EU-MERCI

EU coordinated **ME**thods and procedures based on **R**eal **C**ases for the effective implementation of policies and measures supporting energy efficiency in the **I**ndustry

HORIZON 2020 Project Nr. 693845

EU-MERCI Database

Deliverable D2.2 – EU-MERCI Database

Version: 1.2

WP2: Implementation of the Data Repository

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NOTES:

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For more information on the project EU-MERCI, link to http://www.eumerci.eu

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Abstract

The deliverable D2.2 summarizes the work related to Task 2.2 (Development of the EU MERCI Database) of WP2, which aims at implementing the EU-Merci Database. The objective of the EU-MERCI Database is to organise and store the available information in a way that ensures the traceability of the data and the simple access to it, while providing, at the same time, functionality for further analysis and elaboration. To this purpose, the definition and setup of two Database layers, the intermediate and higher layer have been implemented.

The lower layer of the EU-MERCI Database was implemented in Task 2.1 and is the Repository which contains aggregated data from the elaborations of the original data. The information that is stored in the Repository is related to the real implementation of Energy Efficiency projects in industry, provided by the EU-MERCI "Enablers". The tools are MS ACCESS .mdb files which could be transferred to dropbox or sent by e-mail for population.

The intermediate layer is the EU-MERCI Database itself. The architecture of the database was based on the criteria extracted from the analysis of WP3. It is a web database that contains the merged data sets (provided by the Enablers) of all the selected sectors, with associated Key Performance Indicators (KPIs); it is organized sector-by-sector and it is accessible by an external end-user, through selected filters and queries. The obtained result can be downloaded in excel and other formats. In comparison to the Repository, the intermediate layer has been developed in MYSQL and can be accessed at the following link www.cres.gr/merci2.

The higher Layer of the EU-MERCI database is the EU-MERCI Portal that is being developed to host both the EU-MERCI Database and Library.

The EU-MERCI Library is a document library, containing the schematics of the processes and the reports describing the EU-MERCI selected "Good Practices" and the "Best practices" from literature for each specific sector and process and related supporting documents, either from reference literature or elaborated on purpose by the consortium.

This report describes the finalisation process of the Repository and the development and the features of both the EU-MERCI Database and the EU-MERCI Portal.

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List of Abbreviations and Acronyms

Abbreviation/Acronym	Meaning
DB	Database
Repository	The lower layer, the preliminary version of the EU-MERCI database for data population on MS ACCESS
EU-MERCI Database	The intermediate layer, the server based version of the EU-MERCI database on MYSQL
EU-MERCI Portal	The higher layer, the integration of the EU-MERCI Database with the "Good practices" and "Best practices" Document Library on a Web portal
Enablers	RSE for Italy, KAPE for Poland, AEA for Austria and Carbon Trust for the UK
Netbeans	A software development platform written in Java.
mdb	MS ACCESS database file
WPX	EU-MERCI Work Package X
National data sets or databases	The database that each ENABLER owns and consists of Audits of Energy Efficiency measures implemented in industry in his own country

1 Finalisation of the Repository

1.1 Background

The lower level of the EU-MERCI Database is the Repository: it has been developed in a Database Management System (DBMS) and, for the Enablers' convenience, the MS Access DBMS was chosen. The development of the Repository has been started on a previous task and the activities performed in such a task have been reported in D2.1. This paragraph is a background to connect the initial development with the final version of the EU-MERCI database, described in this report.

To allow a simpler data population by the different partners, CRES created ACCESS database files with blank repository tables to be used as the "data-collector-tool" for each data provider. Moreover, a document containing the instructions for the populations and an excel file automatically calculating the KPIs were also produced, respectively, by CRES and RSE for the convenience of the partners.

The population of the Repository with the data from the National data sets revealed a lot of difficulties and problems regarding the harmonisation of data, the common elaboration and the restrictions of the validation procedure. As a result, the structure of the Repository was changed several times in order to be updated with the new tables and taxonomies and finally tested again: therefore, this report is also an update of the development and finalisation of the Repository.

The final version of the Repository is a table with 81 fields, according to the initial datasets from the Enablers' National data sets and the harmonization of information done in WP3. Each fields has compiled validations rules (a list of predefined entry values), in order to ensure data integrity and reliability.

1.2 Prefinal version

The criteria and taxonomy of the EU-MERCI Repository structure was based on an excel file that was produced for the common data collection (see Annex 2 for the list of the fields). Each Enabler had to convert the national data from its National dataset to this harmonized set of data fields complying with the restrictions of the columns and values (the details of the National datasets in the four countries (AT, IT, PL and UK) and the description of the data harmonization process are reported in D3.2). The population with data of this file revealed the necessity of creating new columns with normalized values[1], to reduce data redundancy and improve data integrity.

[1] Database Normalization is the process of organizing the columns (attributes) and tables (relations) of a relational database to improve data integrity and thus achieve the optimum structure. There are two goals of the normalization process: eliminating redundant data (for example, storing the same data in more than one table) and ensuring data dependencies make sense (only storing related data in a table). Both of these are worthy goals as they reduce the amount of space a database consumes and ensure that data is logically stored (https://en.wikipedia.org/wiki/Database_normalization).

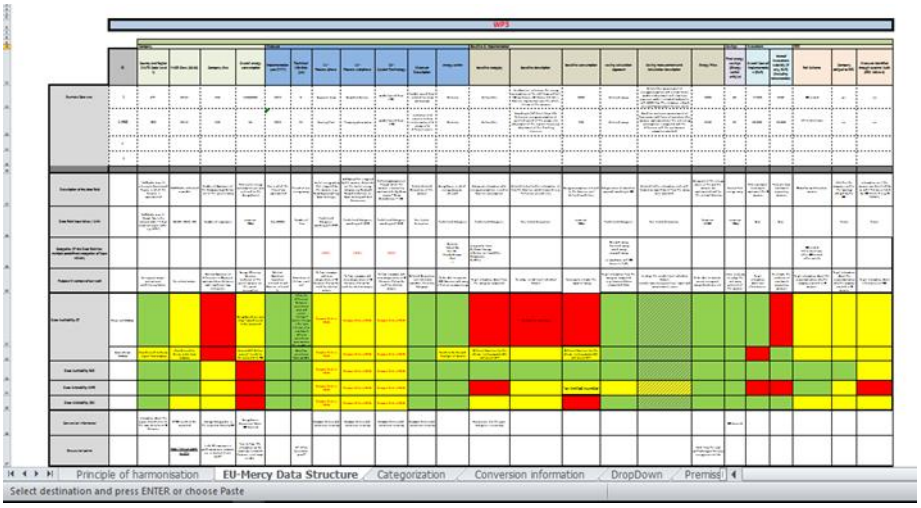


Figure 1: the common excel file for the data harmonization.

For each data field in the excel file, a fixed format (text, number etc.) for the data entry was defined. The excel was then converted into an .mdb format in order to serve as a direct input file for the Repository.

Each column of the excel is a field on the mdb: for the normalized columns, an extra field was created both on the excel and the .mdb. Each field then was defined and received attributes and validation rules.

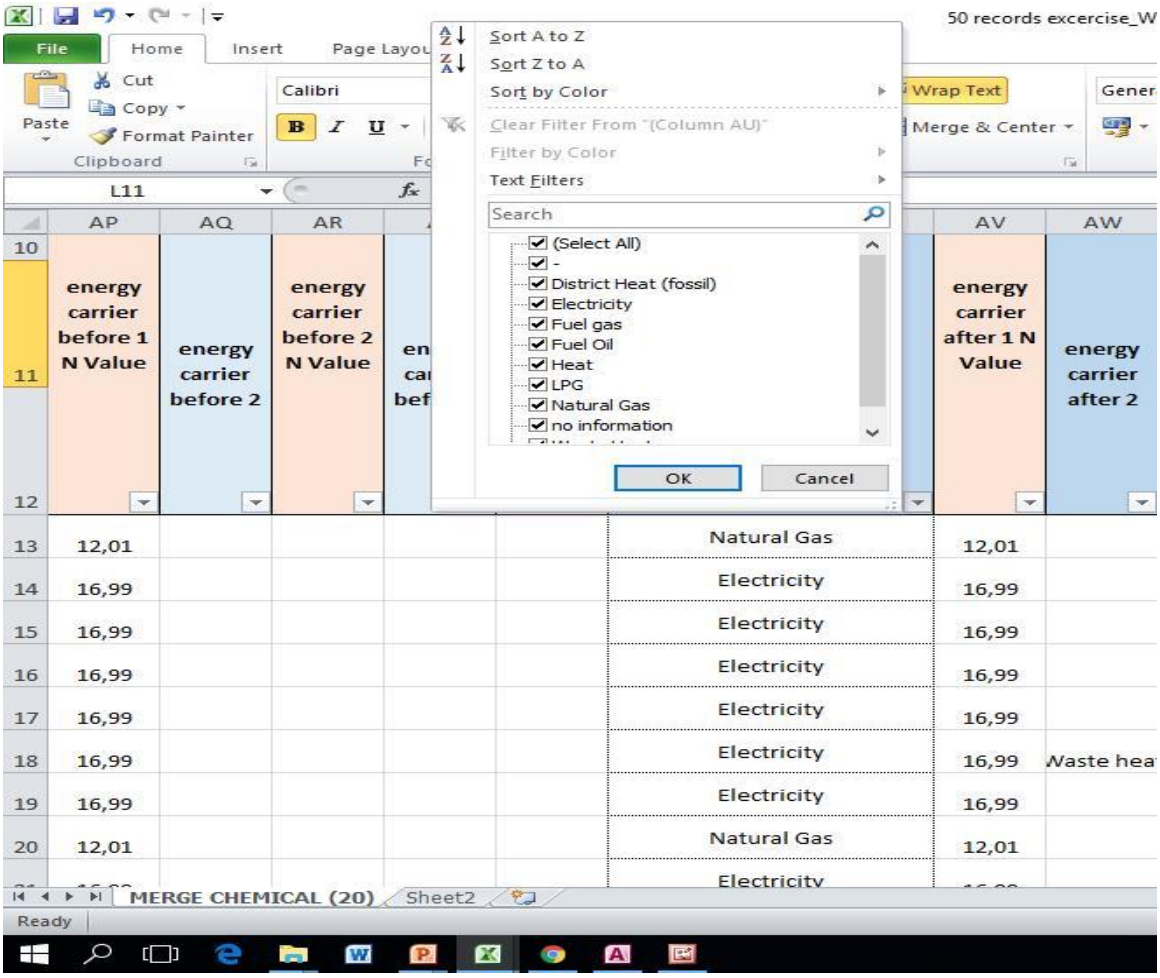


Figure 2: Analysis of the data from the enablers' exercise, as an .mdb file.

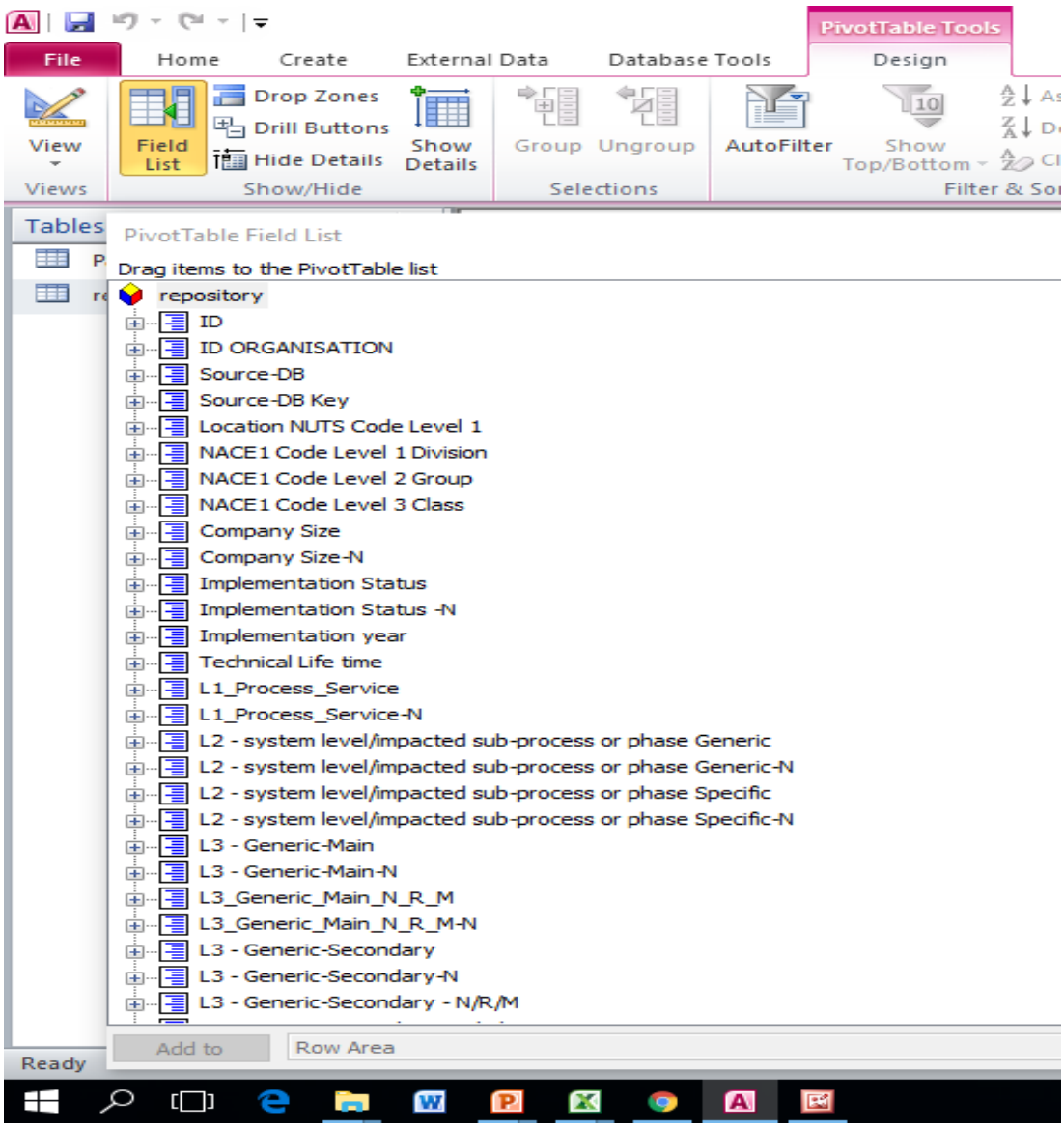


Figure 3: Creation of the fields on the Repository table.

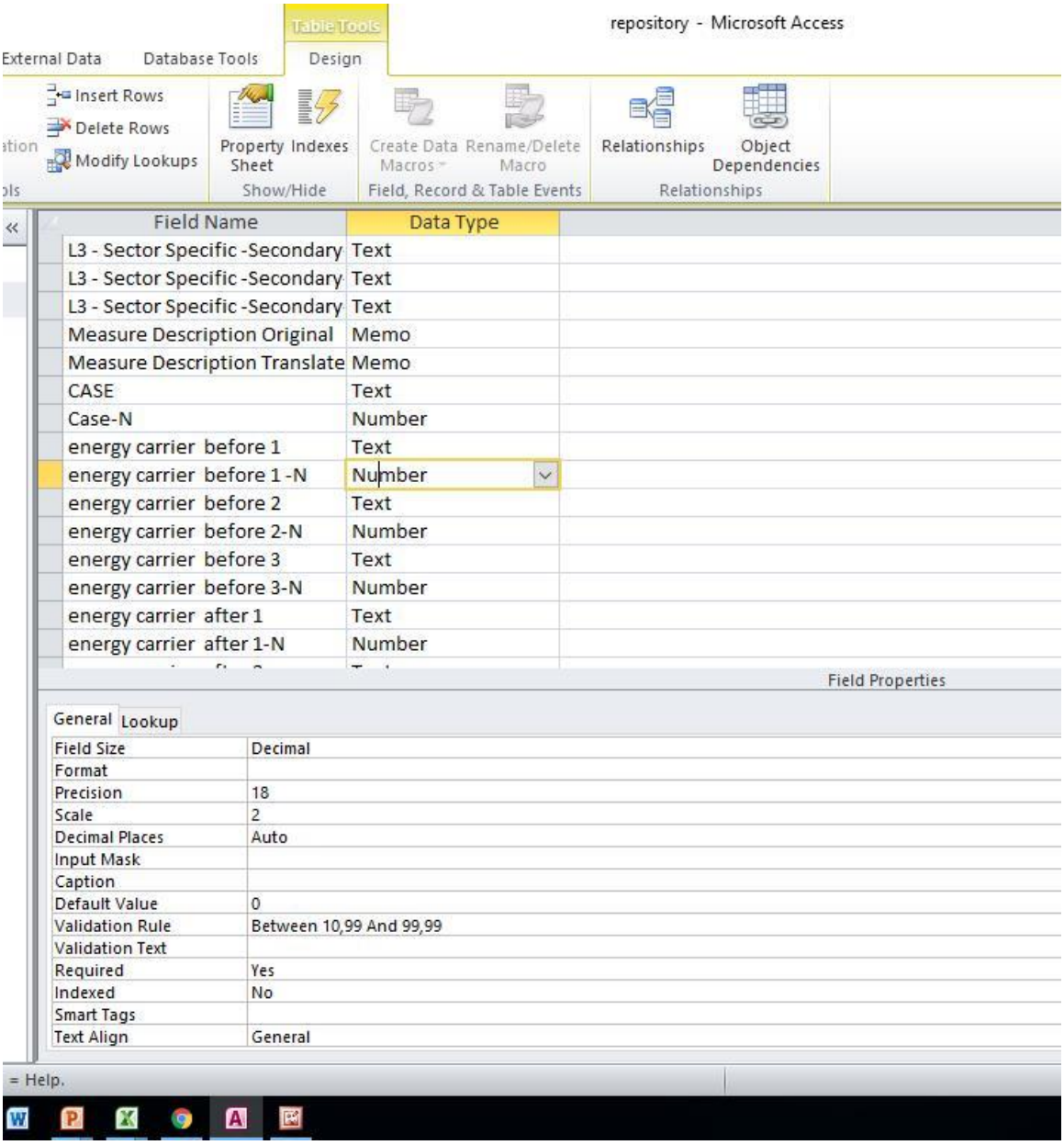
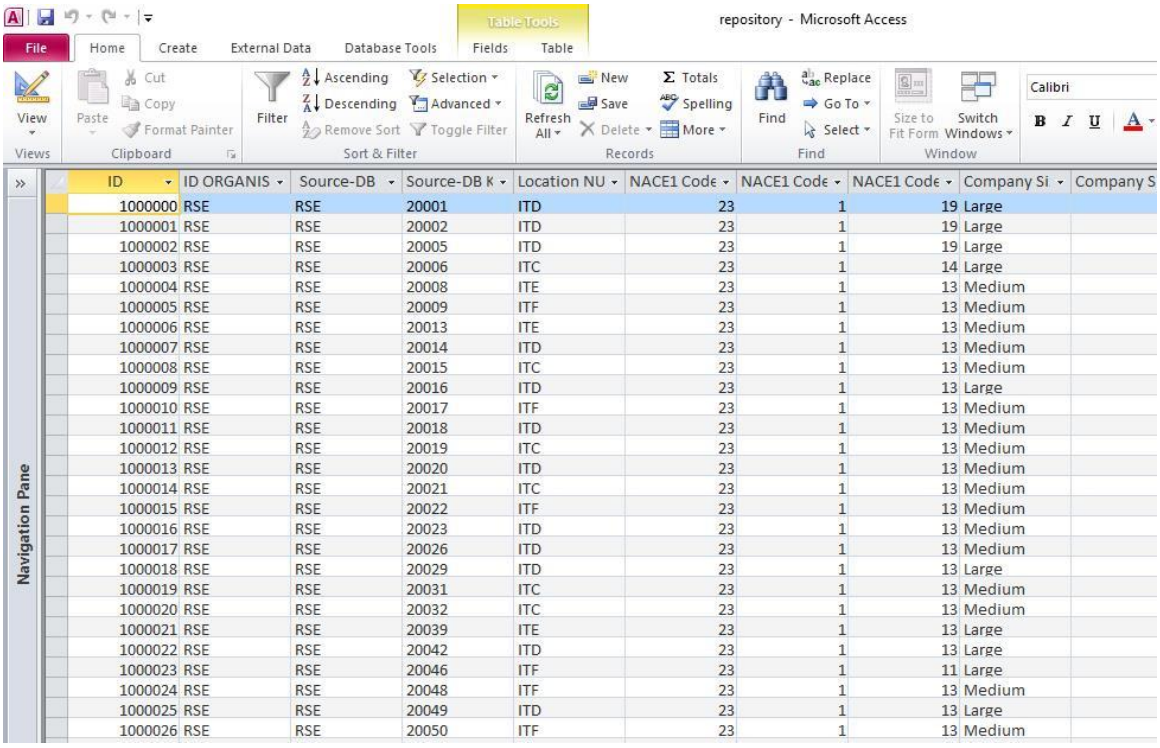


Figure 4: Definition and properties of each field in the Repository.

The Repository then, was tested, adjusted and validated with the data for each of the four countries. This circle had to be repeated several times before the final data migration – import – transfer from mdb to mysql.



