [R_23] FOREIGN KEY ([EmissionSourceId]) REFERENCES
[EMISSIONSOURCE]([EmissionSourceId])
        ON DELETE NO ACTION
        ON UPDATE NO ACTION
)
go

CREATE TABLE [HEALTHEFFECTGROUP]
(
    [HealthEffectGroupId] int NOT NULL IDENTITY ,
    [Name]                 varchar(30) NULL ,
    [Description]          varchar(200) NULL ,
    CONSTRAINT [XPKHEALTHEFFECTGROUP] PRIMARY KEY CLUSTERED
([HealthEffectGroupId] ASC)
)
go

CREATE TABLE [HEALTHEFFECT]
(
    [HealthEffectId]      int NOT NULL ,
    [Type]                 varchar(30) NULL ,
    [Description]          varchar(200) NULL ,
    [HealthEffectGroupId] int NOT NULL IDENTITY ,
    CONSTRAINT [XPKHEALTHEFFECT] PRIMARY KEY CLUSTERED ([HealthEffectId] ASC),
    CONSTRAINT [R_18] FOREIGN KEY ([HealthEffectGroupId]) REFERENCES
[HEALTHEFFECTGROUP]([HealthEffectGroupId])
        ON DELETE NO ACTION

```

```
        ON UPDATE NO ACTION
    )
go

CREATE TABLE [ANNUALDATA]
(
    [Year]                int NOT NULL ,
    [Average]             float NULL ,
    [Sum]                 float NULL ,
    [LimitValue]         float NULL ,
    [MeasurementTypeId]  int NOT NULL ,
    CONSTRAINT [XPKYEARLYSTATISTICS] PRIMARY KEY CLUSTERED ([Year]
ASC,[MeasurementTypeId] ASC),
    CONSTRAINT [R_26] FOREIGN KEY ([MeasurementTypeId]) REFERENCES
[MEASUREMENTTYPE]([MeasurementTypeId])
        ON DELETE NO ACTION
        ON UPDATE NO ACTION
)
go
```

Appendix G Script of the necessary information

```
/*Feil om første kjøring, kjør to ganger*/
USE EHTESTDB2 --EMISSIONSOURCE AND ANNUALDATA DOESNT GENERATE IDENTITY.
GO