ID	ID ORGANIS	Source-DB	Source-DB K	Location NU	NACE1 Code	NACE1 Code	NACE1 Code	Company Si	Company S
1000000	RSE	RSE	20001	ITD	23	1	19	Large	
1000001	RSE	RSE	20002	ITD	23	1	19	Large	
1000002	RSE	RSE	20005	ITD	23	1	19	Large	
1000003	RSE	RSE	20006	ITC	23	1	14	Large	
1000004	RSE	RSE	20008	ITE	23	1	13	Medium	
1000005	RSE	RSE	20009	ITF	23	1	13	Medium	
1000006	RSE	RSE	20013	ITE	23	1	13	Medium	
1000007	RSE	RSE	20014	ITD	23	1	13	Medium	
1000008	RSE	RSE	20015	ITC	23	1	13	Medium	
1000009	RSE	RSE	20016	ITD	23	1	13	Large	
1000010	RSE	RSE	20017	ITF	23	1	13	Medium	
1000011	RSE	RSE	20018	ITD	23	1	13	Medium	
1000012	RSE	RSE	20019	ITC	23	1	13	Medium	
1000013	RSE	RSE	20020	ITD	23	1	13	Medium	
1000014	RSE	RSE	20021	ITC	23	1	13	Medium	
1000015	RSE	RSE	20022	ITF	23	1	13	Medium	
1000016	RSE	RSE	20023	ITD	23	1	13	Medium	
1000017	RSE	RSE	20026	ITD	23	1	13	Medium	
1000018	RSE	RSE	20029	ITD	23	1	13	Large	
1000019	RSE	RSE	20031	ITC	23	1	13	Medium	
1000020	RSE	RSE	20032	ITC	23	1	13	Medium	
1000021	RSE	RSE	20039	ITE	23	1	13	Large	
1000022	RSE	RSE	20042	ITD	23	1	13	Large	
1000023	RSE	RSE	20046	ITF	23	1	11	Large	
1000024	RSE	RSE	20048	ITF	23	1	13	Medium	
1000025	RSE	RSE	20049	ITD	23	1	13	Large	
1000026	RSE	RSE	20050	ITF	23	1	13	Medium	

Figure 5: Population of the Repository .mdb with real data from the National Data sets.

1.3 Support for the Repository population with data

The validation rules on the values that each field is allowed to take in the Database, provide a strict framework where the population takes place. Supportive documents for the population of the Repository mdbs were created in order to guide the Enablers throughout the whole population process.

a. "The data entry tables" Document

The document on "data entry tables" contains, for the predefined fields, the normalized values, the range of values (accepted values) and the units.

For the proper data entry to the Repository and for the future statistical analysis and queries on the EU-MERCI Database, the fields that were developed as database structure were normalized and specified. Considering the criteria and the taxonomy that were specified under WP3 and also the requirements of the database development, each field (or the relevant column) was filled in with specific rules. For most fields, an extra column was provided for the normalized value (N value).

The Columns are divided in 3 categories:

1. The columns that are supported with an extra N (Normalised) value column;
2. The columns that are alphanumeric;
3. The free text columns (for example the description of the measure).

For the 1st category, Enablers have to enter the **N value** they find in document's tables.

For the 2nd category, Enablers have to enter data according to the specifications given in the tables, regarding the data range and the format.

For the 3rd category, the text can be entered as it is in the original data sets.

The two tables below are examples of what the document contains in the following elements:

Overall Cost of implementation

	Data range	Comments
	0 - 999999999.	Real number, dot is the decimal separator. No thousand separator. The unit is Euro Integers are ok, no decimals needed
N/A, blanks	999999999-	

Company Size (column H)

Company size	N - value	Comments
Large	10	
Medium	20	
Small	30	
N/A blanks	99	

The validation rules and the normalized fields were established to:

- Preserve and secure the harmonization of the data (completed under WP3);
- Ensure that the EU-MERCI Database will provide reliable statistical results.

This document was adjusted each time the testing data population procedure by the Enablers was taking place with updated rules and values.

b. "The instructions for the populations" document

For the convenience of the partners, a document with instructions was created. It concerned mainly the transposition of data from the excel to the mdb and the errors that may occur and how to fix them.

2.1 Optimization

The Repository was updated in the following areas:

2.1.1 Data carriers

The columns concerning the data carriers were increased from 3 as initially designed to 5 in order to take into account also those Energy Efficiency projects involving several energy carriers, which can be found especially in the cement sector. In particular, the final data carriers were:

- Energy carrier before[2]
- Energy carrier after[3]
- Baseline energy consumption
- Final energy savings per energy carrier
- Energy price per energy carrier

2.1.2 KPIs

The Key Performance Indicators were calculated in the merged datasets and inserted into the mdb to accompany each case and they could downloaded by the users of the database. The following KPIs were added in the Repository (see Annex 2 for more details about the KPIs):

- Primary Energy Savings: PES [toe]
- Energy consumption improvement: ECI [%]
- Reduction of the energy intensity of production per unit of output: CRU [toe_p/k€]
- Cost of Energy Savings: CAPEX/PES [€/toe]
- Cost of Carbon Savings: CAPEX/CO_2 [€/tonCO_2]
- Renewable Energy Source: RES [%]
- Simple Pay Back Time: PBT [years]
- Cumulative Cash Flow: CCF [€]
- Share of Project Cost Subsidized: SPCS [%]
- "Good Practice" (Proposal (Yes/No) as a "Good Practice" by the Enablers, based on the available national information and on expert judgement)

[2] Energy Carrier before the implementation of the Energy Efficiency project.
[3] Energy Carrier after the implementation of the Energy Efficiency project.

2.1.3 Taxonomy

The creation of a common taxonomy was necessary to ensure that the energy efficiency measures included in the EU-MERCI Repository are categorized using a standard classification across all Enablers' datasets. A taxonomy will enhance the ability to perform a statistical analysis and allow for measures from different Enablers' datasets that are applied to the same process or apply the same technology to be compared against each other as well as against similar technologies.

Two different taxonomies were created to classify the records in the EU-MERCI Database (Generic and Specific Taxonomy) and they are fully described in D3.2.

Generic Taxonomy:

The generic taxonomy consists of three different levels of information:

Level 1: It classifies the measure according to where the measure is applied to within an organization. The taxonomy allows for three different destinations.

1. A process technology is a measure that is applied to a process or has direct effects on a specific process within the operations of the organization.

2. A service technology is a measure that is applied to a service or auxiliary technology, instead of a specific process. This can include technologies that have direct impacts on the compressed air system of a site.

3. An alternative energy technology relates to technologies, which produce electrical or thermal energy via alternative energy carriers, such as biomass, wind or solar.

Level 2: It is dependent on Level 1 and classifies the measure according to a general process or phase. For single measures (only one action/process), only one entry can be provided at level 2, whereas for combined measures (one or more actions are taken under one measure), the taxonomy allows to classify the process/phase up into two actions. If a combined measure involves more than two actions, the two most relevant actions in terms of impact on the final energy savings, are classified at level 2.

Level 3: It relates to level 2 of the taxonomy and applies a specific classification to each technological solution that is applicable across all sectors**.** As with level 2, single measures only require one entry at level 3, whereas combined measures require two entries, classifying the two most relevant actions taken as part of the combined measure.

Sector Specific Taxonomies

The sector "specific taxonomy" defines the technical framework (industry process, phase and technology) specific to each industrial sector. For each industrial sector considered in the EU-MERCI project, the different production processes and, for each process, the respective technologies were identified. A specific taxonomy was created for the following sectors/sub-sectors:

- Food & Beverage
- Iron & Steel

- Aluminum
- Copper
- Chemical
- Ceramic
- Cement
- Machinery
- Glass
- Pulp & Paper
- Coke & Petroleum

The non-ferrous metal sector was split into an aluminum and copper specific taxonomy based on the assumption that most records in this sector related to either of those two metals. The Cement & Ceramics sector was split into two taxonomies as the processes behind the production of cement and ceramics were too different to be combined under one taxonomy.

The structure of each sector specific taxonomy follows a similar structure to the Generic Taxonomy:

Level 1: Level 1 is the same as Level 1 for the generic taxonomy and refers to the destination of the measure.

Level 2: As in the generic taxonomy, level 2 is dependent on level 1. Level 2 refers to the specific process phase in which the measure is being implemented.

Level 3: Level 3 of the specific taxonomies refers to a specific technology in a specific process phase to which the measure is applied.

As with the generic taxonomy, the specific taxonomies allow for two entries to be made at level 2 and 3 for measures, for those Energy Efficiency projects which involve more than one action/process (combined measures).

2.1.4 Implementation of Taxonomy in the Repository

Regarding the design and implementation of the taxonomy fields, two approaches were considered:

a) The three L1, L2, L3 fields are DEPENDENT from each other and are also dependent on the sector

b) The three L1, L2, L3 fields are INDEPENDENT from each other and are only sector-dependent

Under scenario (a), ONLY SPECIFIC COMBINATIONS OF SECTOR+L1+L2+L3 values are acceptable.

Under scenario (b) ANY COMBINATION OF SECTOR+L1+L2+L3 values are acceptable.

Example 1, Waste water treatment in the Pulp & Paper sector:

Under scenario (b) a row in the paper sector can accept the following taxonomy field combination:

SECTOR= 35 PULP & PAPER

L1= 30 Process Technology

L2= 304 Papermaking

L3= 3046 Waste water treatment

Under scenario (a) this combination is rejected by the rdbms validation rules.

Example 2 , Waste water treatment in the Pulp & Paper sector:

Under scenario (a) a row in the paper sector will only have the L3 field as follows:

L3= 35-02-02-001 Waste water treatment

The above code contains (encapsulates) the following information:

L2=35-02-02 Pulp preparation

L1=35-02 Service Technologies

SECTOR=35 Paper & Pulp

The same row under scenario (b) will be implemented with 4 fields as follows:

SECTOR=Paper & Pulp

L1= 40 Service Technologies

L2= 305 Pulp preparation

L3= 3046 Waste water treatment

The consortium decided to use scenario a and the taxonomy table was created under this logic:

The Taxonomies (generic and specific) consists of 3 levels. Starting from L2 two entry possibilities (entry A and entry B) are defined. This structure was decided because of the need to state multiple actions within one efficiency measure (for example: The measure is named “Optimization of pumps” and the related action which leads to the savings are “pump exchange” and “installation of a variable speed drive (VSD)”). The EU-MERCI Repository is designed in a way that the 3 levels of each set are dependent from each other in a parent-child relation. A table has been created combining the 4 levels for each sector. For the data entry, only the L3 (4th level) is required and the other 3 levels are compiled and displayed in the database, based on the taxonomy table. This prevents the data entry user to enter any combination of processes and secures the parent-child relation of processes as only specific combinations of sector+L1+L2+L3 values are acceptable.

For example:

id	SECTOR	SECTOR DESCRI	LEVEL1_N	LEVEL 1	LEVEL2_N	LEVEL 2	LEVEL3_N	LEVEL 3
1	00	GENERIC	00-03	Alternative energy	00-03-**	UN L2 (L1=Alternative Energy)	00-03-**-***	UN L2, L3 (L1=Alternative Energy)
2	00	GENERIC	00-03	Alternative energy	00-03-01	CHP	00-03-01-***	UN L3 (L2=CHP)
3	00	GENERIC	00-03	Alternative energy	00-03-01	CHP	00-03-01-001	Biomass CHP
4	00	GENERIC	00-03	Alternative energy	00-03-01	CHP	00-03-01-002	Fossil fuel CHP
5	00	GENERIC	00-03	Alternative energy	00-03-01	CHP	00-03-01-003	other

The user enters only the LEVEL3_N value. From the categorisation that is visible on the above table, we see that 00-03-01-001 means and retrieves the following:

00: Generic sector

00-03: Alternative energy for the Generic sector

00-03-01: CHP for the Alternative energy of the Generic sector

00-03-01-001: The process Biomass CHP of the Alternative energy of the Generic sector

The stars are used on Level 3 if only Level 2 or Level 1 are known.

Following the same logic, the database functions with relating the tables of the taxonomy with the Repository.

One of the benefits of scenario (a) is that the number of allowed combinations is predefined. This increases the reliability of the statistical analysis.

The Taxonomy table in the Repository contains 1,994 rows and can be viewed at the maintenance tables of the EU-MERCI Database.

2.1.5 NACE codes

The NACE codes are entered in the Repository only using the Level 3 (Class). Group and Division classification are produced by the same relation as the Taxonomy of processes.

Below you can an example of the NACE codes normalisation table:

id	SECTION	DIVISION	GROUP	CLASS	DESCRIPTION
401	C	C*	C*.*	C*.**	Manufacturing
402	C	10	10.*	10.**	Manufacture of food products
403	C	10	10.1	10.1*	Processing and preserving of meat and production of meat products
404	C	10	10.1	10.11	Processing and preserving of meat
405	C	10	10.1	10.12	Processing and preserving of poultry meat

NACE codes table in the Repository contains 351 rows and can be viewed at the maintenance tables of the EU-MERCI Database. It refers to all the manufacturing sector based on the NACE2 revision.

2.1.6 The other lookup tables

For all the Normalised fields, related tables were created and populated with the predefined values. In this report, they can be found at ANNEX 1 and at the following link www.cres.gr/merci2 in the "explore tables" section.

2.2 Final version

The Repository (mdb file) finally consists of the following fields:

FIELDS
ID
Source_DB
Source_DB_Key
Country
NACE_Code_Level_3
Company_Size
Company_Size_N
Implementation_Status
Implementation_Status_N
Implementation_Year

Technical_Life_Time
L3A_Generic_N
L3A_Generic_NRM_N
L3B_Generic_N
L3B_Generic_NRM_N
L3A_Specific_N
L3A_Specific_NRM_N
L3B_Specific_N
L3B_Specific_NRM_N
Measure_Description_Original
Measure_Description_Translated
CASE
Case_N
Energy_Carrier_before_1
Energy_Carrier_before_1_N
Energy_Carrier_before_2
Energy_Carrier_before_2_N
Energy_Carrier_before_3
Energy_Carrier_before_3_N
Energy_Carrier_before_4
Energy_Carrier_before_4_N
Energy_Carrier_before_5
Energy_Carrier_before_5_N
Energy_Carrier_after_1
Energy_Carrier_after_1_N
Energy_Carrier_after_2
Energy_Carrier_after 2_N
Energy_Carrier_after_3
Energy_Carrier_after_3_N
Energy_Carrier_after_4
Energy_Carrier_after_4_N
Energy_Carrier_after_5
Energy_Carrier_after_5_N
Baseline_Category
Baseline_Category_N
Baseline_Consumption_Carrier_1
Baseline_Consumption_Carrier_2
Baseline_Consumption_Carrier_3
Baseline_Consumption_Carrier_4
Baseline_Consumption_Carrier_5
Final_Energy_Saving_Carrier_1
Final_Energy_Saving_Carrier_2
Final_Energy_Saving_Carrier_3
Final_Energy_Saving_Carrier_4
Final_Energy_Saving_Carrier_5
Total_Final_Energy_Savings
Savings_Calculation_Approach
Savings_Calculation_Approach_N
Overall_Cost_of_Implementation
Investment_Subsidy_Qualitative
Investment_Subsidy_Qualitative_N
Investment_Subsidiy_Quantitative
Energy_Price_Carrier_1
Energy_Price_Carrier_2
Energy_Price_Carrier_3
Energy_Price_Carrier_4

Energy_Price_Carrier_5
Reference_Scheme
Reference_Scheme_N
Measure_Identified_through_external_Audit
Measure_Identified_through_external_Audit_N
PES_Primary_Energy_Savings
Energy_Consumption_Improvement
CRU_Consumption_Reduction_per_Unit_product
CAPEX_PES
CAPEX_CO2
RES
Payback_Time
CCF_Cumulative_Cash_Flow
SPCS
Good_Practice
Good_Practice_N

In ANNEX 2, there is detailed description of the fields and the KPIs. The Repository table was related to the other tables of the N-values.

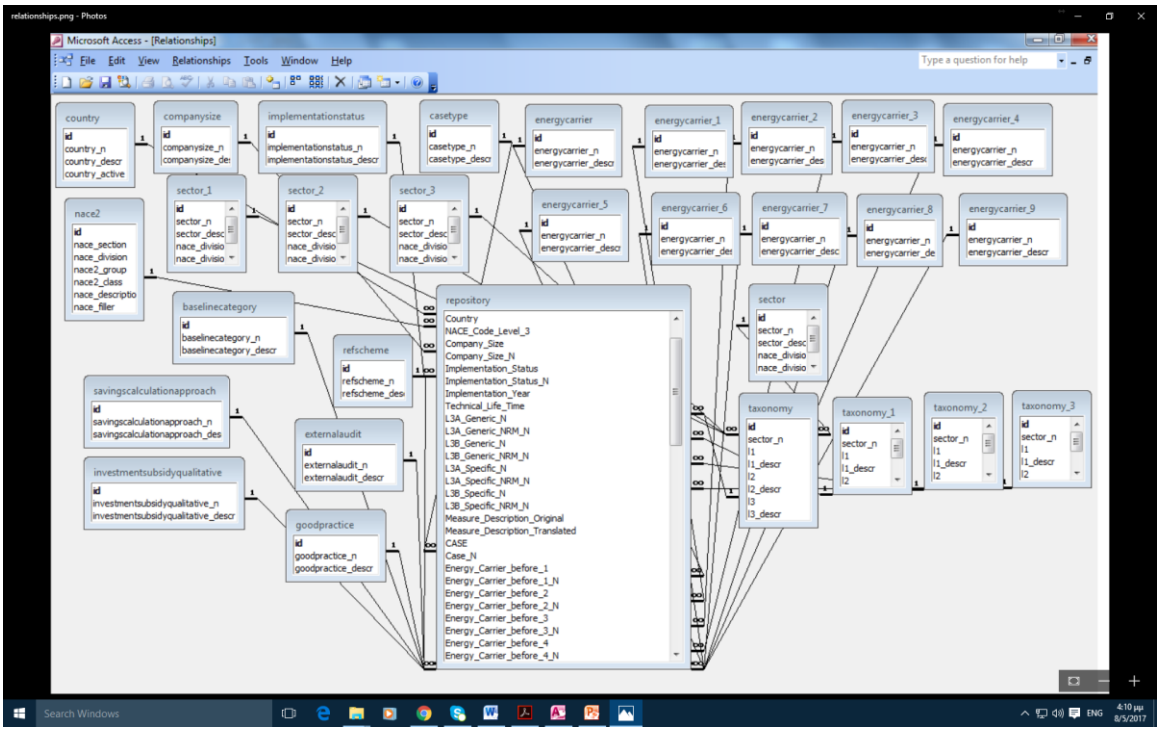


Figure 6: The relations on the Repository.

After that, the Repository was available again to Enablers for population. A sample of the populated Repository for the Glass sector is presented in the figures below.

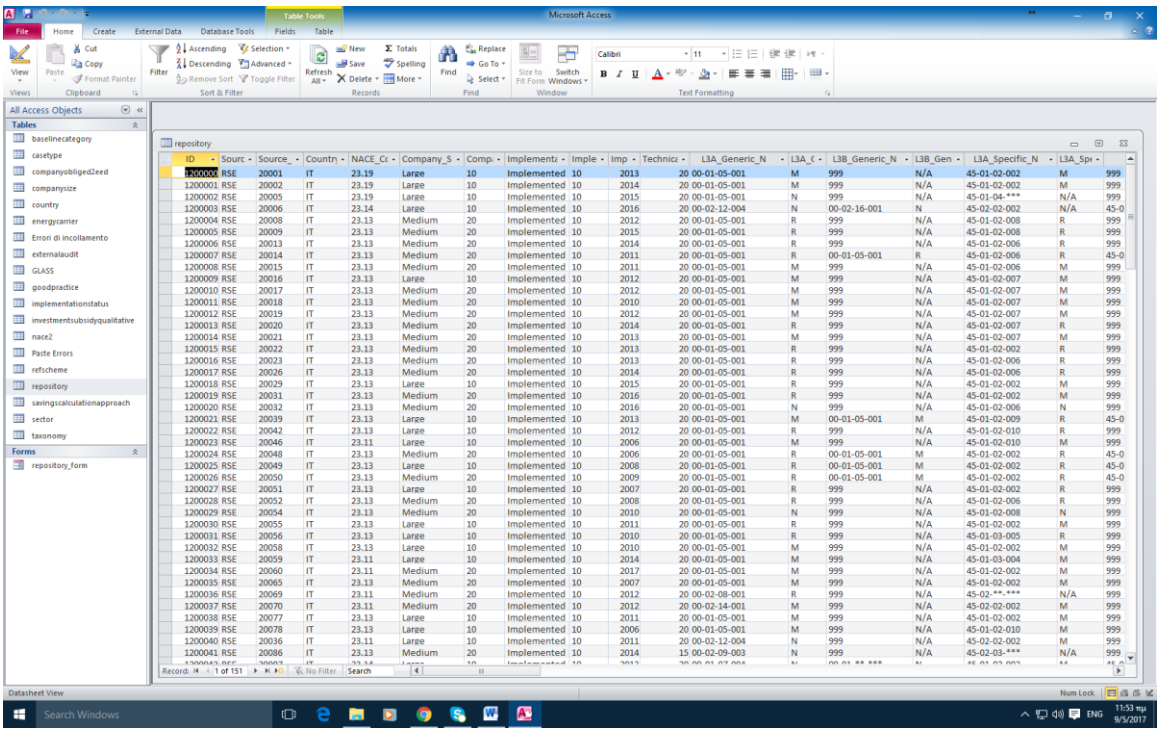


Figure 7: Populated Repository for the Glass sector (1/6).

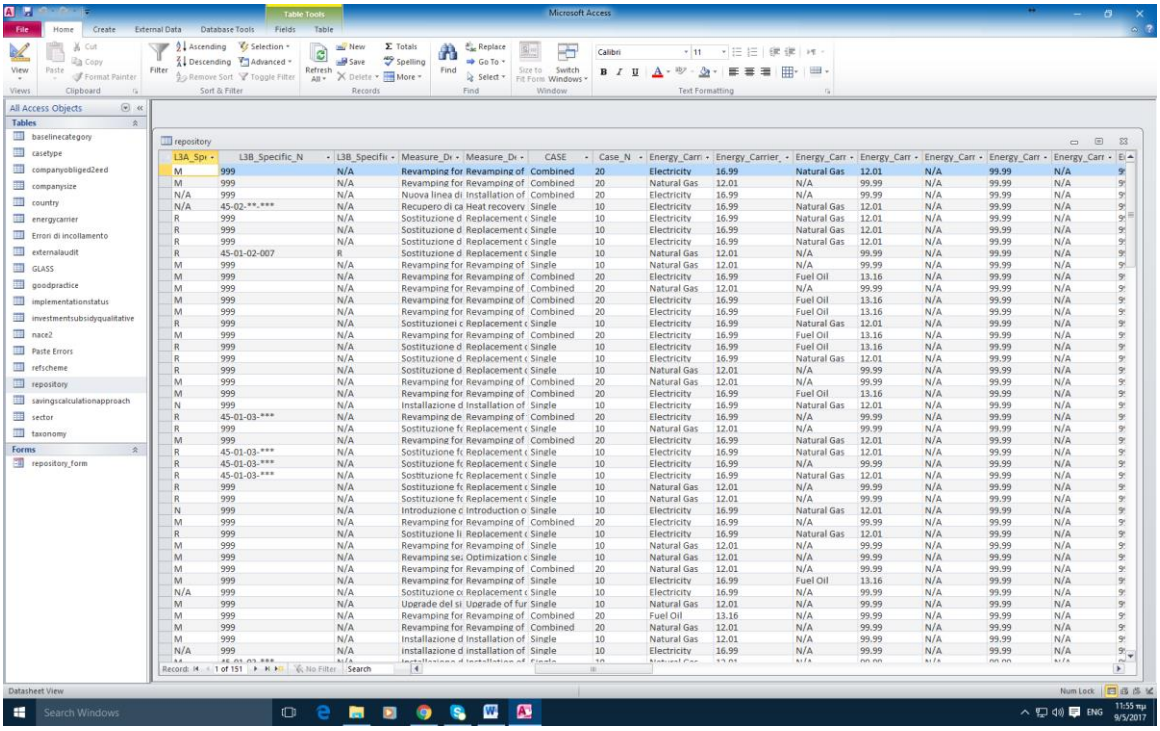


Figure 8: Populated Repository for the Glass sector (2/6).

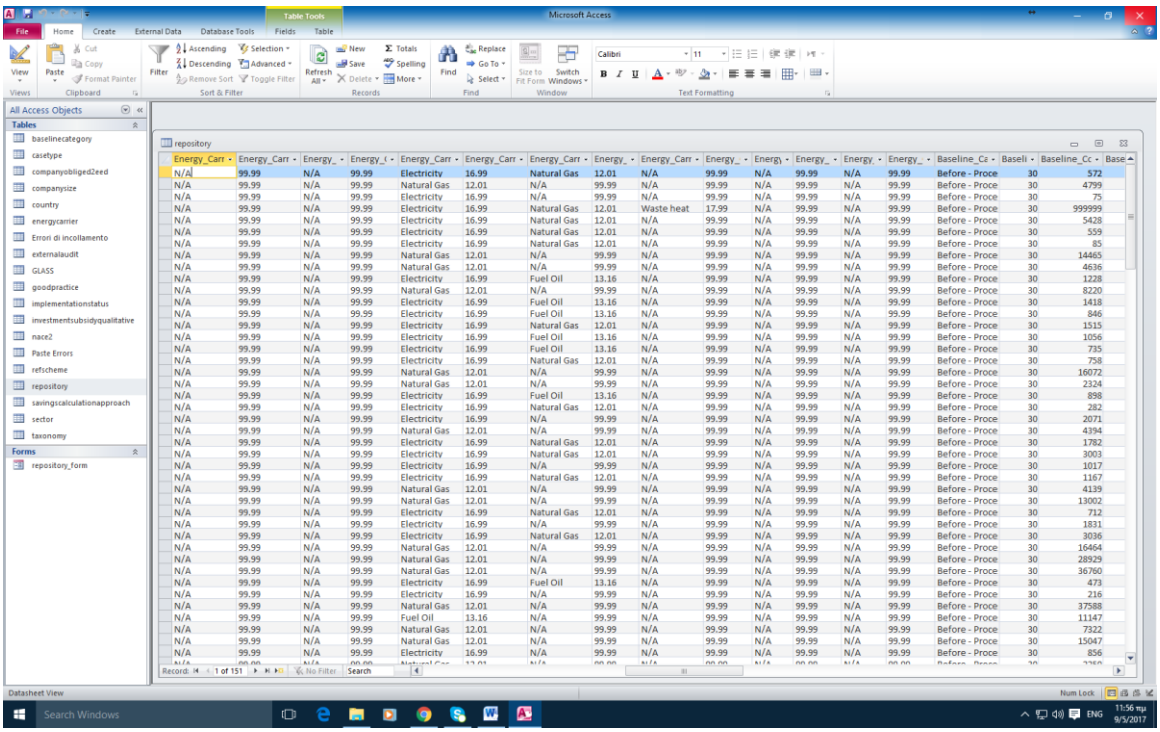


Figure 9: Populated Repository for the Glass sector (3/6).

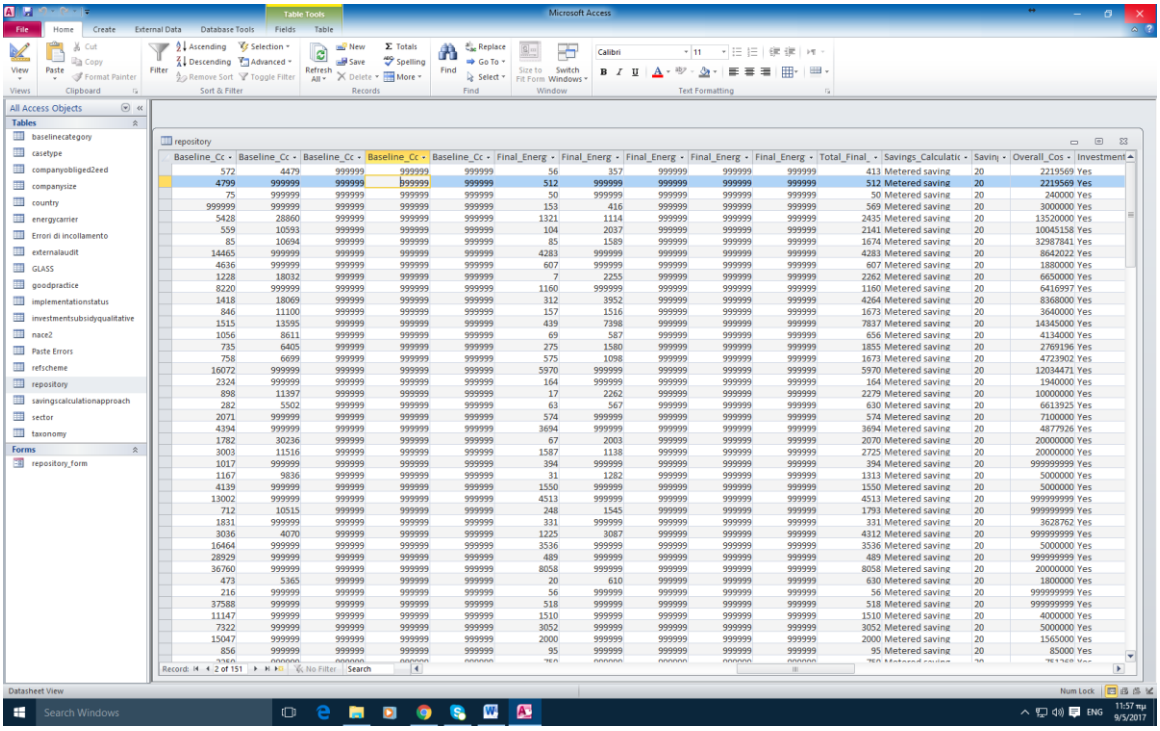


Figure 10: Populated Repository for the Glass sector (4/6).

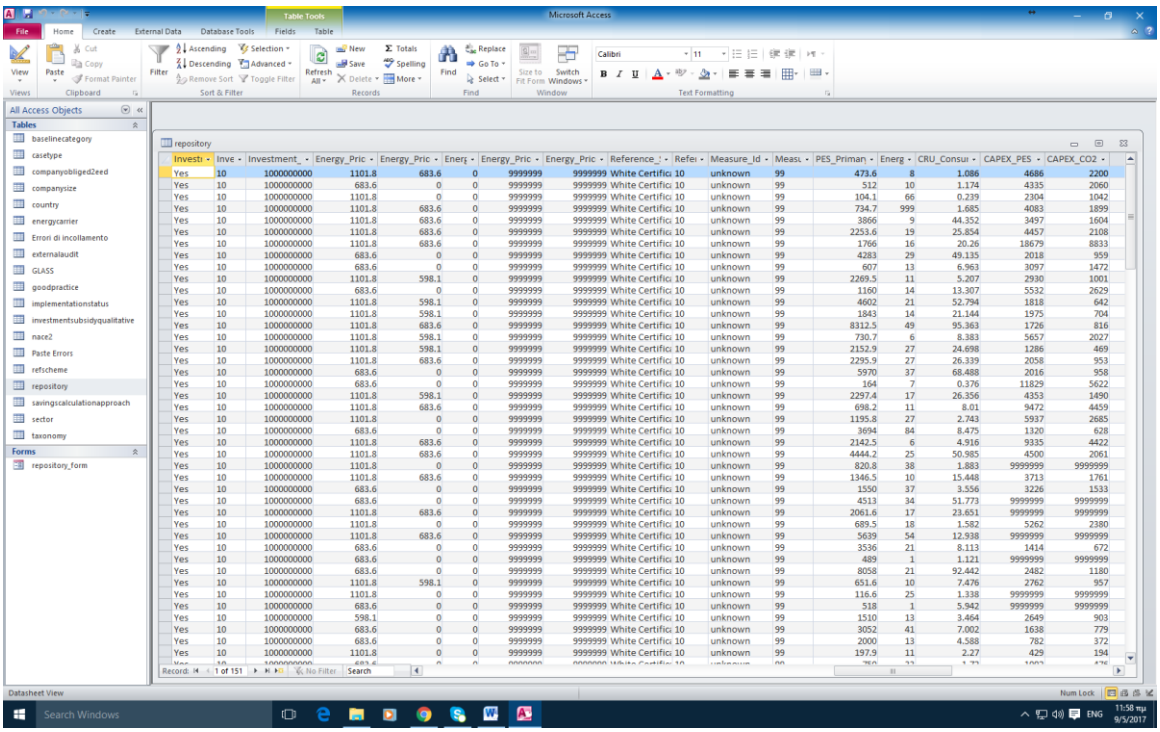


Figure 11: Populated Repository for the Glass sector (5/6).

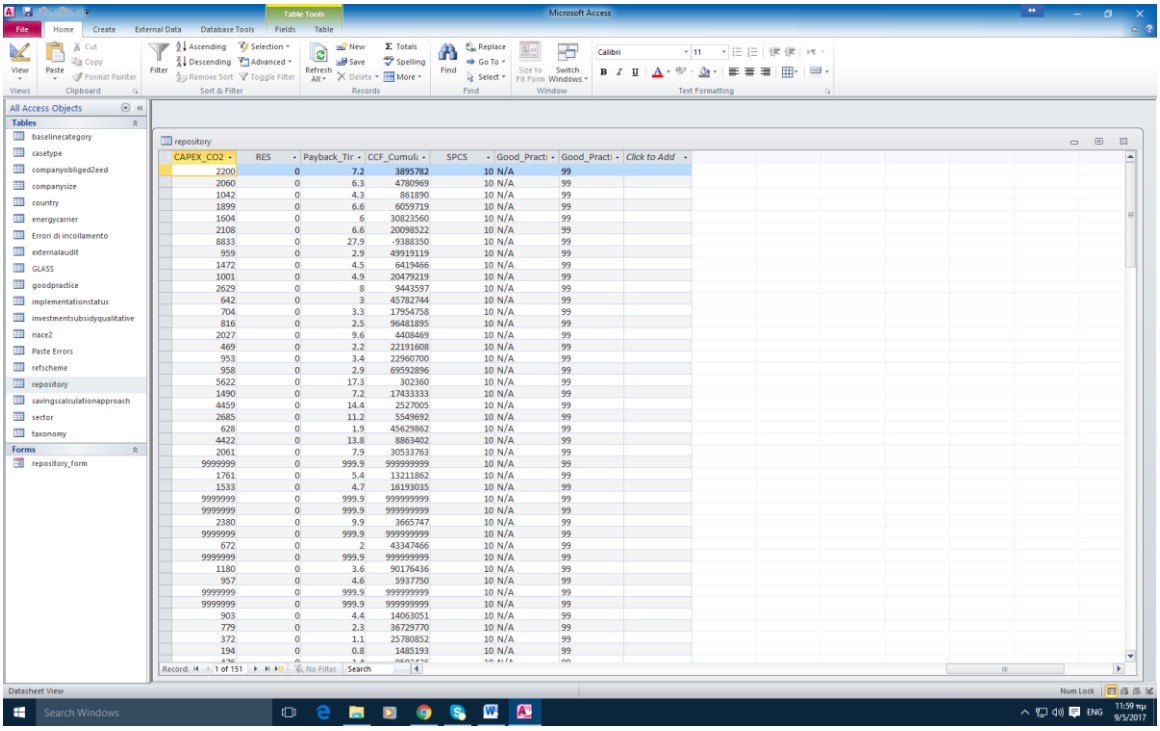


Figure 12: Populated Repository for the Glass sector (6/6).

3 The EU-MERCI Database

3.1 Technical Description

The EU-MERCI Database is implemented using the n-tier approach.

The primary layers (tiers) are

- ✓ Database server
- ✓ Application server
- ✓ Web server
- ✓ Client browser

Various tools/technologies have been used, such as Java Primefaces, Persistence, Apache web server, Apache Tomcat, mySql, etc..

The Java Persistence API (JPA) is a Java application programming interface specification that describes the management of relational data in applications using Java Platform, Standard Edition and Java Platform, Enterprise Edition.

Persistence in this context covers three areas:

- the API itself, defined in the javax.persistence package;
- the Java Persistence Query Language (JPQL);
- object/relational metadata.

The reference implementation for JPA is EclipseLink.

EclipseLink is an open-source mapping and persistence framework for use in a Java environment.

JPA is the Java API for object/relational mapping (ORM), where Java objects are mapped to database artifacts, for the purpose of managing relational data in Java applications. JPA includes Java Persistence Query Language (JPQL), the Java Persistence Criteria API and the Java API and XML schema for defining object/relational mapping metadata.

The following diagram schematically represents the architecture used for implementing the EU-MERCI Database with the above mentioned tools.

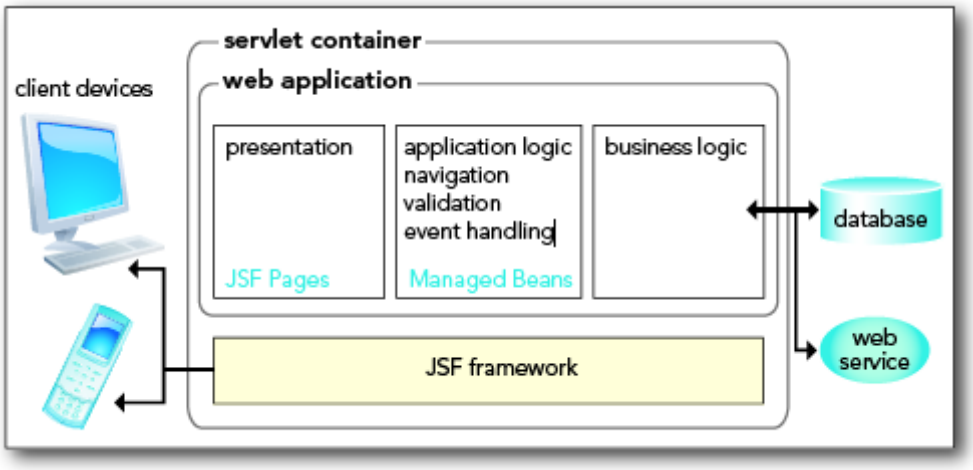


Figure 13: diagram of the architecture used for implementing the EU-MERCI Database.

The relational database (RDBMS) hosts 17 tables and numerous views.

The following image is a snapshot from MySQL Workbench, which is the tool used form administrating the RDBMS.

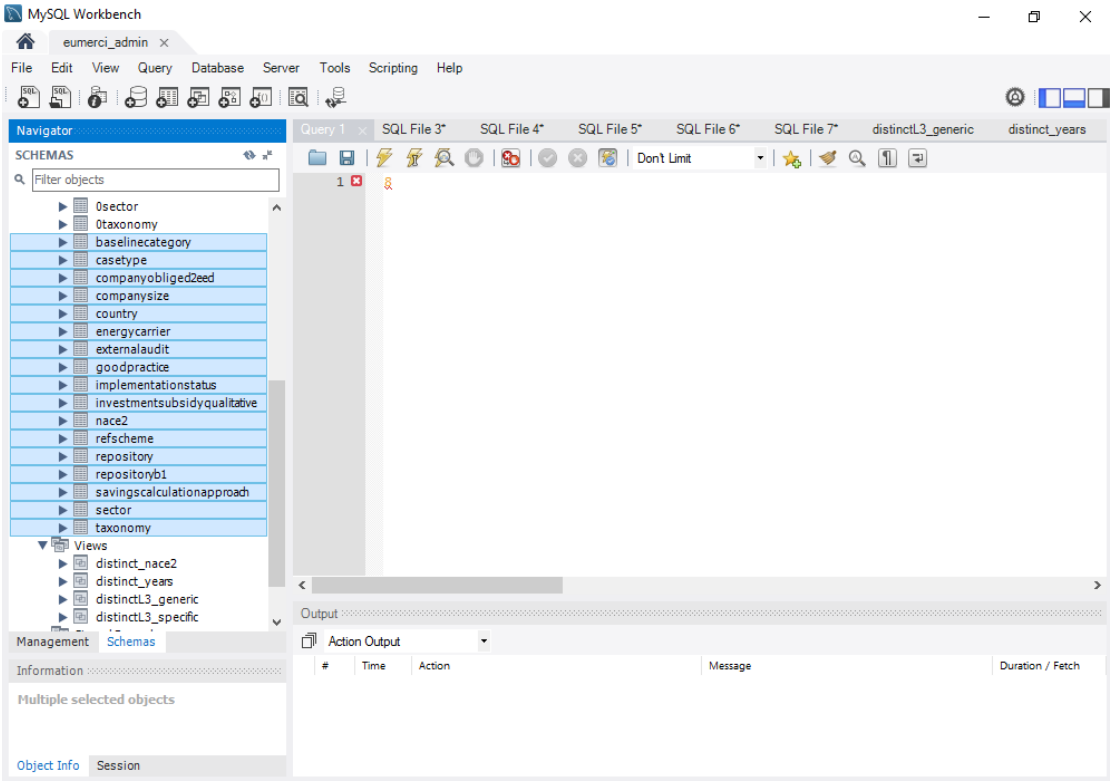


Figure 14: a snapshot from MySQL Workbench.

The full schema creation details are listed in ANNEX 3.

The development of the business and application logic was carried under Netbeans IDE 8.2.