--DELETING PREVIOUS INFORMATION
DELETE FROM EMISSIONSOURCE
GO
DBCC CHECKIDENT ('EMISSIONSOURCE', RESEED, 0)
GO
DELETE FROM MEASUREMENTSTATION
GO
DBCC CHECKIDENT ('MEASUREMENTSTATION', RESEED, 0)
GO
DELETE FROM CITY
GO
DBCC CHECKIDENT ('CITY', RESEED, 0)
GO
DELETE FROM AREA
GO
DBCC CHECKIDENT ('AREA', RESEED, 0)
GO
DELETE FROM COUNTRY
GO
DBCC CHECKIDENT ('COUNTRY', RESEED, 0)
GO
DELETE FROM MEASUREMENTTYPE
GO
DBCC CHECKIDENT ('MEASUREMENTTYPE', RESEED, 0)
GO
DELETE FROM MEASUREMENTGROUP
GO
DBCC CHECKIDENT ('MEASUREMENTGROUP', RESEED, 0)
GO
DELETE FROM MEASUREMENTUNIT
GO
DBCC CHECKIDENT ('MEASUREMENTUNIT', RESEED, 0)
GO
DELETE FROM MEASUREMENTUNITGROUP
GO
DBCC CHECKIDENT ('MEASUREMENTUNITGROUP', RESEED, 0)
GO
DELETE FROM ANNUALDATA
GO
DBCC CHECKIDENT ('ANNUALDATA', RESEED, 0)
```

GO

--COUNTRY TABLE INFO

INSERT INTO COUNTRY(Name) VALUES ('Norway')

--AREA TABLE INFO

INSERT INTO AREA(Name, CountryId) VALUES ('Grenland', 1)

--CITY TABLE INFO

INSERT INTO CITY(Name, AreaId, CountryId) VALUES ('Porsgrunn', 1, 1)

INSERT INTO CITY(Name, AreaId, CountryId) VALUES ('Skien', 1, 1)

--MEASUREMENTSTATION TABLE INFO

INSERT INTO MEASUREMENTSTATION(Name, Longitude, Latitude, CityId, AreaId, CountryId)
VALUES ('Sverresgate Målestasjon', 9.652195, 59.138162, 1, 1, 1)

INSERT INTO MEASUREMENTSTATION(Name, Longitude, Latitude, CityId, AreaId, CountryId)
VALUES ('Øyekast Målestasjon', 9.642207, 59.129194, 1, 1, 1)

INSERT INTO MEASUREMENTSTATION(Name, Longitude, Latitude, CityId, AreaId, CountryId)
VALUES ('Lensmannsdalen Målestasjon', 9.635742, 59.159296, 2, 1, 1)

INSERT INTO MEASUREMENTSTATION(Name, Longitude, Latitude, CityId, AreaId, CountryId)
VALUES ('Haukenes Målestasjon', 9.48708966, 59.20243518, 2, 1, 1)

INSERT INTO MEASUREMENTSTATION(Name, Longitude, Latitude, CityId, AreaId, CountryId)
VALUES ('Furulund Målestasjon', 9.69563115, 59.05730396, 1, 1, 1)

--MEASUREMENTGROUP TABLE INFO

INSERT INTO MEASUREMENTGROUP(Name, Description) VALUES ('Air Quality', 'Contains types
of data related to Air Quality.')

INSERT INTO MEASUREMENTGROUP(Name, Description) VALUES ('Global Pollution', 'Global
pollutant problem.')

INSERT INTO MEASUREMENTGROUP(Name, Description) VALUES ('Old Pollution', 'The
pollutants that was used long time ago.')

--MEASUREMENTUNITGROUP TABLE INFO

INSERT INTO MEASUREMENTUNITGROUP(Name, Description) VALUES ('Density', 'Mass divided
by volume')

INSERT INTO MEASUREMENTUNITGROUP(Name, Description) VALUES ('Mass', 'Mass of
substance')

--MEASUREMENTUNIT TABLE INFO

INSERT INTO MEASUREMENTUNIT(Property, Description, Scaling, MeasurementUnitGroupId)
VALUES ('ug/m^3', 'Micro gram per cubic meter', 0, 1)

--MEASUREMENTTYPE TABLE INFO

INSERT INTO

MEASUREMENTTYPE(Name, Description, Acronym, MeasurementGroupId, MeasurementUnitId) VALUES
('Nitrogen dioxide', 'An intermediate in the industrial synthesis of nitric acid,
millions of tons of which are produced each year.', 'NO2', 1, 1)

```

INSERT INTO
MEASUREMENTTYPE(Name,Description,Acronym,MeasurmentGroupId,MeasurementUnitId) VALUES
('NOx','Combination of NO and NO2 that is formed in a high temperature.','NOx',1,1)
INSERT INTO
MEASUREMENTTYPE(Name,Description,Acronym,MeasurmentGroupId,MeasurementUnitId) VALUES
('Sulfur Dioxide','Formed by combustion by sulphurous materials mainly oil and
coal.','SO2',1,1)
INSERT INTO
MEASUREMENTTYPE(Name,Description,Acronym,MeasurmentGroupId,MeasurementUnitId) VALUES
('Particulate Matter 10','Dust particles smaller than 10µm.','PM10',1,1)
INSERT INTO
MEASUREMENTTYPE(Name,Description,Acronym,MeasurmentGroupId,MeasurementUnitId) VALUES
('Particulate Matter 2.5','Dust particles smaller than 2.5µm.','PM2.5',1,1)
INSERT INTO
MEASUREMENTTYPE(Name,Description,Acronym,MeasurmentGroupId,MeasurementUnitId) VALUES
('Ozone','A reactive gas that exist both near the ground and in the
stratosphere.','O3',1,1)
--EMISSIONSOURCE TABLE INFO
INSERT INTO EMISSIONSOURCE(Name,Description,CityId, AreaId, CountryId) VALUES
('Porsgrunn Municipality','Measures the local quality in air',1,1,1)

```

Appendix I Code for the website

Index.php,