The EU-MERCI project consists of various web pages, source packages, libraries, test libraries and configuration files, as indicated in the following snapshot:

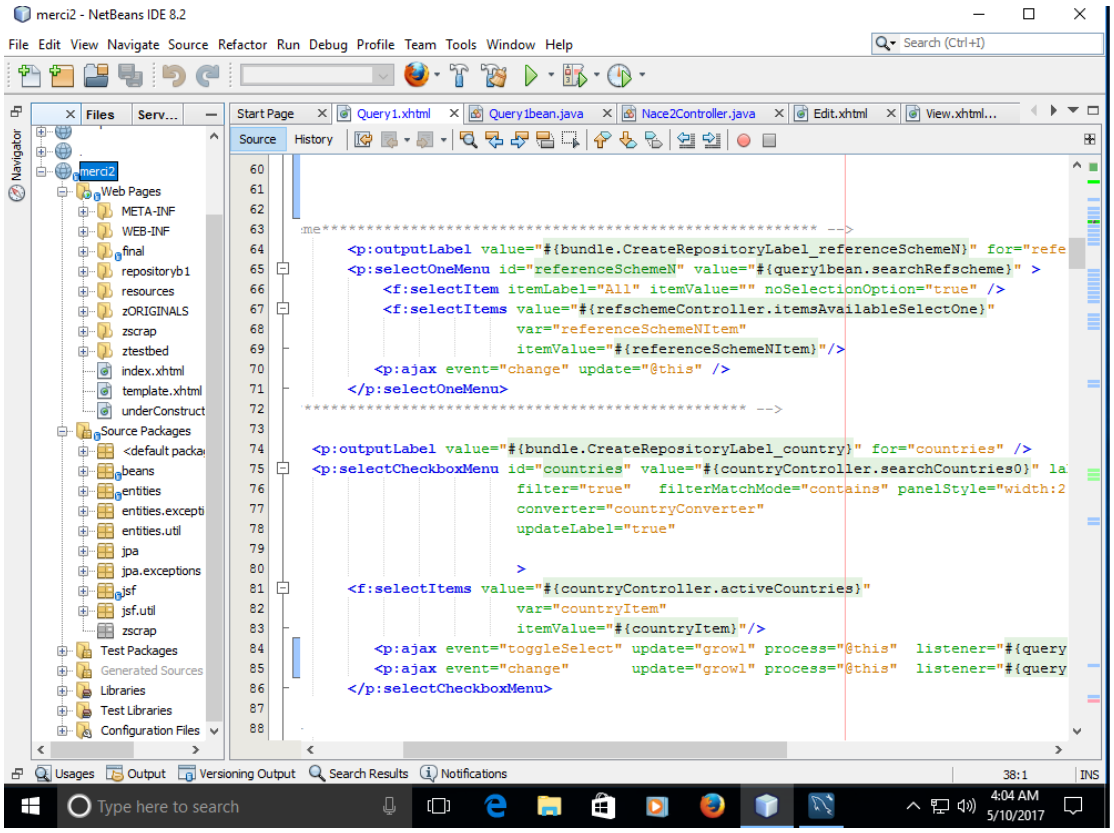


Figure 15: Database snapshot.

The system hosts about 12 screens, which provide detailed information to the user about the contents of each basic table and one screen enabling the user to execute complex multi-selection queries.

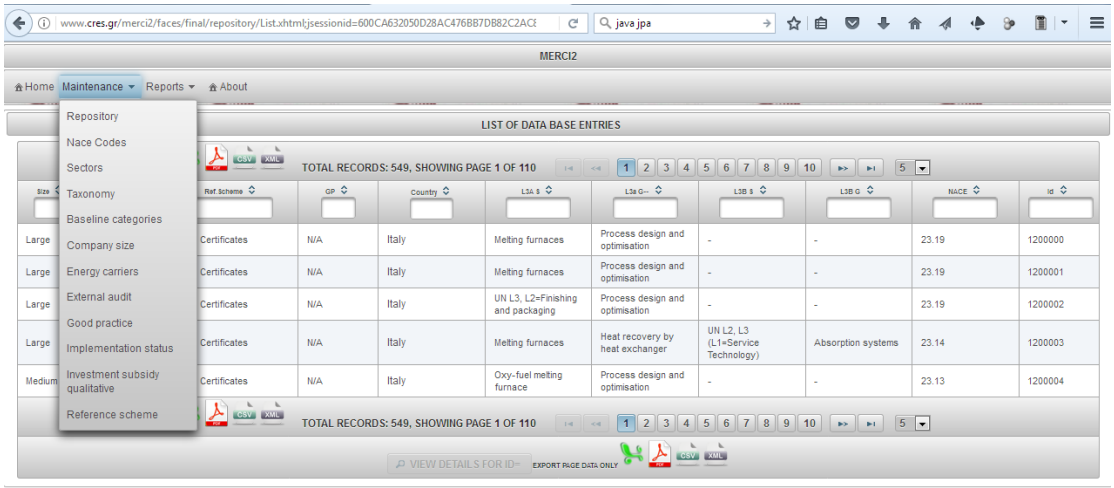


Figure 16: The basic tables.

3.2 Quantitative statistics of source code files

CRES used the program LOC Metrics for the quantitative statistics of source code files. The output, in summary, as per 25 May 2017, is reported in the following table:

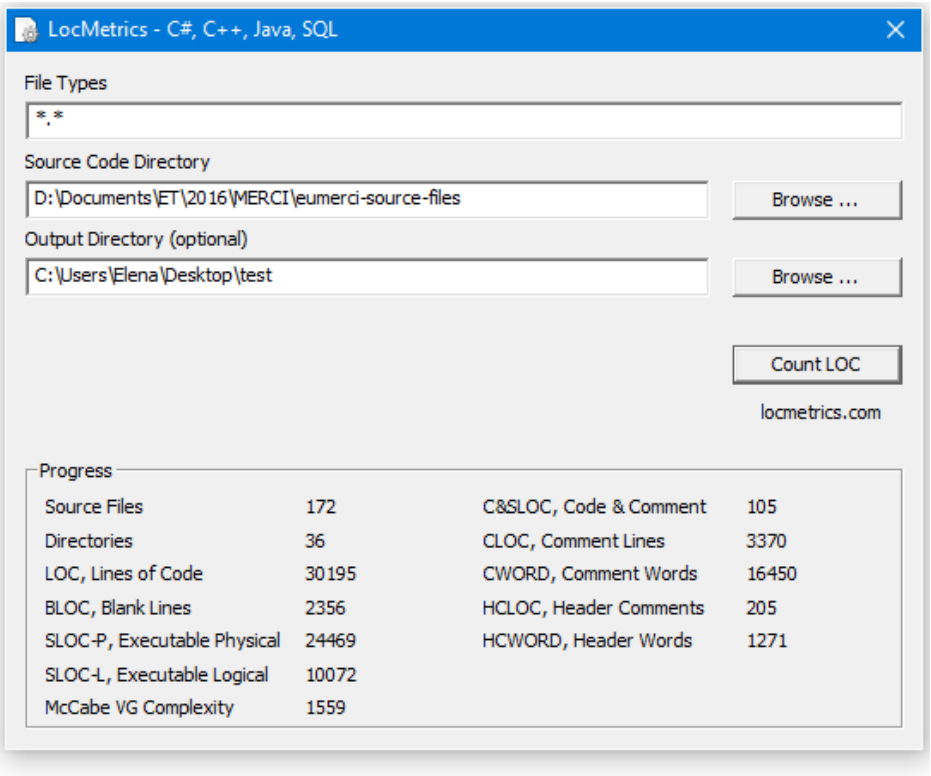


Figure 17: quantitative statistics of source code files for the development of the EU-MERCI Database.

The distribution of physical executable code in folders is reported in the pie below:

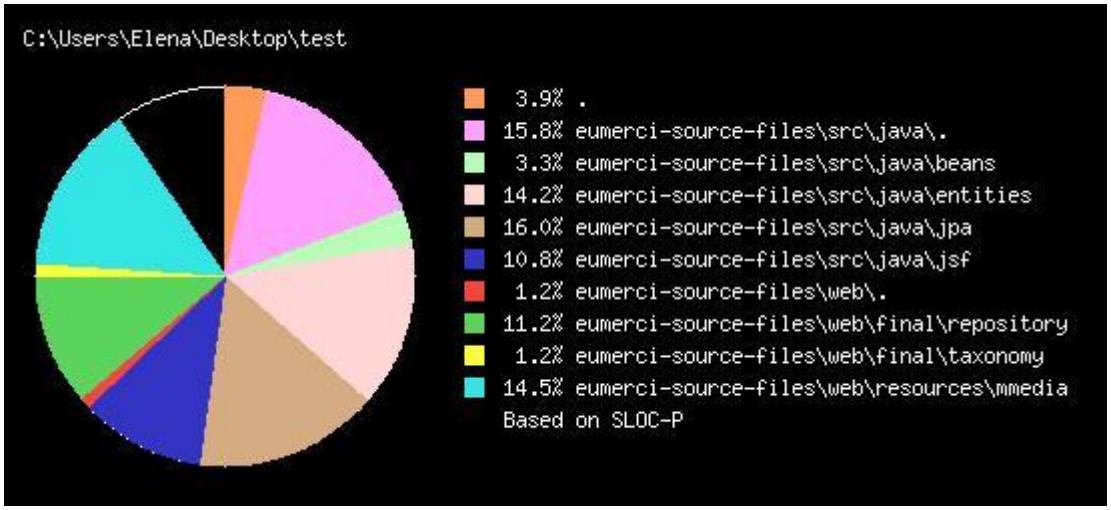


Figure 18: distribution of physical executable code in folders for the development of the EU-MERCI Database.

Detailed lists of the Lines Of Code statistics are attached on ANNEX 4 of this report.

As per May 22, 2015, the merci2 Netbeans folder contains 892 files and 308 folders. The total size is about 177 MB (properties shown below):

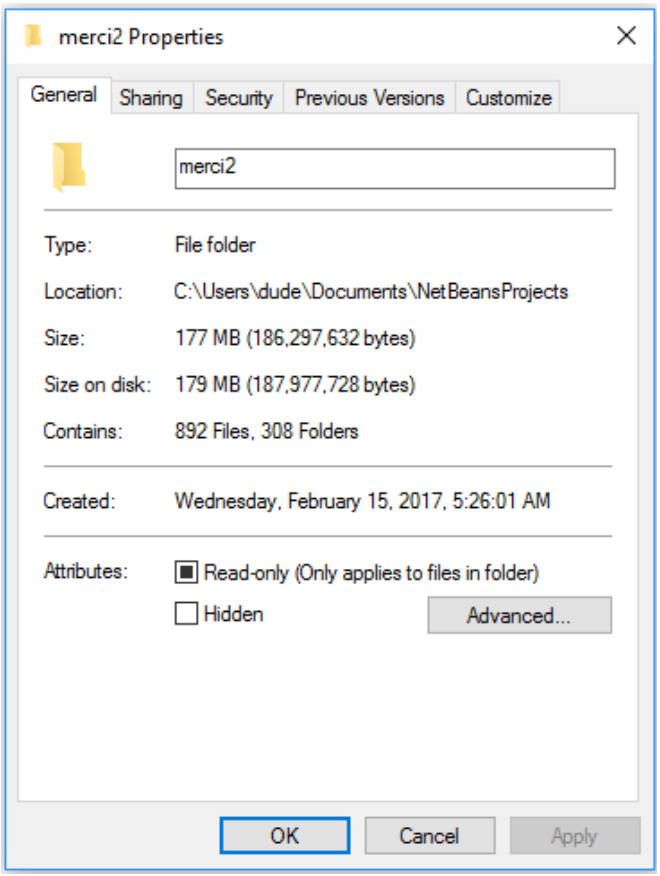


Figure 19: number of files and folders in the Netbeans folder.

The system contains:

410 java class files

228 html page files

The Netbeans project structure is as follows:

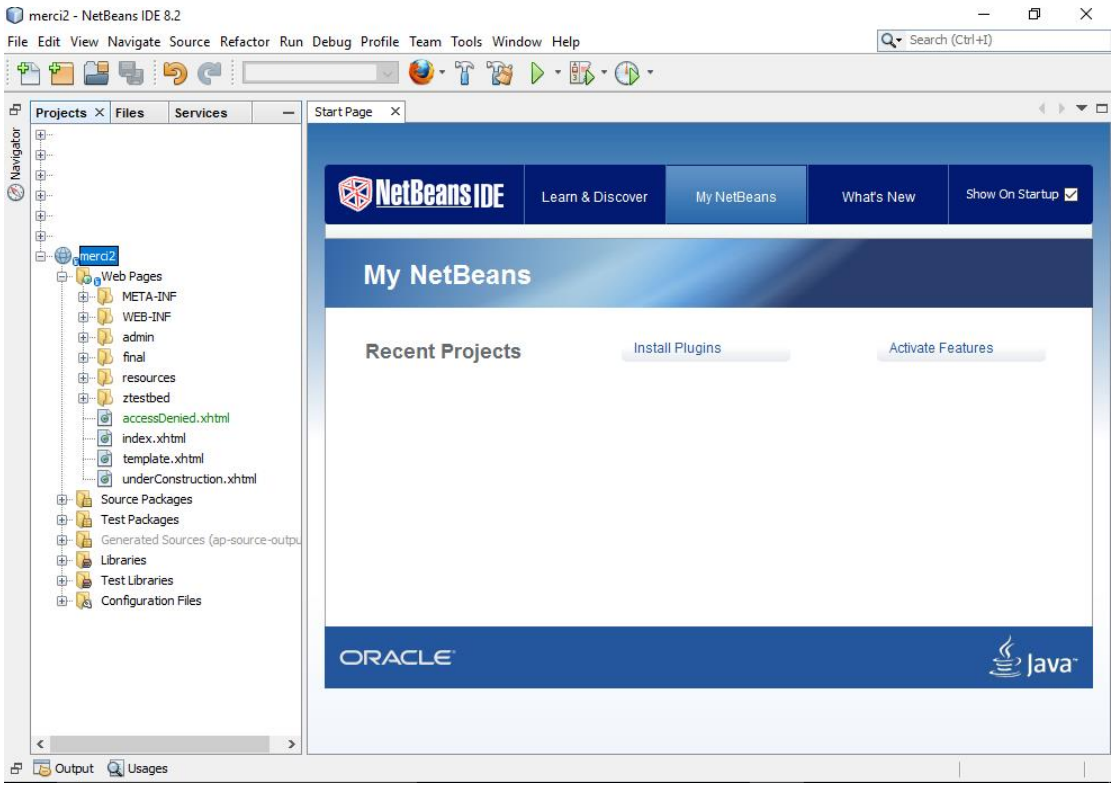


Figure 20: structure of the Netbeans project.

TEAM DEVELOPEMENT

Project development was carried out by CRES "Energy Information Systems & Planning Department".

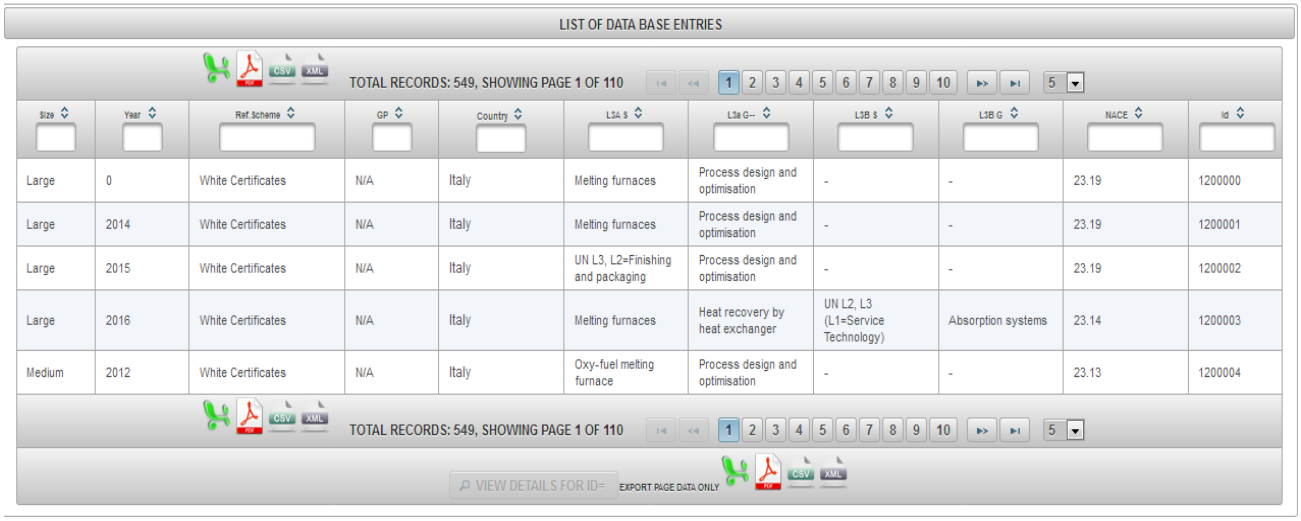
The team used Apache Subversion™ as an open source version control system.

Apache Subversion™ is a centralized version control system characterized by its reliability as a safe haven for valuable data, the simplicity of its model and usage.

The project was divided into smaller sub-projects and further into sub-tasks (for instance user interface modules, database integrity, business logic modules, entity design, etc) and each developer delivered the workflow/task he was assigned to. This approach ensures the highest possible quality of the produced code into the minimum time.

3.3 Basic data base screen

The basic screen lists a subset of the database entries, providing the user with a set of filters as follows:



LIST OF DATA BASE ENTRIES

TOTAL RECORDS: 549, SHOWING PAGE 1 OF 110

Size	Year	Ref.Scheme	GP	Country	L3A S	L3a G--	L3B S	L3B G	NACE	Id
Large	0	White Certificates	N/A	Italy	Melting furnaces	Process design and optimisation	-	-	23.19	1200000
Large	2014	White Certificates	N/A	Italy	Melting furnaces	Process design and optimisation	-	-	23.19	1200001
Large	2015	White Certificates	N/A	Italy	UN L3, L2=Finishing and packaging	Process design and optimisation	-	-	23.19	1200002
Large	2016	White Certificates	N/A	Italy	Melting furnaces	Heat recovery by heat exchanger	UN L2, L3 (L1=Service Technology)	Absorption systems	23.14	1200003
Medium	2012	White Certificates	N/A	Italy	Oxy-fuel melting furnace	Process design and optimisation	-	-	23.13	1200004

TOTAL RECORDS: 549, SHOWING PAGE 1 OF 110

VIEW DETAILS FOR ID= EXPORT PAGE DATA ONLY

Figure 21: the basic database screen.

The list shows the following 11 basic fields:

- Company size
- Implementation Year
- Reference Scheme
- Good Practice
- Country
- L3 A specific
- L3 A generic
- L3 B specific
- L3 B generic
- NACE code
- Id

By selecting one row, the user can view full details of this row by pressing the view button of the bottom of the table. View details screen is activated upon pressing the “view button”.

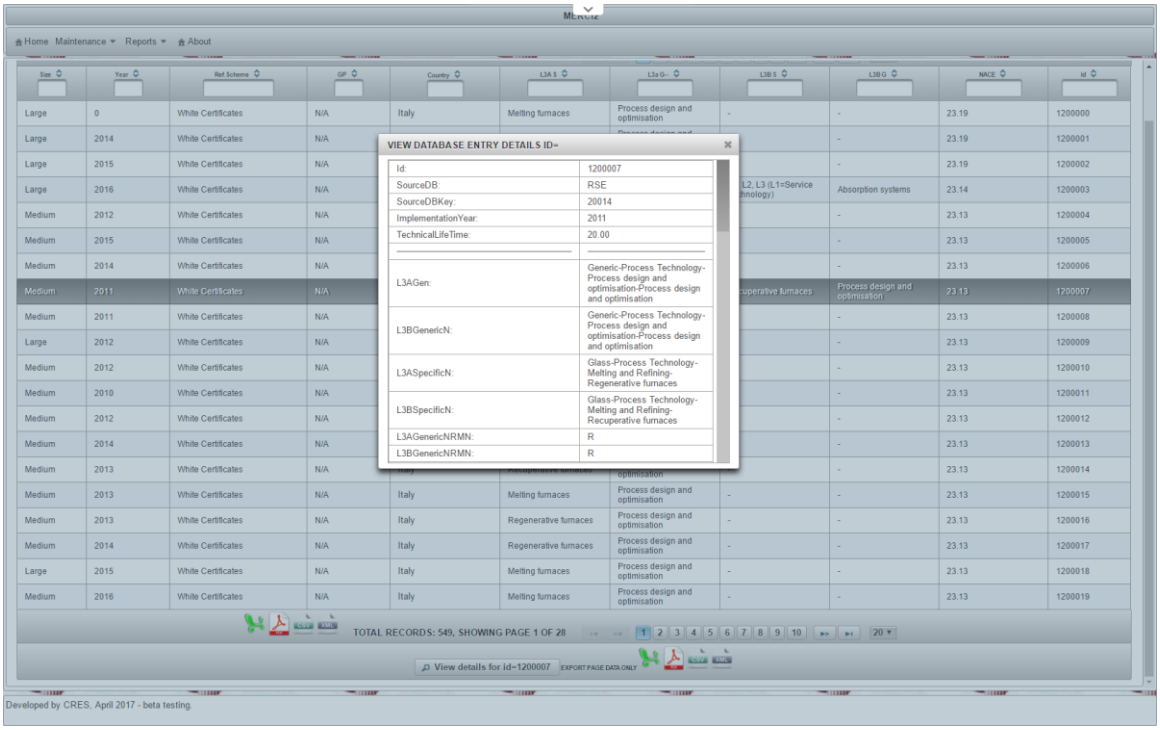


Figure 22: The view details screen.

The view details screen contains the 46 fields out of 82 of the Repository.

On top and bottom (header-footer) of the list, export buttons are implemented, which provide the user with the extremely useful facility to export the list in any of the possible formats (excel, pdf). In this way the user can further process the data and produce practically unlimited reports-statistics. The 46 fields of the Repository are downloaded for each row.

For example:

Pressing the excel button, the user is presented in the following dialogue.

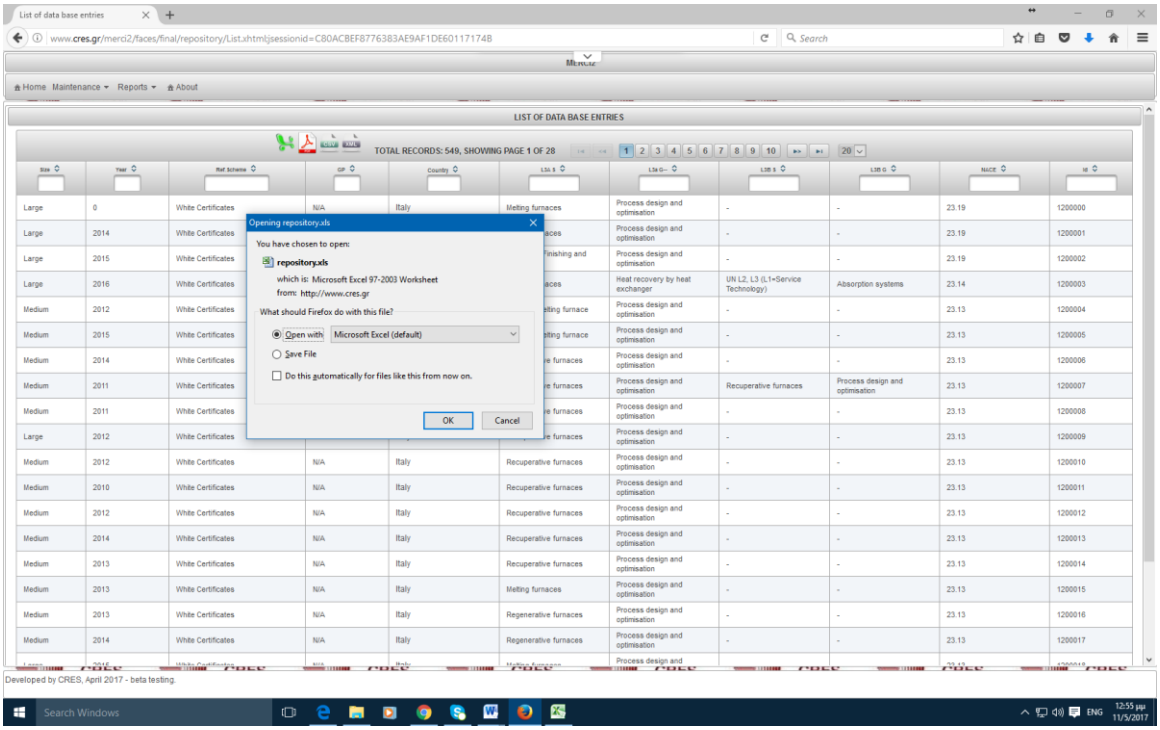


Figure 23: The dialogue box for excel file downloading.

The data are transformed in excel format as follows:

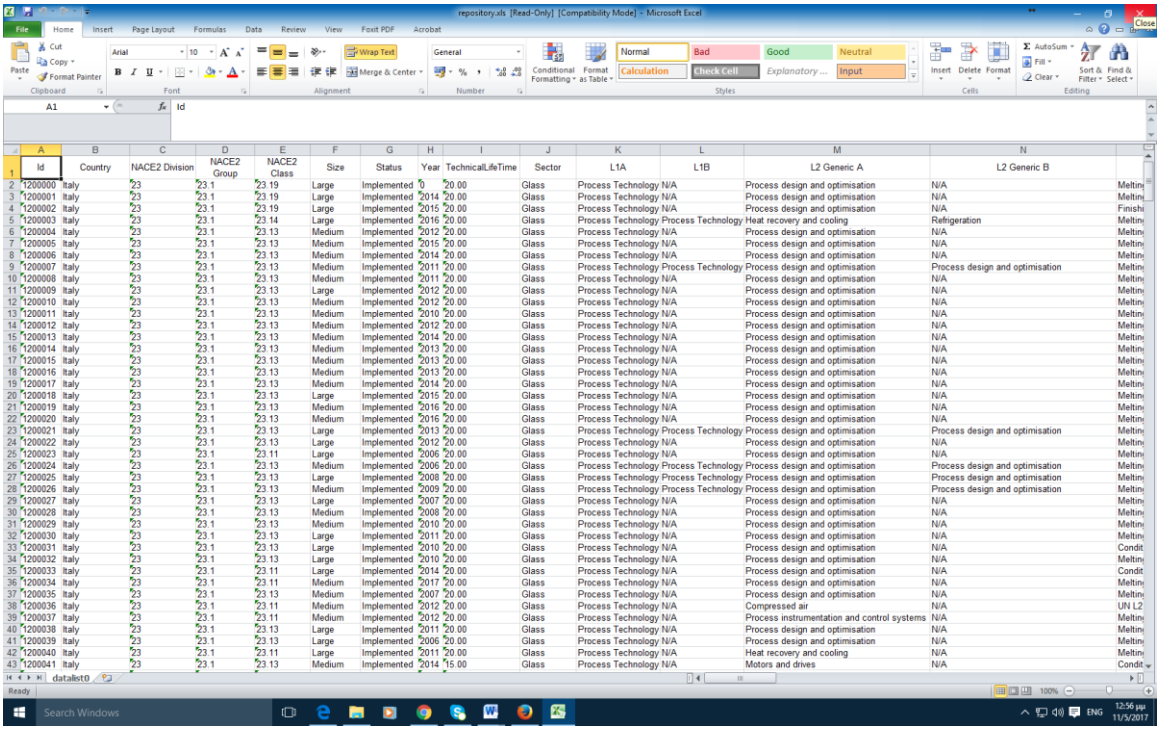


Figure 24: The downloaded excel file.

On the left side of the buttons, the system displays the total number of records available in the database, the current displayed page and the total number of pages.

Further left, there are the "navigation" buttons, which enable to user to easy navigate through the pages.

For each field a special filter is defined which enables the user to quickly filter the values displayed according to custom criteria.

The filter criteria are defined as follows:

- Company size: ***begins with***
- Implementation Year: ***begins with***
- Reference Scheme: ***begins with***
- Good Practice: ***begins with***
- Country: ***contains***
- L3 A specific: ***contains***
- L3 A generic: ***contains***
- L3 B specific: ***contains***
- L3 B generic: ***contains***
- NACE code: ***contains***
- Id: ***begins with***

Each field offers furthermore the "sort" function, which means that the user can sort the table either ascending or descending order by simply clicking on the "sort arrow" displayed next to each column label.

3.4 Explaining the N-codes

The usage of the "N-codes-approach" is a big advantage of the EU-MERCI Database because each parameter of the Repository has been analysed to the extent of the allowable values it can host. For instance, all the energy carriers fields are "coded" accorded to their coded value and NOT according to their description.

Technically speaking this is called "database normalization" and offers two major advantages:

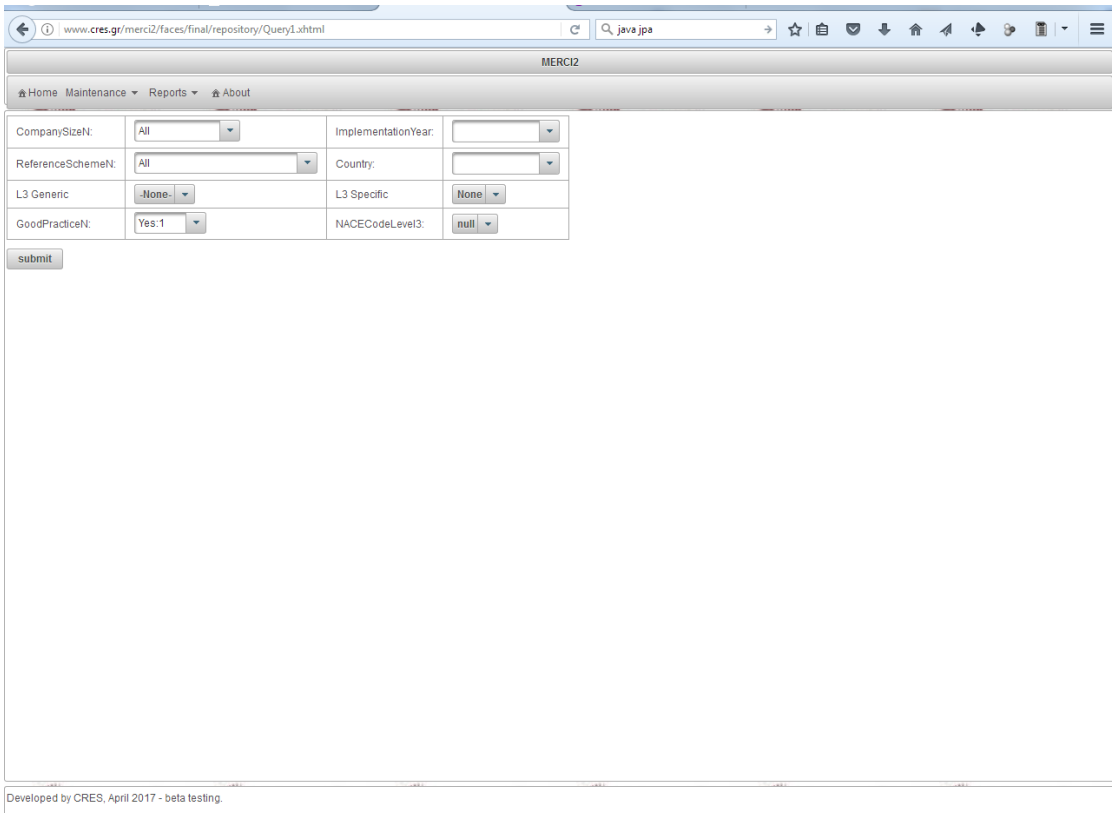
- ✓ Absolute **flexibility.** If a new value needs to be inserted into the database, the administrator simply appends a record in the corresponding table and the new N-code value is immediately available
- ✓ Absolute **reliability** in statistics compilation capabilities, since the data base contains N-codes and not text descriptions (for instance "Wind power" is stored with the N-code "11.02", therefore all queries concerning energy carriers will search for the corresponding code which will always be "11.02" for any records concerning "Wind power")[4].

[4] From the database point of view, the entry "**Wind power**" differs from the entry "**Wind Power**" which is different with the entry "**Wind power**" (with three in-between spaces), etc. If the "N-codes-approach" was not used, the user would be free to enter whichever text he would like describing the "Wind power" energy carrier, thus disabling the system to statistically correct analyse all the text entries concerning "Wind power" and produce reliable statistic results.

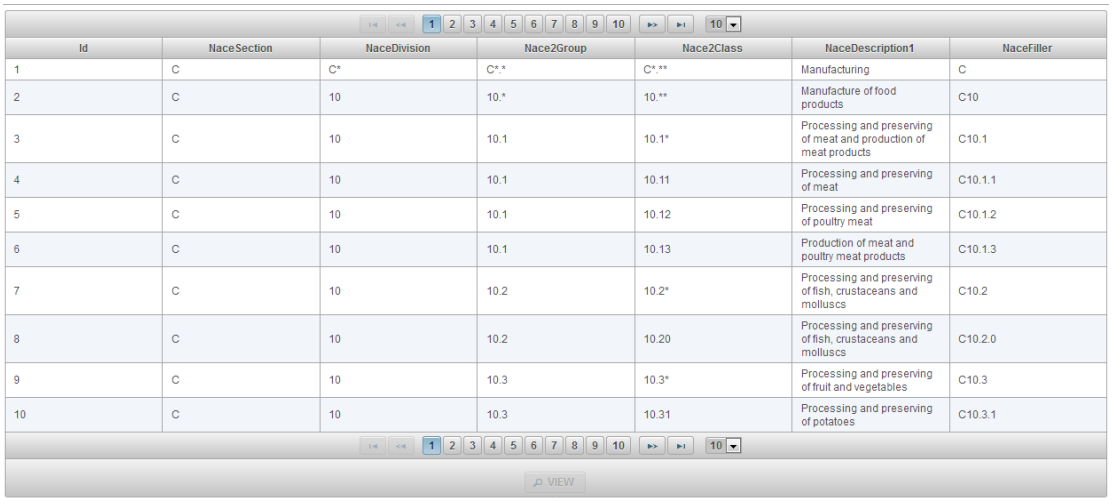
3.5 Query and N-table Screens

The query-selection-criteria screen offers further advance querying capabilities, in terms of concurrent multi selections on the basic fields.

The Query Screen

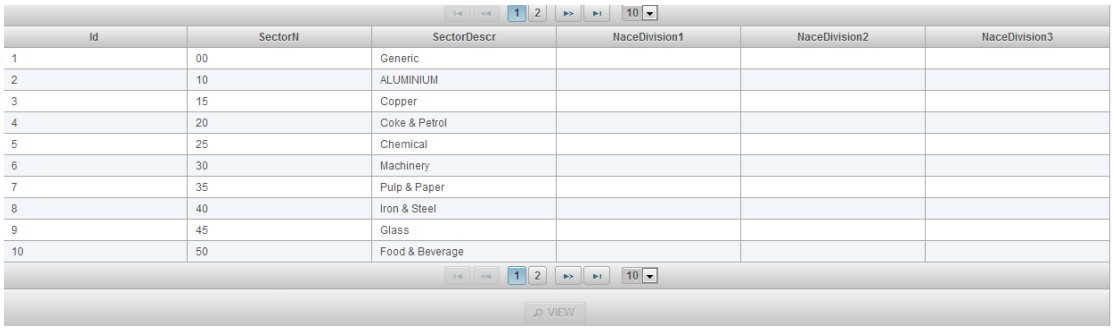


NACE codes screen



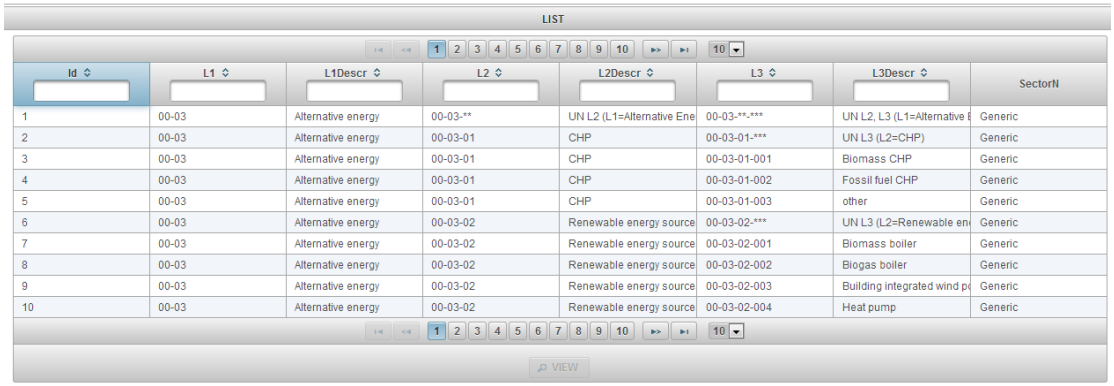
Id	NaceSection	NaceDivision	Nace2Group	Nace2Class	NaceDescription1	NaceFiller
1	C	C*	C*.*	C*.**	Manufacturing	C
2	C	10	10.*	10.**	Manufacture of food products	C10
3	C	10	10.1	10.1*	Processing and preserving of meat and production of meat products	C10.1
4	C	10	10.1	10.11	Processing and preserving of meat	C10.1.1
5	C	10	10.1	10.12	Processing and preserving of poultry meat	C10.1.2
6	C	10	10.1	10.13	Production of meat and poultry meat products	C10.1.3
7	C	10	10.2	10.2*	Processing and preserving of fish, crustaceans and molluscs	C10.2
8	C	10	10.2	10.20	Processing and preserving of fish, crustaceans and molluscs	C10.2.0
9	C	10	10.3	10.3*	Processing and preserving of fruit and vegetables	C10.3
10	C	10	10.3	10.31	Processing and preserving of potatoes	C10.3.1

Sector N-codes screen



Id	SectorN	SectorDescr	NaceDivision1	NaceDivision2	NaceDivision3
1	00	Generic			
2	10	ALUMINIUM			
3	15	Copper			
4	20	Coke & Petrol			
5	25	Chemical			
6	30	Machinery			
7	35	Pulp & Paper			
8	40	Iron & Steel			
9	45	Glass			
10	50	Food & Beverage			

Taxonomy N-codes screen



LIST

Id	L1	L1Descr	L2	L2Descr	L3	L3Descr	SectorN
1	00-03	Alternative energy	00-03-**	UN L2 (L1=Alternative Ene	00-03-**-***	UN L2, L3 (L1=Alternative E	Generic
2	00-03	Alternative energy	00-03-01	CHP	00-03-01-***	UN L3 (L2=CHP)	Generic
3	00-03	Alternative energy	00-03-01	CHP	00-03-01-001	Biomass CHP	Generic
4	00-03	Alternative energy	00-03-01	CHP	00-03-01-002	Fossil fuel CHP	Generic
5	00-03	Alternative energy	00-03-01	CHP	00-03-01-003	other	Generic
6	00-03	Alternative energy	00-03-02	Renewable energy source	00-03-02-***	UN L3 (L2=Renewable en	Generic
7	00-03	Alternative energy	00-03-02	Renewable energy source	00-03-02-001	Biomass boiler	Generic
8	00-03	Alternative energy	00-03-02	Renewable energy source	00-03-02-002	Biogas boiler	Generic
9	00-03	Alternative energy	00-03-02	Renewable energy source	00-03-02-003	Building integrated wind p	Generic
10	00-03	Alternative energy	00-03-02	Renewable energy source	00-03-02-004	Heat pump	Generic

Baseline Category N-codes screen

Id	BaselinecategoryN	BaselinecategoryDescr
1	10	Before Implementation
2	20	Before - Baseline Site consumption
3	30	Before - Process Relevant Consumptions
4	99	N/A, blank

Company Size N-codes screen

Id	CompanysizeN	CompanysizeDescr
1	10	Large
2	20	Medium
3	30	Small
4	99	N/A blanks

Energy Carrier N-codes screen

Id	EnergycarrierN	EnergycarrierDescr
1	10.99	WASTE
2	10.01	Waste (non-renewable)
3	10.02	Municipal waste (non-renewable)
4	10.03	Industrial wastes
5	11.99	RES
6	11.01	Hydro power
7	11.02	Wind power
8	11.03	Solar thermal
9	11.04	Solar photovoltaic
10	11.05	Tide, Wave and Ocean

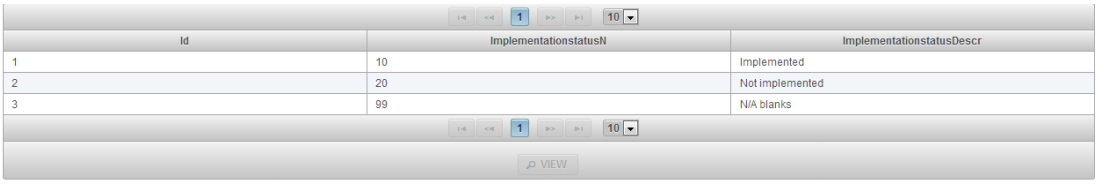
External Audit N-codes screen

Id	ExternalauditN	ExternalauditDescr
1	10	Yes
2	20	No
3	99	N/A, blanks

Good Practice N-codes screen

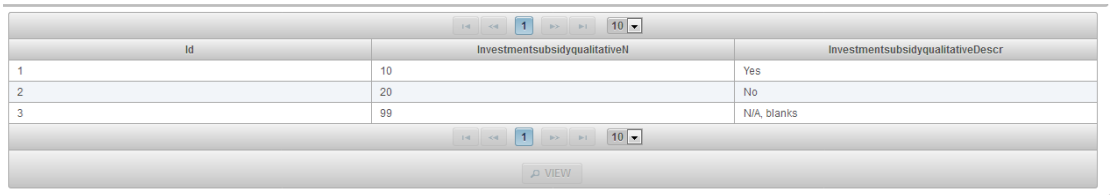
Id	GoodpracticeN	GoodpracticeDescr
1	10	Yes
2	20	No
3	99	N/A

Implementation Status N-codes screen



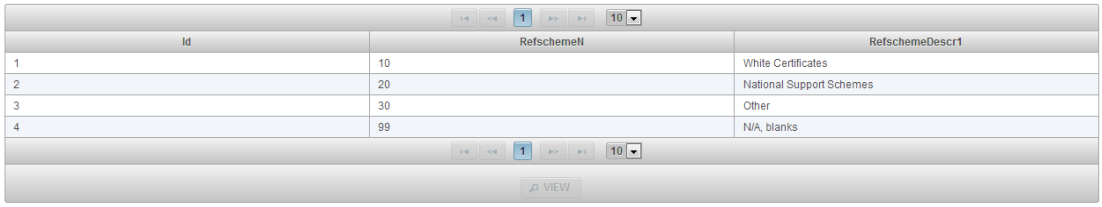
Id	ImplementationstatusN	ImplementationstatusDescr
1	10	Implemented
2	20	Not implemented
3	99	N/A blanks

Investment Subsidy Quantitative N-codes screen



Id	InvestmentsubsidyqualitativeN	InvestmentsubsidyqualitativeDescr
1	10	Yes
2	20	No
3	99	N/A, blanks

Reference Scheme N-codes screen



Id	RefschemeN	RefschemeDescr1
1	10	White Certificates
2	20	National Support Schemes
3	30	Other
4	99	N/A, blanks

Note: All the above tasks are currently under beta version and will be finalized when the exact fields and queries will be agreed. The beta version is constantly updated.

4 The EU-MERCI Portal

4.1 Introduction

Both Database and Library will be accessible through a dedicated interface, openly accessible to external users. This interface is titled '**EU-MERCI PORTAL'** and will have three main functionalities:

- **Free Navigation**: it allows the access, navigation and search to the EU-MERCI DATABASE, thus allowing the download of selected fields of the "raw" data records (in excel format, in an anonymous way) through a free filtering operation or applying predefined queries;
- **Tutorial tool**: it allows the access to the first section of the EU-MERCI LIBRARY, which allows external users to download predefined reports about the EU-MERCI "Good Practices" based on the database analysis and the "Best practices" based on literature;
- **Country/Sector analysis**: it allows the access to the second section of the EU-MERCI LIBRARY, which allows external users to download the documents about technical and statistical analysis of the sectors and the country statistics. There is also a link to the section containing the "Good Practices" and the "Best practices" from literature.