```
1 <!DOCTYPE html>
2 <html lang="no">
3 <head>
4 <meta charset="UTF-8">
5 <meta name="viewport" content="width=device-width, initial-scale=1.0">
6 <title>Miljø og helse</title>
7 <link rel="icon" type="image/ico" href="favicon.ico">
8 <script src="http://ajax.googleapis.com/ajax/libs/jquery/1.7.1/jquery.min.js"
type="text/javascript"></script>
9 <link href="CSS/main.css" rel="stylesheet" type="text/css"> <!-- includes the javascript for the chart
(HIGHCHARTS) -->
10 <script src="http://code.highcharts.com/highcharts.js"></script>
11 </head>
12
13 <body>
14 <form>
15 <div class="image-container" style="background-image: url('IMG/GRENLAND.png')">
16 </div>
17
18
19 <?php
20 include 'includes/nav.php';
21
22 ?>
23 <div id="mainB">
24
25
26 <article>
27 <h1>Dette er en webside med forurensingstall for Grenland</h1>
28
29
30 </article>
31 </div>
32 </body>
33 </html>
```

Main.css

```

1 @charset "utf-8";
2 /* CSS Document */
3 body{
4 background-color: #282931;
5
6 }
7 .image-container {
8 padding-bottom: 56.25%;
9 background-size: cover;
10 background-position: top;
11 }
12
13 header {
14 font-family: Verdana, Geneva, sans-serif;
15 background-color: #494949;
16 margin: 0px;
17 padding: -5px;
18 position: relative;
19 top: -11px;
20 overflow: auto;
21 width: 100%;
22 height: 65px;
23 text-align: center;
24 vertical-align: bottom;
25 }
26 footer {
27 position: fixed;
28 height: 40;
29 width: 100%;
30 bottom: 0px;
31 text-align: center;
32 vertical-align: middle;
33 }
34
35 #mainB {
36 min-height: 500px;
37 margin: 0px;
38 padding: 0px;
39 display: flex;
40 flex-direction: column;
41 }
42
43
44 #mainB > article {
45 flex: 1 0 0;
46 min-height: 300px;
47 margin: 30px;
48 padding: 5px;
49 border: 1px solid #e6e6e6;
50 border-radius: 7pt;
51 background-image: url(..IMG/tile.png);
52 background-repeat: repeat;
53 background-color: #FFF;
54 font-family: Arial, Helvetica, sans-serif;
55 }
56 #mainB > #map {
57 flex: 2 0 0;
58 margin: 4px;
59 padding: 5px;

```

```

60 }
61 #mainB > #graph1 {
62 flex: 1;
63 margin: 4px;
64 padding: 5px;
65 }
66
67 /* Remove margins and padding from the list, and add a black background color */
68 ul.topnav {
69 list-style-type: none;
70 margin: 0;
71 padding: 5;
72 min-height:45px;
73 border: 2px solid #f1f1f1;
74 border-radius: 7pt;
75 overflow: hidden;
76 background-color: #dfdfdf;
77 font-family: Arial, Helvetica, sans-serif;
78 }
79
80 /* Float the list items side by side */
81 ul.topnav li {float: left;}
82
83 /* Hide the list item that contains the link that should open and close the topnav on small screens */
84 ul.topnav li.icon {display: none;}
85
86 ul.topnav li a, .dropbtn {
87 display: inline-block;
88 color: #FFFFFF;
89 text-align: center;
90 padding: 14px 16px;
91 text-decoration: none;
92 }
93 ul.topnav li a:hover, .dropdown:hover .dropbtn {
94 background-color:#707070 ;
95 }
96 ul.topnav li.dropdown {
97 display: block;
98 }
99 .dropdown-content {
100 display: none;
101 position: absolute;
102 background-color: #f9f9f9;
103 min-width: 160px;
104 box-shadow: 0px 8px 16px 0px rgba(0,0,0,0.2);
105 }
106 .dropdown-content a {
107 color: black;
108 padding: 12px 16px;
109 text-decoration: none;
110 display: block;
111 text-align: left;
112 }
113 .dropdown-content a:hover {background-color: #f1f1f1}
114 .dropdown:hover .dropdown-content {
115 display: flex;
116 flex-direction: column;
117 }
118
119

```