The **EU-MERCI LIBRARY** is a document library, containing the reports describing the EU-MERCI selected "Good Practices", the "Best practices" from literature for each specific sector and process and also related supporting documents, either from reference literature or elaborated on purpose by the consortium. Such documents may also be downloaded by external users.
In the EU-MERCI LIBRARY, the sectors will be split according to NACE level 1 for technical and statistical analysis, while a further split of the sectors will be implemented for the "Good practices" and the "Best practices" according to defined sectors. Moreover, the EU-MERCI "Good Practices" will be labelled by the EU-MERCI miniature logo, while the "Best practices" will not have any label.
The EU-MERCI Library will also have a specific page for the "Good practices" and "Best practices" involving renewable energy and biomass in particular.

4.2 Implementation of the EU-MERCI Portal

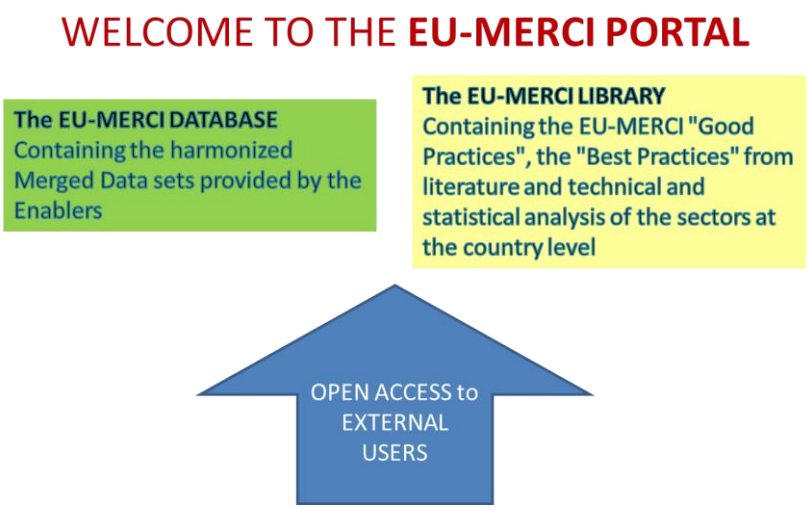


Figure 25: Schematic approach of the main categorization in the EU-MERCI Portal.

4.2.1 The EU-MERCI Library

The EU-MERCI Library reports the results of the analysis of EU-MERCI, in particular the description of the "Good Practices" according to the EU-MERCI methodology. It is a place in which the end user can find, for each sector, a description of the different processes and the related EU-MERCI "Good Practices" described in the EU-MERCI format.
This selection will consist of 11 selections (one for each sector/sub-sector analyzed in EU-MERCI) and each of them will lead to a new page displaying the schematics of the sector, as you can see in the figures below. On the schematics there are a series of links to download the EU-MERCI documents[5].
The steps are the following:

The end user is asked to choose, from a drop-down menu, the sector to analyse and investigate.

SELECT THE SECTOR
Food & Beverage
Iron & Steel
Aluminum
Copper
Chemical
Ceramic
Cement
Machinery
Glass
Pulp & Paper
Coke & Petroleum

[5] The total number of documents for all sectors is expected to be around 600.

After that, the screen shows a schematic of all the phases and processes in that specific sector and a list of energy efficiency practices associated to each phase and process is also shown in the scheme, as you can see in the figure below.

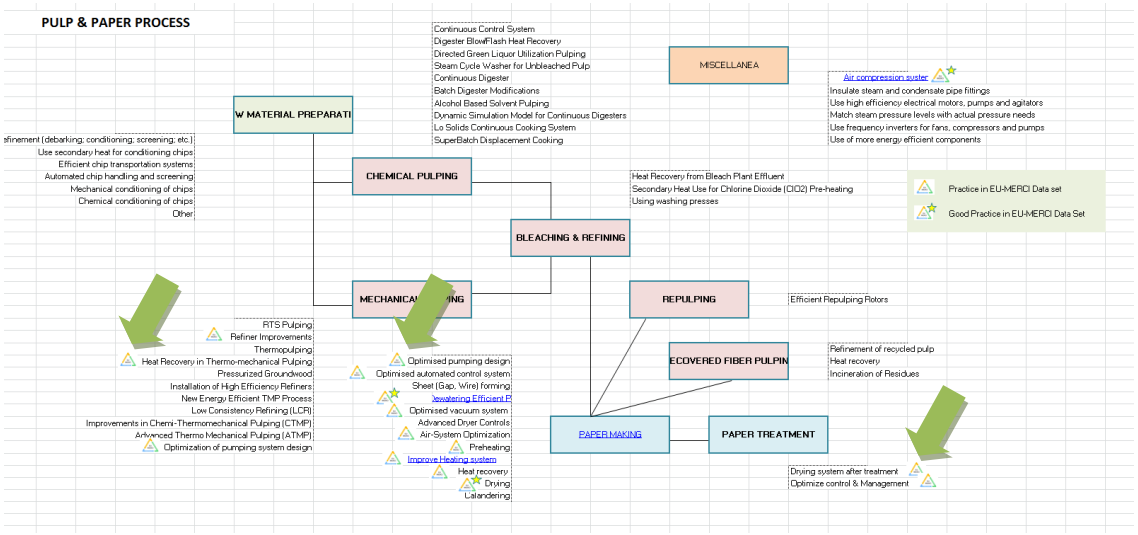
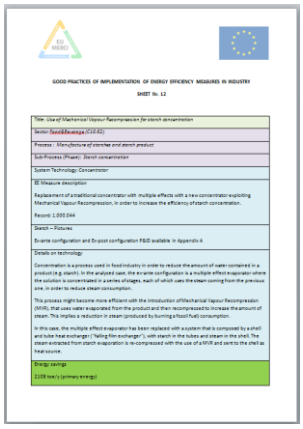


Figure 26: Schematics for the Pulp and Paper sector.

Among those practices, EU-MERCI "Good practices" are identified by the logo of EU-MERCI[6] (see green arrow in the figure above). By clicking on them, the end user can find their downloadable description as EU-MERCI "Good Practice" (a document in a *.pdf format) according to a predefined template.



Such a template contains all the information describing the "Good practice" besides the explanation of the reasons why this is a "Good Practice" according to EU-MERCI. It also contains a number of computed KPIs based on EU statistics supporting such reasons.

The practices without the EU-MERCI logo are the "Best practices" based on literature and the user can also download their description in the same template shown above, in order to have a comprehensive picture of the energy effiency in that specific sector.

[6] Or another suitable identifier.

Below you can find the the schematics for the sectors analysed in EU-MERCI, which will be available on the EU-MERCI Portal.

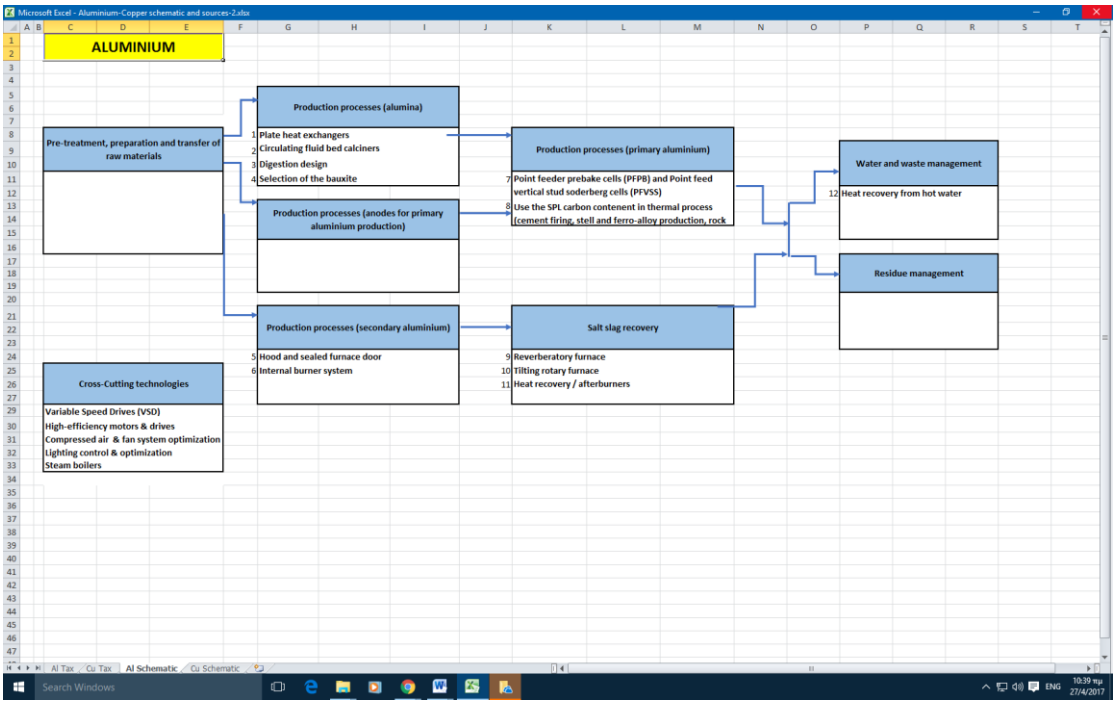


Figure 27: schematics for the Aluminium sector.

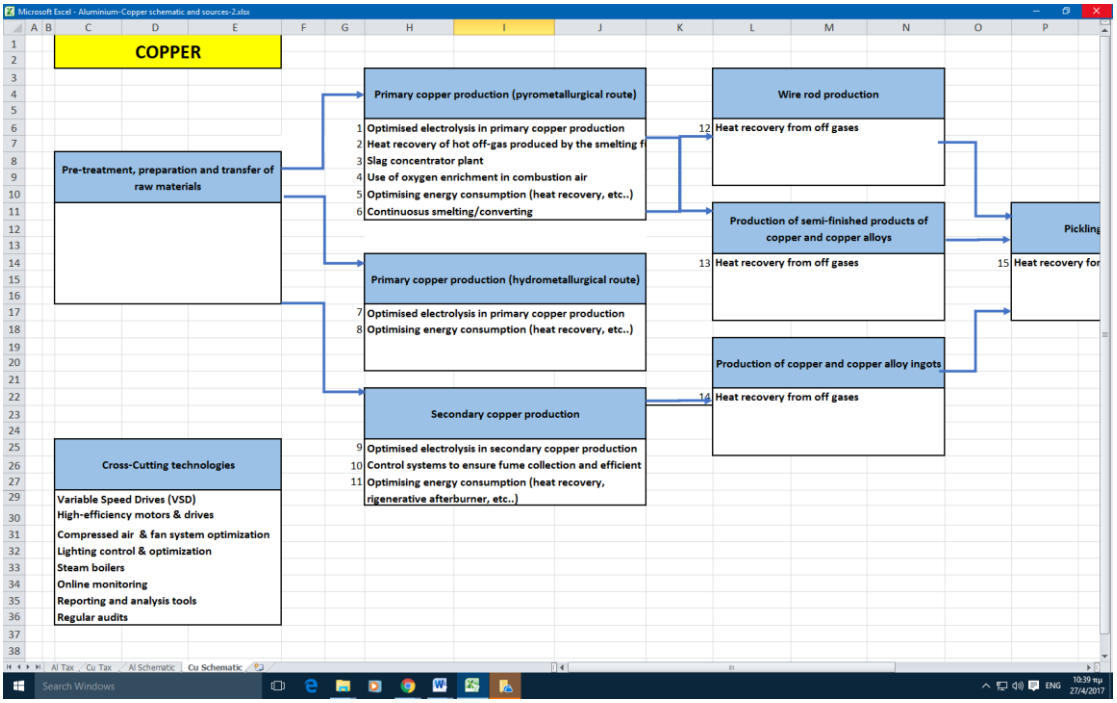


Figure 28: schematics for the Copper sector.

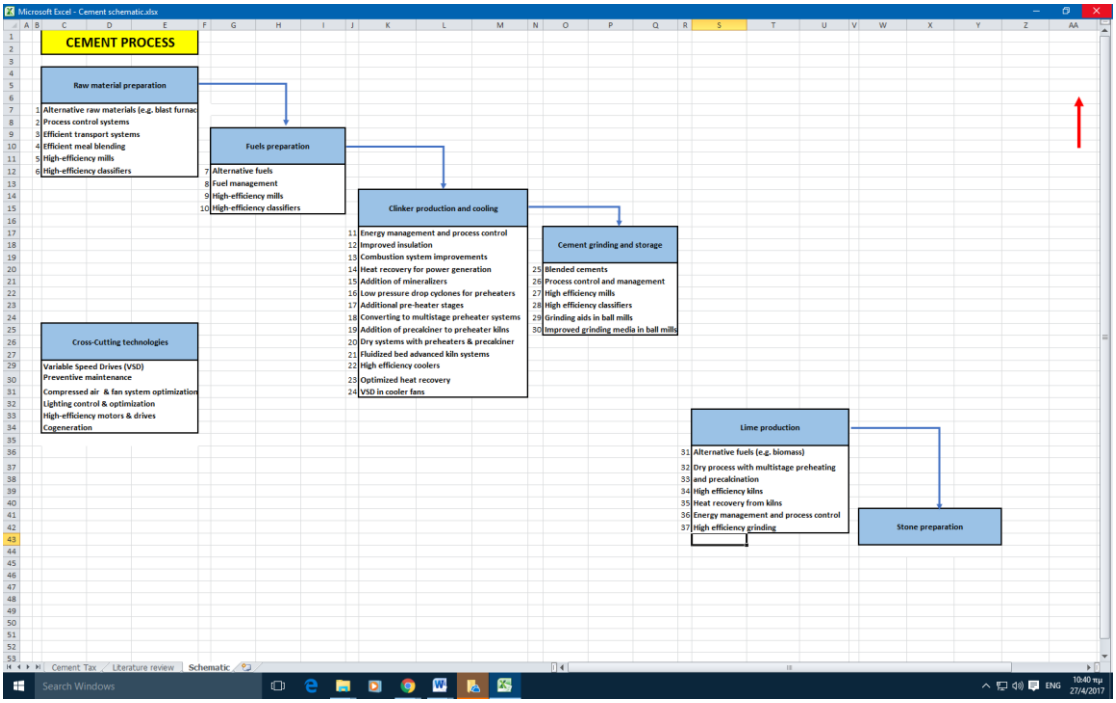


Figure 29: schematics for the Cement sector.

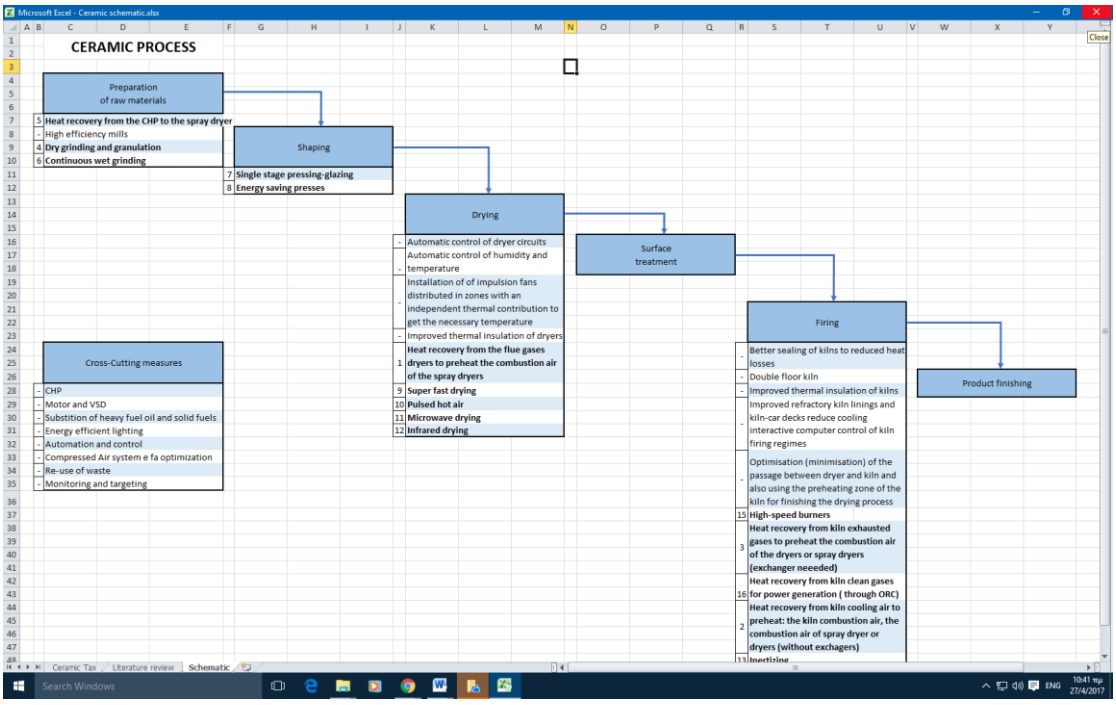


Figure 30: schematics for the Ceramic sector.

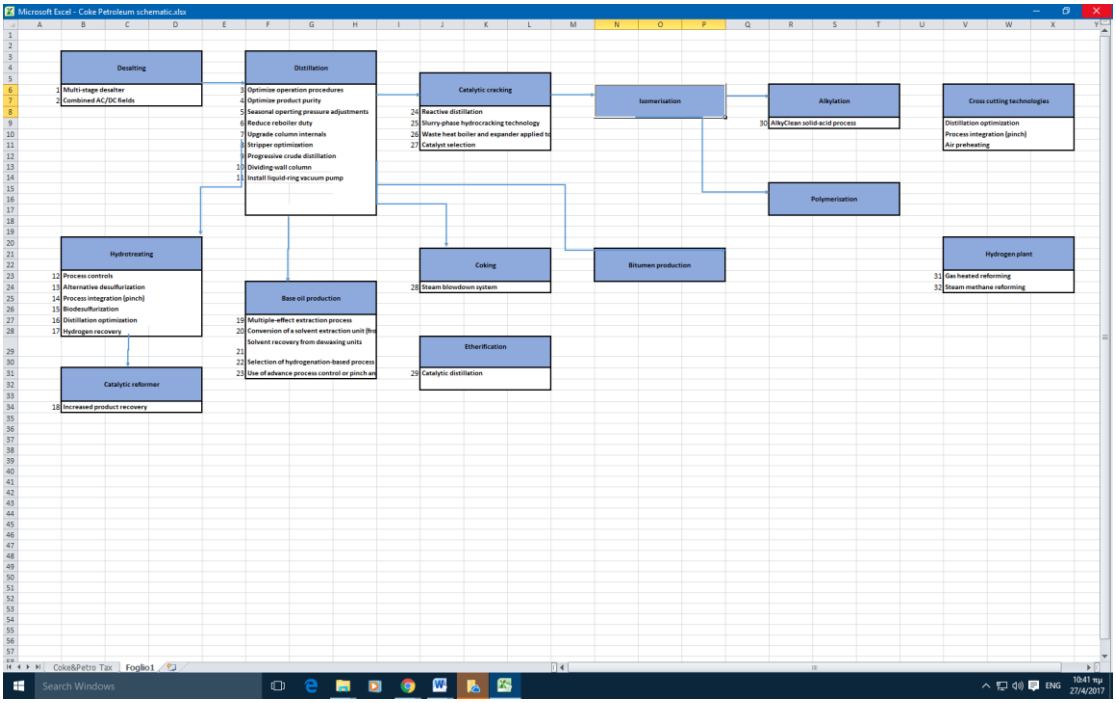


Figure 31: schematics for the Coke and Petroleum sector.

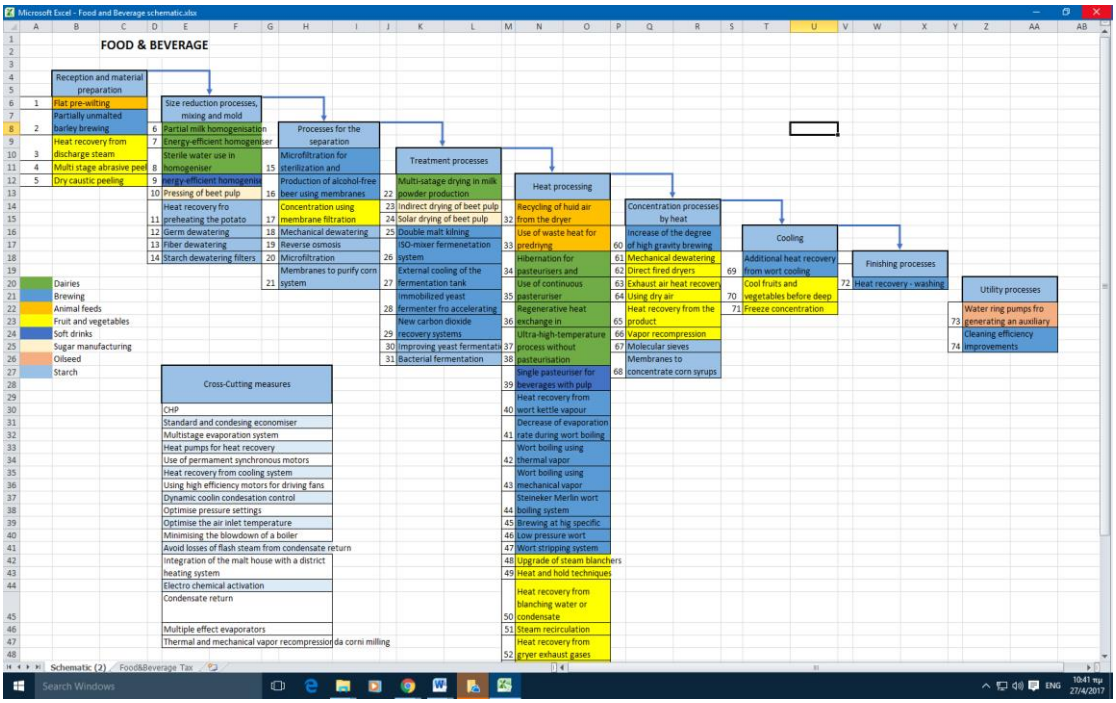


Figure 32: schematics for the Food and Beverage sector.