```

120
121 /* When the screen is less than 680 pixels wide, hide all list items, except for the first one
("Home"). Show the list item that contain
ns the link to open and close the topnav (li.icon) */
122 @media screen and (max-width:680px) {
123 ul.topnav li:not(:first-child) {display: none;}
124 ul.topnav li.icon {
125 float: right;
126 display: inline-block;
127 }
128 #mainB {
129 flex-direction: column;
130 }
131
132 #main > article, #graph1{
133 /* Return them to document order */
134 order: 0;
135 align-items: center;
136 }
137
138 #main > nav, #main > aside, header, footer {
139 min-height: 50px;
140 max-height: 50px;
141 }
142
143 }
144
145 /* The "responsive" class is added to the topnav with JavaScript when the user clicks on the icon.
This class makes the topnav look
ok good on small screens */
146 @media screen and (max-width:680px) {
147 ul.topnav.responsive {position: relative;}
148 ul.topnav.responsive li.icon {
149 position: absolute;
150 right: 0;
151 top: 0;
152 }
153 ul.topnav.responsive li {
154 float: none;
155 display: inline;
156 }
157 ul.topnav.responsive li a {
158 display: block;
159 text-align: left;
160 }
161 }
162
163 }
164
165
166
167

```

Nav.php

```

1 <ul id="myTopnav" class="topnav">
2 <li><a href="index.php" >Hjem</a> </li>
3 <li><a href="#">Contact</a></li>
4 <li class="dropdown">
5 <a href="#" class="dropbtn">Luftforurensing</a>
6 <div class="dropdown-content">
7 <a href="NO2.php">NO2</a>
8 <a href="NOX.php">NOx</a>
9 <a href="PM10.php">PM10</a>
10 <a href="PM2dot5.php">PM2.5</a>
11 <a href="SO2.php">SO2</a>
12 </div>
13 </li>
14 <li class="icon">
15 <a href="javascript:void(0);" onclick="myFunction()">&#9776;</a>
16 </li>
17 </ul>
18 <script>
19 /* Toggle between adding and removing the "responsive" class to topnav when the user clicks on
the icon */
20 function myFunction() {
21 var x = document.getElementById("myTopnav");
22 if (x.className === "topnav") {
23 x.className += " responsive" ;
24 } else {
25 x.className = "topnav" ;
26 }
27 }
28 </script>

```

PM10.php