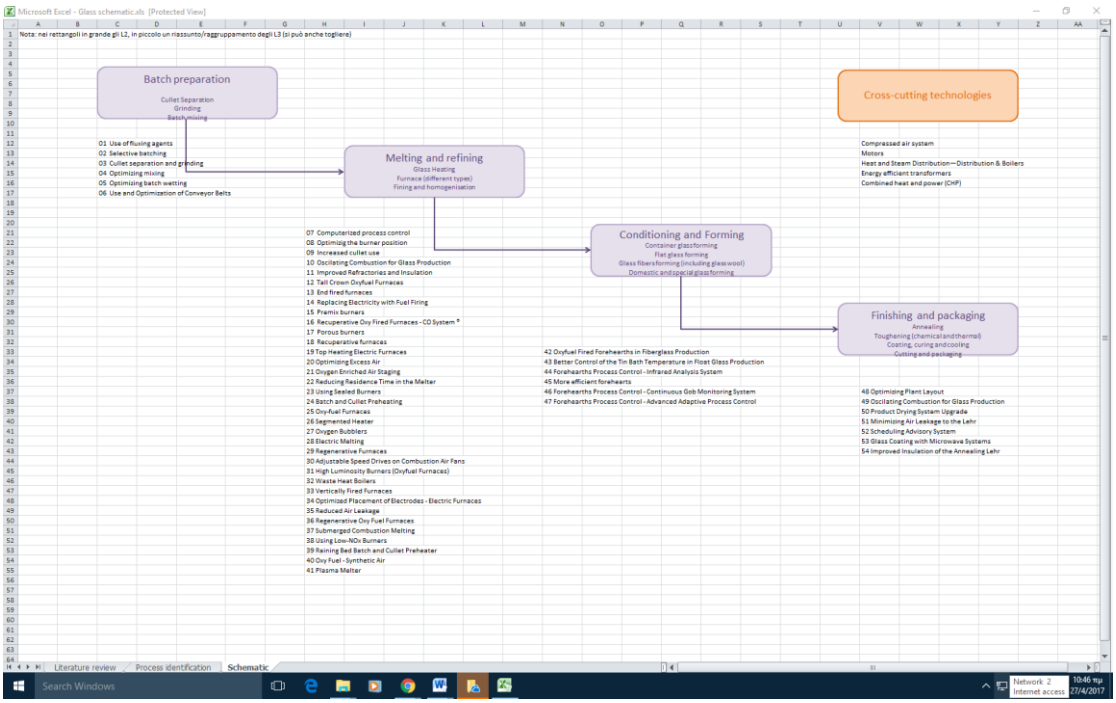


Figure 33: Schematics for the Glass sector.

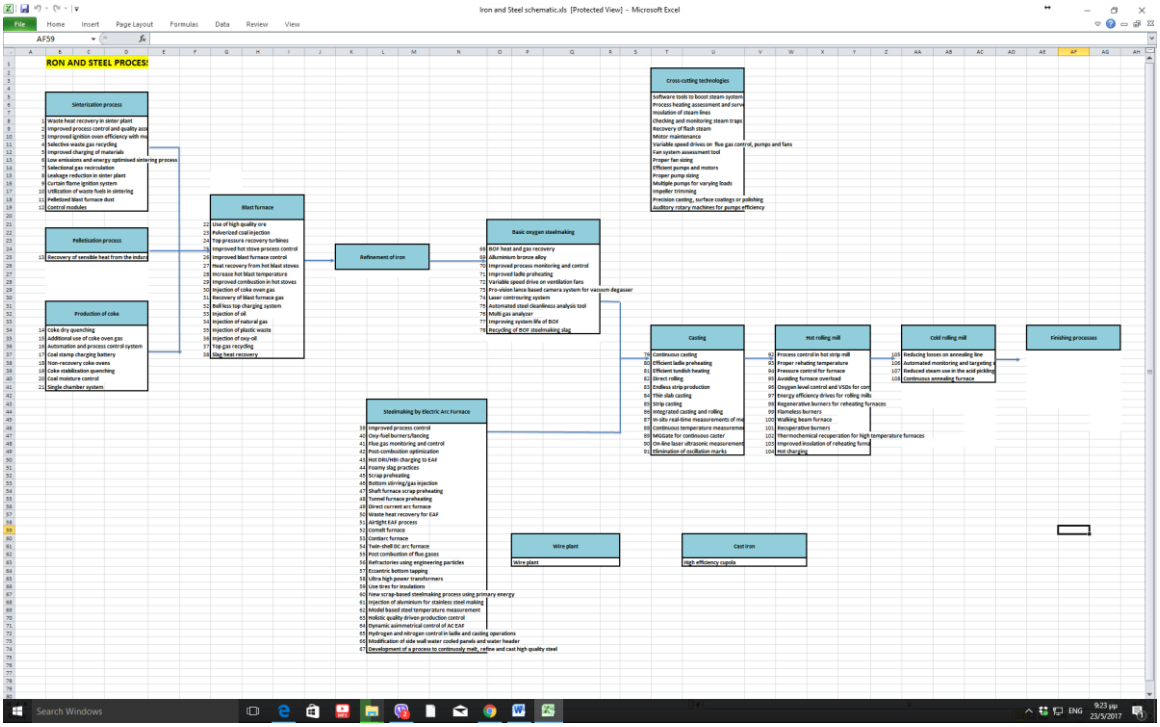


Figure 34: Schematics for the Iron and Steel sector.

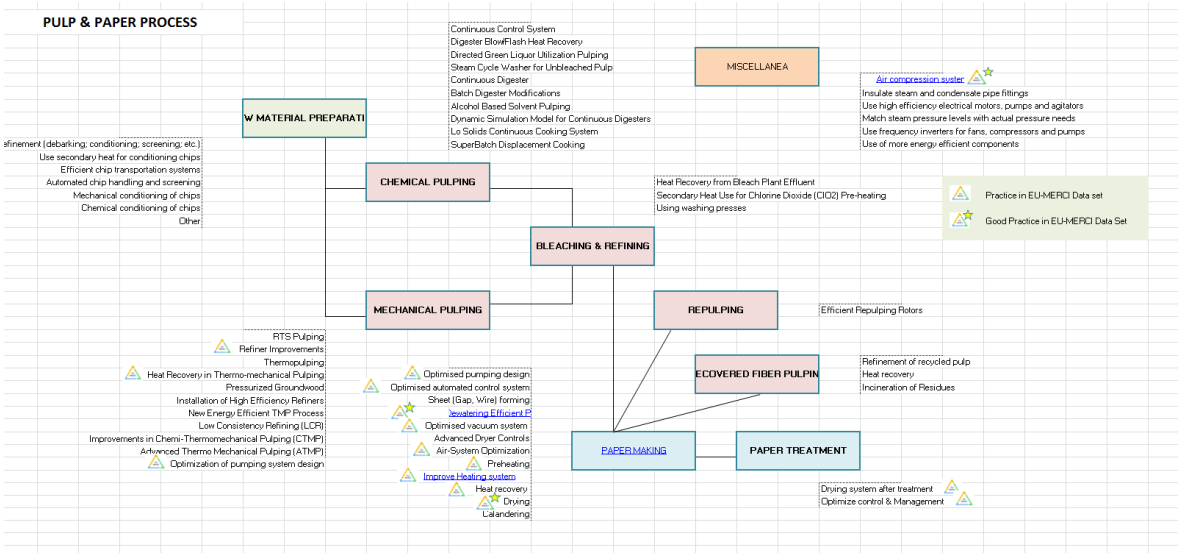


Figure 35: Schematics for the Pulp and Paper sector.

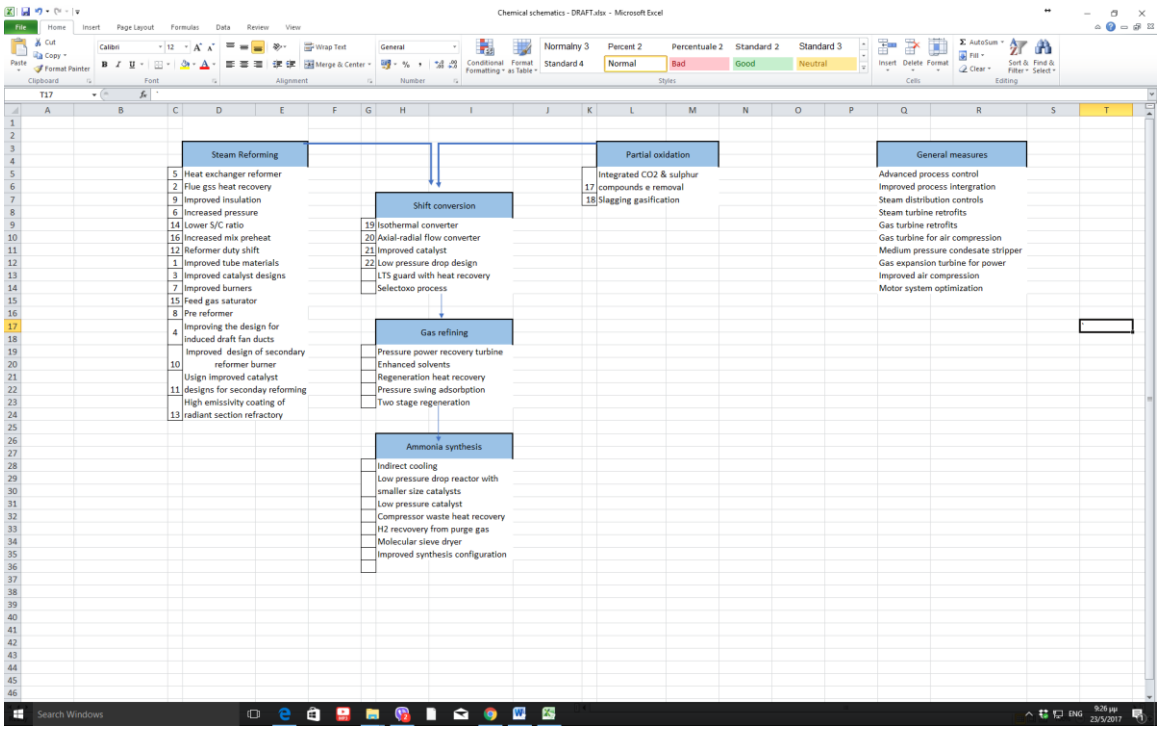


Figure 36: Schematics for the Chemical sector.

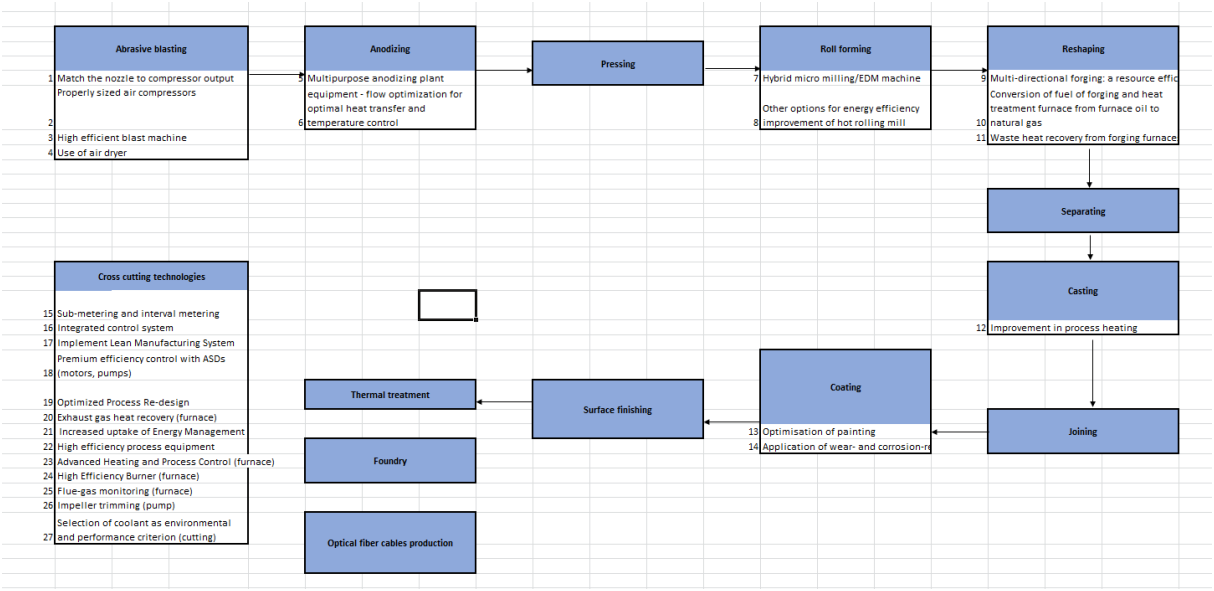


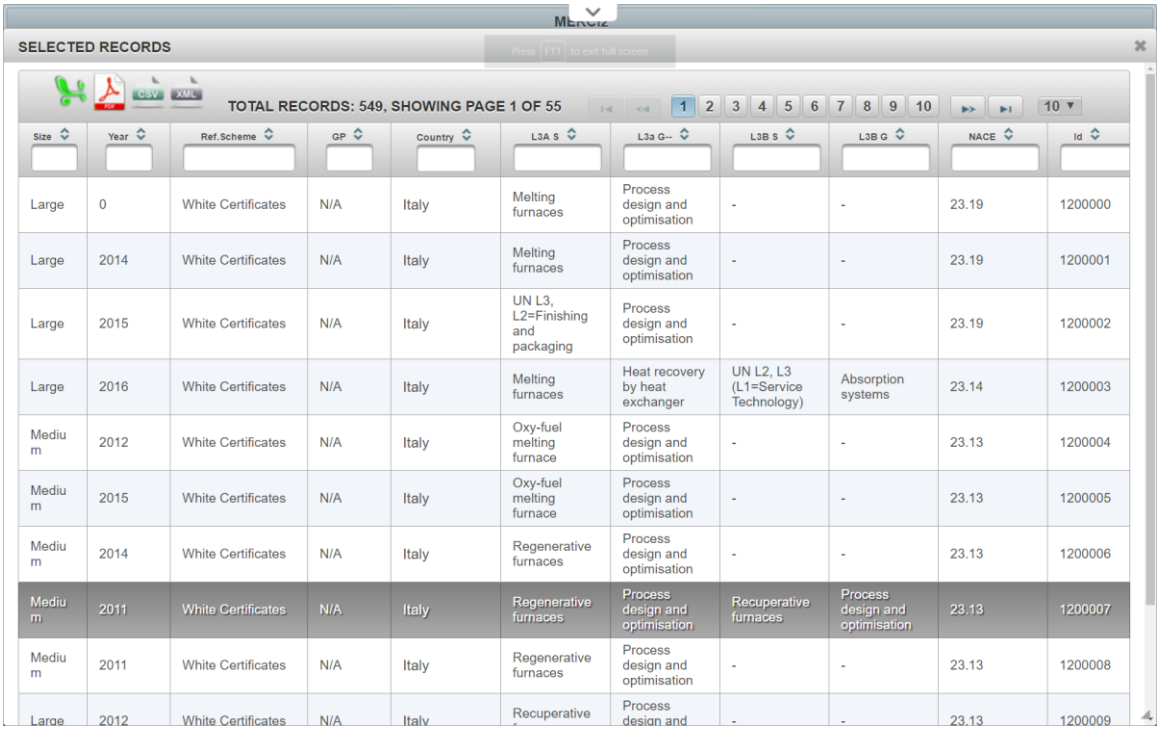
Figure 37: Schematics for the Machinery sector.

4.2.2 The EU-MERCI Database

The EU-MERCI Database will be connected to the EU-MERCI Portal. The Free Navigation selection will be a page with a selection of 8 criteria (the query). The user can select, for example, the Country and/or the NACE code and/or the Company size as shown in the table below. Each criteria can be single or multiple choice from a dropdown menu.

Company Size
Implementation Year
Reference Scheme
Country
Generic Taxonomy
Specific Taxonomy
Good Practice
NACE Code

The output of user selection will be available either on the screen or to be downloaded as a document (in pdf or excel format, for example), as shown in the following figure:



SELECTED RECORDS

TOTAL RECORDS: 549, SHOWING PAGE 1 OF 55

Size	Year	Ref.Scheme	GP	Country	L3A S	L3a G--	L3B S	L3B G	NACE	Id
Large	0	White Certificates	N/A	Italy	Melting furnaces	Process design and optimisation	-	-	23.19	1200000
Large	2014	White Certificates	N/A	Italy	Melting furnaces	Process design and optimisation	-	-	23.19	1200001
Large	2015	White Certificates	N/A	Italy	UN L3, L2=Finishing and packaging	Process design and optimisation	-	-	23.19	1200002
Large	2016	White Certificates	N/A	Italy	Melting furnaces	Heat recovery by heat exchanger	UN L2, L3 (L1=Service Technology)	Absorption systems	23.14	1200003
Mediu m	2012	White Certificates	N/A	Italy	Oxy-fuel melting furnace	Process design and optimisation	-	-	23.13	1200004
Mediu m	2015	White Certificates	N/A	Italy	Oxy-fuel melting furnace	Process design and optimisation	-	-	23.13	1200005
Mediu m	2014	White Certificates	N/A	Italy	Regenerative furnaces	Process design and optimisation	-	-	23.13	1200006
Mediu m	2011	White Certificates	N/A	Italy	Regenerative furnaces	Process design and optimisation	Recuperative furnaces	Process design and optimisation	23.13	1200007
Mediu m	2011	White Certificates	N/A	Italy	Regenerative furnaces	Process design and optimisation	-	-	23.13	1200008
Large	2012	White Certificates	N/A	Italy	Recuperative	Process design and	-	-	23.13	1200009

Figure 38: User selection output.

All Database functions described in Chapter 3, will be accessed also from the EU-MERCI Portal.