```

1 <!doctype html>
2 <html lang="no">
3 <head>
4 <meta charset="utf-8">
5 <meta name="viewport" content="width=device-width, initial-scale=1.0">
6 <title>Miljø og helse</title>
7
8 <link rel="icon" type="image/ico" href="favicon.ico">
9 <script src="http://ajax.googleapis.com/ajax/libs/jquery/1.7.1/jquery.min.js"
type="text/javascript"></script>
10 <link href="CSS/main.css" rel="stylesheet" type="text/css">
11 <script src="http://code.highcharts.com/highcharts.js"></script>
12 </head>
13 <?php
14 include 'includes/nav.php';
15
16 ?>
17
18 <div id="mainB">
19 <script> <!--this is the script for defining the trend, I am using HighCharts-->
20 $(function () {
21 var myChart = Highcharts.chart('graph1', {
22 chart : {
23 type: 'line' <!--Type of chart-->
24 },
25
26 credits: {
27 enabled : false <!--Hides the highcharts logo-->
28 },
29 title: {
30 text : 'PM10'
31 },
32 subtitle: {
33 text : "
34 },
35 scrollbar: {
36 enabled : true
37 },
38
39
40 xAxis: {
41 type: 'datetime' , <!--Sets type on xaxis to datetime-->
42 },
43 yAxis: {
44 title : {
45 text : 'PM10 (µg/m^3)'
46 },
47
48
49 },
50 tooltip: {
51 enabled : true,
52 formatter: function() {
53 return '<b>' + this.series.name + '</b><br/>' + <!--Formats the tooltip datetime format p-->
54 Highcharts.dateFormat('%e.%b.%Y %H:%M:%S',
55 new Date(this.x))
56 + ', ' + this.y + 'ug/m^3';
57 }
58 },

```

```

59 plotOptions: {
60 line : {
61 dataLabels : {
62 enabled : true
63 },
64 enableMouseTracking: true
65 }
66 },
67 series: [{
68 name: 'PM10 Lensmannsdalen' ,
69 color : '#ffae00' ,
70 dashStyle : 'ShortDash' ,
71
72 data:[ <?php
73 //Connecting to database
74 $servername = "azg.asuscomm.com,49172" ;
75 $connectInfo = array ("Database" =>"EHTESTDB2", "UID" =>"sa" ,"PWD" =>"hitsce" );
76 $con = sqlsrv_connect ($servername , $connectInfo );
77
78
79 //Error connecting?
80 if (!$con )
81 {
82 echo ("Failed to connect to MSSQL: " );
83 }
84 $sql = "SELECT Value, TimeStamp FROM MEASUREMENT WHERE MeasurementTypeId = 4
AND Value <> -9
900" ; //SQL query
85 $result = sqlsrv_query ($con , $sql ); // answer from query
86
87 while ($row =sqlsrv_fetch_array ($result ))
88 {
89 $TimeStamp = $row ['TimeStamp' ];
90 $UTS = $TimeStamp ->getTimestamp ();
91 $UTS *= 1000;
92 echo (" [$UTS," . $row ['Value' ]."," ); // writes out each point for setpoint
93 }
94 sqlsrv_close ($con );
95 ?>]}
96
97 ]
98 });
99 });
100
101
102
103 </script>
104 <article>
105 <h1>Lensmannsdalen Målestasjon: Particulate Matter 10</h1>
106 <h3> Fakta om PM</h3>
107 <?php
108 $servername = "azg.asuscomm.com,49172";
109 $connectInfo = array("Database"=>"EHTESTDB2", "UID"=>"sa", "PWD"=>"hitsce");
110 $con = sqlsrv_connect($servername,$connectInfo);
111
112 if (!$con)
113 {
114 echo("Failed to connect to MSSQL: ");
115 }

```

```
116 $sql = "SELECT Description FROM HEALTHEFFECT WHERE HealthEffectGroupId = 1"; //SQL
query
117 $result = sqlsrv_query($con,$sql); // answer from query
118
119 echo '<ul>';
120
121 while($data = sqlsrv_fetch_array( $result, SQLSRV_FETCH_ASSOC)) {
122 echo utf8_encode('<li>'.implode(' ', $data).'</li>');
123 }
124
125 echo '</ul>';
126 ?>
127 </article>
128 <article>
129 <iframe
130 width="100%"
131 height="300px"
132 frameborder="0" style="border:0"
133 src="https://www.google.com/maps/embed/v1/search?key=#####3oVzJjibhk0qdbfys6IEc7Djfa-
eOQak
134 &q=59.159296,9.635742" allowfullscreen></iframe>
135 </article>
136 <div id="graph1"></div>
137 </div>
138 </html>
139
```