5 ANNEX 1 – Normalised lookup tables

TABLE NUTS Code level 0	N - value
Italy	IT
United Kingdom	UK
Poland	PL
Austria	AT
Belgium	BE
Bulgaria	BG
Switzerland	CH
Cyprus	CY
Czech Rep.	CZ
Germany	DE
Denmark	DK
Estonia	EE
Greece	EL
Spain	ES
Finland	FI
France	FR
Croatia	HR
Hungary	HU
Ireland	IE
Iceland	IS
Lithuania	LT
Luxembourg	LU
Latvia	LV
FYROM	MK
Malta	MT
The Netherlands	NL
Norway	NO
Portugal	PT
Romania	RO
Sweden	SE
Slovenia	SI
Slovakia	SK
Turkey	TR

Company size	N - value
Large	10
Medium	20
Small	30
N/A blanks	99

Implementation status	N - value
Implemented	10
Not implemented	20
N/A blanks	99

Case	N - value
Single	10
Combined	20
N/A	99

Baseline Category	N - value
Before Implementation	10
Before - Baseline Site consumption	20
Before - Process Relevant Consumptions	30
N/A, blank	99

Savings calculation approach	N - value
Deemed Saving	10
Metered Saving	20
N/A, blanks	99

Investment Subsidy Qualitative	N - value
Yes	10
No	20
N/A, blanks	99

Reference_Scheme	N-Value
White Certificates	10

Energy Carrier	N value
WASTE	10.99
Waste (non-renewable)	10.01

National Support Schemes	20
Other	30
N/A, blanks	99

audit	audit_N
Yes	10
No	20
N/A, blanks	99

Good practice	Good practice_N
Yes	10
No	20
N/A, blanks	99

Municipal waste (non-renewable)	10.02
Industrial wastes	10.03
RES	11.99
Hydro power	11.01
Wind power	11.02
Solar thermal	11.03
Solar photovoltaic	11.04
Tide, Wave and Ocean	11.05
Geothermal Energy	11.06
Solid biofuels (excluding charcoal)	11.07
Biogas	11.08
Municipal waste (renewable)	11.09
Charcoal	11.1
Liquid biofuels	11.11
Biogasoline	11.12
Biodiesels	11.13
Other liquid biofuels	11.14
Bio jet kerosene	11.15
GAS	12.99
Natural gas	12.01
Derived gases	12.02
Coke Oven Gas	12.03
Blast Furnace Gas	12.04
Gas Works Gas	12.05
Other recovered gases	12.06
OIL	13.99
Crude oil (without NGL)	13.01
Natural gas liquids (NGL)	13.02
Refinery feedstocks	13.03
Additives/Oxygenates	13.04
Other hydrocarbons	13.05
Refinery gas	13.06
Ethane	13.07
Liquified petroleum gas (LPG)	13.08
Gasoline (without bio components)	13.09
Aviation gasoline	13.1
Other kerosene	13.11
Gasoline type jet fuel	13.12
Kerosene type jet fuel (without bio components)	13.13
Naphtha	13.14
Gas/diesel oil (without bio components)	13.15
Fuel oil	13.16
White Spirit and SBP	13.17
Lubricants	13.18
Bitumen	13.19
Petroleum coke	13.2
Paraffin Waxes	13.21
Other Oil Products	13.22

		SOLID	14.99
		Hard coal	14.01
		Patent Fuels	14.02
		Anthracite	14.03
		Coking Coal	14.04
		Other Bituminous Coal	14.05
		Sub-bituminous Coal	14.06
		Coke Oven Coke	14.07
		Gas Coke	14.08
		Coal Tar	14.09
		Lignite/Brown Coal	14.1
		BKB (brown coal briquettes)	14.11
		Peat	14.12
		Peat products	14.13
		NUCLEAR	15.99
		ELECTRICITY	16.99
		Waste heat	17.99
		N/A	99.99
		ELT - End of Life Tyres	10.04
		RDS (Refuse-derived fuel)	10.05
		Solvents	11.16
		Fossil dh	
		Biomass dh	
		Other	

6 ANNEX 2 – Definition of the fields and the KPIs in the Repository

Definition of the fields

ID: numeric code to univocally identify the measure in the EU-MERCI Repository;

Source: name of the Enabler who provided the record;

DB Source-DB Key: numeric code to univocally identify the measure in the National data set;

Location: country in which the measure is implemented;

NACE Code: it is a standard code used in EUROSTAT and other statistics databases to identify the sector in which a Company operates. In EU-MERCI project, it is defined, when available, up to the fourth numeric digit (e.g. NACE C23.13). All the records in the Repository belong to sector C (Manufacturing);

Company size: it defines the size of the company that has put in place the Energy Efficiency project. It has been chosen to use as a basis the number of employees: Small, up to 50 employees; Medium, from 51 to 250 employees; Large, more than 250 employees;

Implementation Status: it defines whether the project has been realized. It can be "implemented" or "not implemented" (in case the measure is still not put in place);

Implementation year: if the measure is implemented, it shows the year of implementation (the year when savings started to be computed);

Technical Life time: it gives the expected life time of the measure (in years);

Taxonomy: it has been built in order to categorize the energy efficiency measures and enable a consistent comparison and the analysis of the different types of measures coming from the National data sets. The taxonomy gives a clear understanding of what component, process and system was affected by each individual measure described in the dataset. Two types of taxonomy have been developed: a generic taxonomy, which is not related to a specific sector and process and thus allow a basic categorization of the measures, and a specific taxonomy aimed at defining the production process and/or sub-process in each sector;

Measure Description Original: full textual description of the adopted measure in the original language;

Measure Description Translated: full textual description of the adopted measure translated in English from the original language;

Case: it is used to distinguish measures with one action (Single) from measures with multiple actions (Combined): e.g. installation of inverters on a compressor is considered a single measure, while the

contemporary installation of inverter and heat recovery on a compressor is considered a combined measure;

Energy carriers: it shows the energy carriers (from 1 to 5) involved before and after the implementation of the measure;

Baseline category: when the baseline is available, it defines whether it was calculated before putting in place the measure and whether it is referred to the whole plant or only to the specific process (identified in taxonomy);

Baseline consumption: it gives the value of the baseline consumption for each energy carrier (from 1 to 5);

Final energy saving: it gives the amount of final energy saved thanks to the measure for each energy carrier (from 1 to 5);

Savings calculation approach: it specifies which calculation approach has been followed to compute savings: it can be deemed (savings are calculated from electricity and fuel bills or using standard methodologies) or measured (specific instrumentation is installed in order to measure electricity and fuel consumption, e.g. flowmeters);

Overall Cost of implementation (EUR): it represents the cost of implementation of the project, considering the capital expenditure (CAPEX) to put in place the measure, without Operating costs;

Investment Subsidy Qualitative: it is a Boolean field that specifies whether the measure has received any subsidies from the policy makers;

Investment Subsidy Quantitative: if any subsidy has been received, it specifies its value;

Energy Price: for each energy carrier, it specifies its cost in €/toe; the costs have been calculated using average EU-28 energy costs for all carriers;

Reference Scheme: it specifies under which kind of policy the measure has been incentivised (e.g. White Certificates);

Measure Identified through external Audit (EED Article 8): it specifies whether the measure has been identified as a consequence of the Audits required by EED Article 8;

DEFINITION OF THE KPIs IN THE REPOSITORY

- **Primary Energy Savings (PES)**: they are calculated in order to be able to compare Final Energy Savings (FES) coming from different sources, in particular thermal and electrical energy savings;
- **Energy Consumption Improvement (ECI)**: it is used to understand the improvement of energy performances of the measure with respect to the previous situation;
- **CRU (Consumption_Reduction_per_Unit_product)**: it is comparable to an Energy Intensity reduction, where the Primary Energy Savings are divided by the cumulative produced value of the sector;

- **Cost of Energy Savings (CES)**: it represents the capital invested in order to obtain one ton of oil equivalent per year of Primary Energy Savings. It is obtained by dividing the cost of the project by the Primary Energy Savings;
- **Cost of Carbon Savings (CCS)**: it represents the capital invested in order to reduce CO_2 emissions of one ton per year. It is obtained by dividing the cost of the project by the ton of CO_2 not released in atmosphere thanks to the energy savings;
- **Renewable Energy Source (RES)**: it takes into account the amount of used energy (in savings) produced with renewable energy sources;
- **Simple Pay-back Time (PBT)**: it is calculated as the period of time after which the investment is completely paid back. Since investments in Energy Efficiency are performed in different countries and years, it has been chosen not to take into account the discount rate, and to consider each project as not incentivised. This last choice has been taken in order to understand which of the implemented measures could be replicated also in absence of support schemes and which ones require higher incentives from policy makers;
- **Cumulative Cash Flow (CCF)**: it is a measure of the incomes generated by the Energy Savings introduced by the adoption of the Energy Efficiency Measure. Also in this case, it has been chosen not to take into account the discount rate, and to consider each project as not incentivised;
- **Share of Project Cost Subsidized (SPCS)**: it is a measure to verify how much of the project has received incentives from the policy makers. This can support also the analysis of the quality of each policy, especially for those policies that set incentives based on the achieved savings and not proportional to the investment cost (e.g. Italian White Certificates mechanism).

7 ANNEX 3 - Schema definition

```
CREATE TABLE `baselinecategory` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `baselinecategory_n` smallint(6) DEFAULT NULL,
  `baselinecategory_descr` varchar(60) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `baselinecategory_n_UNIQUE` (`baselinecategory_n`)
) ENGINE=InnoDB AUTO_INCREMENT=5 DEFAULT CHARSET=greek;

CREATE TABLE `casetype` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `casetype_n` varchar(2) DEFAULT NULL,
  `casetype_descr` varchar(60) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `casetype_n_UNIQUE` (`casetype_n`)
) ENGINE=InnoDB AUTO_INCREMENT=4 DEFAULT CHARSET=greek;

CREATE TABLE `companyobliged2eed` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `companyobliged2eed_n` varchar(2) NOT NULL,
  `companyobliged2eed_descr` varchar(60) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `companyobliged2eed_n_UNIQUE` (`companyobliged2eed_n`)
) ENGINE=InnoDB AUTO_INCREMENT=4 DEFAULT CHARSET=greek;

CREATE TABLE `companysize` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `companysize_n` varchar(2) NOT NULL,
  `companysize_descr` varchar(60) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `companysize_n_UNIQUE` (`companysize_n`)
) ENGINE=InnoDB AUTO_INCREMENT=5 DEFAULT CHARSET=greek;

CREATE TABLE `country` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `country_n` varchar(2) NOT NULL,
  `country_descr` varchar(60) DEFAULT NULL,
  `country_active` smallint(6) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `country_n_UNIQUE` (`country_n`)
) ENGINE=InnoDB AUTO_INCREMENT=34 DEFAULT CHARSET=greek;
```

```
CREATE TABLE `energycarrier` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `energycarrier_n` varchar(5) NOT NULL,
  `energycarrier_descr` varchar(60) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `energycarrier_n_UNIQUE` (`energycarrier_n`)
) ENGINE=InnoDB AUTO_INCREMENT=75 DEFAULT CHARSET=greek;

CREATE TABLE `externalaudit` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `externalaudit_n` varchar(2) NOT NULL,
  `externalaudit_descr` varchar(60) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `externalaudit_n_UNIQUE` (`externalaudit_n`)
) ENGINE=InnoDB AUTO_INCREMENT=4 DEFAULT CHARSET=greek;

CREATE TABLE `goodpractice` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `goodpractice_n` varchar(2) NOT NULL,
  `goodpractice_descr` varchar(60) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `goodpractice_n_UNIQUE` (`goodpractice_n`)
) ENGINE=InnoDB AUTO_INCREMENT=4 DEFAULT CHARSET=greek;

CREATE TABLE `implementationstatus` (
  `id` int(11) NOT NULL,
  `implementationstatus_n` varchar(2) NOT NULL,
  `implementationstatus_descr` varchar(60) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `implementationstatus_n_UNIQUE` (`implementationstatus_n`)
) ENGINE=InnoDB DEFAULT CHARSET=greek;

CREATE TABLE `investmentsubsidyqualitative` (
  `id` int(11) NOT NULL,
  `investmentsubsidyqualitative_n` varchar(2) NOT NULL,
  `investmentsubsidyqualitative_descr` varchar(60) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `investmentsubsidyqualitative_n_UNIQUE` (`investmentsubsidyqualitative_n`)
) ENGINE=InnoDB DEFAULT CHARSET=greek;

CREATE TABLE `nace2` (
  `id` int(11) NOT NULL,
```

```
  `nace_section` varchar(1) DEFAULT NULL,
  `nace_division` varchar(2) DEFAULT NULL,
  `nace2_group` varchar(4) DEFAULT NULL,
  `nace2_class` varchar(6) NOT NULL,
  `nace_description1` varchar(150) DEFAULT NULL,
  `nace_filler` varchar(10) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `nace2_class_UNIQUE` (`nace2_class`)
) ENGINE=InnoDB DEFAULT CHARSET=greek;

CREATE TABLE `refscheme` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `refscheme_n` varchar(2) NOT NULL,
  `refscheme_descr1` varchar(60) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `refscheme_n_UNIQUE` (`refscheme_n`)
) ENGINE=InnoDB AUTO_INCREMENT=5 DEFAULT CHARSET=greek;

CREATE TABLE `repository` (
  `ID` int(11) NOT NULL AUTO_INCREMENT,
  `Source_DB` varchar(50) DEFAULT NULL,
  `Source_DB_Key` varchar(255) DEFAULT NULL,
  `Country` varchar(5) DEFAULT NULL,
  `NACE_Code_Level_3` varchar(5) DEFAULT NULL,
  `Company_Size` varchar(50) DEFAULT NULL,
  `Company_Size_N` varchar(2) DEFAULT NULL,
  `Implementation_Status` varchar(50) DEFAULT NULL,
  `Implementation_Status_N` varchar(2) DEFAULT NULL,
  `Implementation_Year` float DEFAULT NULL,
  `Technical_Life_Time` decimal(10,2) DEFAULT NULL,
  `L3A_Generic_N` varchar(12) DEFAULT NULL,
  `L3A_Generic_NRM_N` varchar(3) DEFAULT NULL,
  `L3B_Generic_N` varchar(12) DEFAULT NULL,
  `L3B_Generic_NRM_N` varchar(3) DEFAULT NULL,
  `L3A_Specific_N` varchar(12) DEFAULT NULL,
  `L3A_Specific_NRM_N` varchar(3) DEFAULT NULL,
  `L3B_Specific_N` varchar(12) DEFAULT NULL,
  `L3B_Specific_NRM_N` varchar(3) DEFAULT NULL,
  `Measure_Description_Original` mediumtext,
  `Measure_Description_Translated` mediumtext,
  `CASE0` varchar(50) DEFAULT NULL,
  `Case_N` varchar(2) DEFAULT NULL,
  `Energy_Carrier_before_1` varchar(50) DEFAULT NULL,
```

```
`Energy_Carrier_before_1_N` varchar(5) DEFAULT NULL,
`Energy_Carrier_before_2` varchar(50) DEFAULT NULL,
`Energy_Carrier_before_2_N` varchar(5) DEFAULT NULL,
`Energy_Carrier_before_3` varchar(50) DEFAULT NULL,
`Energy_Carrier_before_3_N` varchar(5) DEFAULT NULL,
`Energy_Carrier_before_4` varchar(50) DEFAULT NULL,
`Energy_Carrier_before_4_N` varchar(5) DEFAULT NULL,
`Energy_Carrier_before_5` varchar(50) DEFAULT NULL,
`Energy_Carrier_before_5_N` varchar(5) DEFAULT NULL,
`Energy_Carrier_after_1` varchar(50) DEFAULT NULL,
`Energy_Carrier_after_1_N` varchar(5) DEFAULT NULL,
`Energy_Carrier_after_2` varchar(50) DEFAULT NULL,
`Energy_Carrier_after_2_N` varchar(5) DEFAULT NULL,
`Energy_Carrier_after_3` varchar(50) DEFAULT NULL,
`Energy_Carrier_after_3_N` varchar(5) DEFAULT NULL,
`Energy_Carrier_after_4` varchar(255) DEFAULT NULL,
`Energy_Carrier_after_4_N` varchar(5) DEFAULT NULL,
`Energy_Carrier_after_5` varchar(255) DEFAULT NULL,
`Energy_Carrier_after_5_N` varchar(5) DEFAULT NULL,
`Baseline_Category` varchar(50) DEFAULT NULL,
`Baseline_Category_N` smallint(6) DEFAULT NULL,
`Baseline_Consumption_Carrier_1` decimal(10,2) DEFAULT NULL,
`Baseline_Consumption_Carrier_2` decimal(10,2) DEFAULT NULL,
`Baseline_Consumption_Carrier_3` decimal(10,2) DEFAULT NULL,
`Baseline_Consumption_Carrier_4` decimal(10,2) DEFAULT NULL,
`Baseline_Consumption_Carrier_5` decimal(10,2) DEFAULT NULL,
`Final_Energy_Saving_Carrier_1` decimal(10,2) DEFAULT NULL,
`Final_Energy_Saving_Carrier_2` decimal(10,2) DEFAULT NULL,
`Final_Energy_Saving_Carrier_3` decimal(10,2) DEFAULT NULL,
`Final_Energy_Saving_Carrier_4` decimal(10,2) DEFAULT NULL,
`Final_Energy_Saving_Carrier_5` decimal(10,2) DEFAULT NULL,
`Total_Final_Energy_Savings` decimal(10,2) DEFAULT NULL,
`Savings_Calculation_Approach` varchar(50) DEFAULT NULL,
`Savings_Calculation_Approach_N` varchar(2) DEFAULT NULL,
`Overall_Cost_of_Implementation` int(11) DEFAULT NULL,
`Investment_Subsidy_Qualitative` varchar(50) DEFAULT NULL,
`Investment_Subsidy_Qualitative_N` varchar(2) DEFAULT NULL,
`Investment_Subsidiy_Quantitative` int(11) DEFAULT NULL,
`Energy_Price_Carrier_1` decimal(10,1) DEFAULT NULL,
`Energy_Price_Carrier_2` decimal(10,1) DEFAULT NULL,
`Energy_Price_Carrier_3` decimal(10,1) DEFAULT NULL,
`Energy_Price_Carrier_4` decimal(10,1) DEFAULT NULL,
`Energy_Price_Carrier_5` decimal(10,1) DEFAULT NULL,
```

```
`Reference_Scheme` varchar(50) DEFAULT NULL,
`Reference_Scheme_N` varchar(2) DEFAULT NULL,
`Measure_Identified_through_external_Audit` varchar(50) DEFAULT NULL,
`Externalaudit_N` varchar(2) DEFAULT NULL,
`PES_Primary_Energy_Savings` decimal(10,1) DEFAULT NULL,
`Energy_Consumption_Improvement` smallint(6) DEFAULT NULL,
`CRU_Consumption_Reduction_per_Unit_product` decimal(10,3) DEFAULT NULL,
`CAPEX_PES` int(11) DEFAULT NULL,
`CAPEX_CO2` int(11) DEFAULT NULL,
`RES` smallint(6) DEFAULT NULL,
`Payback_Time` decimal(5,1) DEFAULT NULL,
`CCF_Cumulative_Cash_Flow` int(11) DEFAULT NULL,
`SPCS` smallint(6) DEFAULT NULL,
`Good_Practice` varchar(50) DEFAULT NULL,
`Good_Practice_N` varchar(2) DEFAULT NULL,
PRIMARY KEY (`ID`),
KEY `baselinecategoryFK_idx` (`Baseline_Category_N`),
KEY `companysizeFK_idx` (`Company_Size_N`),
KEY `countryFK_idx` (`Country`),
KEY `energycarrierB2FK_idx` (`Energy_Carrier_before_2_N`),
KEY `energycarrierB3FK_idx` (`Energy_Carrier_before_3_N`),
KEY `energycarrierB4FK_idx` (`Energy_Carrier_before_4_N`),
KEY `energycarrierB5FK_idx` (`Energy_Carrier_before_5_N`),
KEY `energycarrierA1FK_idx` (`Energy_Carrier_after_1_N`),
KEY `energycarrierA2FK_idx` (`Energy_Carrier_after_2_N`),
KEY `energycarrierA3FK_idx` (`Energy_Carrier_after_3_N`),
KEY `energycarrierA4FK_idx` (`Energy_Carrier_after_4_N`),
KEY `energycarrierA5FK_idx` (`Energy_Carrier_after_5_N`),
KEY `externalauditFK_idx` (`Externalaudit_N`),
KEY `goodpracticeFK_idx` (`Good_Practice_N`),
KEY `implementationstatusFK_idx` (`Implementation_Status_N`),
KEY `investmentsubsidyqualitativeFK_idx` (`Investment_Subsidy_Qualitative_N`),
KEY `nace2FK_idx` (`NACE_Code_Level_3`),
KEY `refschemeFK_idx` (`Reference_Scheme_N`),
KEY `savingscalculationapproachFK_idx` (`Savings_Calculation_Approach_N`),
KEY `taxonomyGAFK_idx` (`L3A_Generic_N`),
KEY `taxonomyGBFK_idx` (`L3B_Generic_N`),
KEY `taxonomySAFK_idx` (`L3A_Specific_N`),
KEY `taxonomySBFK_idx` (`L3B_Specific_N`),
KEY `energycarrierB1FK_idx` (`Energy_Carrier_before_1_N`),
KEY `casetypeFK_idx` (`Case_N`),
CONSTRAINT `casetypeFK` FOREIGN KEY (`Case_N`) REFERENCES `casetype` (`casetype_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,
```

```
  CONSTRAINT `baselinecategoryFK` FOREIGN KEY (`Baseline_Category_N`) REFERENCES `baselinecategory` (`baselinecategory_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `companysizeFK` FOREIGN KEY (`Company_Size_N`) REFERENCES `companysize` (`companysize_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `countryFK` FOREIGN KEY (`Country`) REFERENCES `country` (`country_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `energycarrierA1FK` FOREIGN KEY (`Energy_Carrier_after_1_N`) REFERENCES `energycarrier` (`energycarrier_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `energycarrierA2FK` FOREIGN KEY (`Energy_Carrier_after_2_N`) REFERENCES `energycarrier` (`energycarrier_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `energycarrierA3FK` FOREIGN KEY (`Energy_Carrier_after_3_N`) REFERENCES `energycarrier` (`energycarrier_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `energycarrierA4FK` FOREIGN KEY (`Energy_Carrier_after_4_N`) REFERENCES `energycarrier` (`energycarrier_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `energycarrierA5FK` FOREIGN KEY (`Energy_Carrier_after_5_N`) REFERENCES `energycarrier` (`energycarrier_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `energycarrierB1FK` FOREIGN KEY (`Energy_Carrier_before_1_N`) REFERENCES `energycarrier` (`energycarrier_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `energycarrierB2FK` FOREIGN KEY (`Energy_Carrier_before_2_N`) REFERENCES `energycarrier` (`energycarrier_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `energycarrierB3FK` FOREIGN KEY (`Energy_Carrier_before_3_N`) REFERENCES `energycarrier` (`energycarrier_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `energycarrierB4FK` FOREIGN KEY (`Energy_Carrier_before_4_N`) REFERENCES `energycarrier` (`energycarrier_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `energycarrierB5FK` FOREIGN KEY (`Energy_Carrier_before_5_N`) REFERENCES `energycarrier` (`energycarrier_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `externalauditFK` FOREIGN KEY (`Externalaudit_N`) REFERENCES `externalaudit` (`externalaudit_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `goodpracticeFK` FOREIGN KEY (`Good_Practice_N`) REFERENCES `goodpractice` (`goodpractice_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `implementationstatusFK` FOREIGN KEY (`Implementation_Status_N`) REFERENCES `implementationstatus` (`implementationstatus_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `investmentsubsidyqualitativeFK` FOREIGN KEY (`Investment_Subsidy_Qualitative_N`) REFERENCES `investmentsubsidyqualitative` (`investmentsubsidyqualitative_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `nace2FK` FOREIGN KEY (`NACE_Code_Level_3`) REFERENCES `nace2` (`nace2_class`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `refschemeFK` FOREIGN KEY (`Reference_Scheme_N`) REFERENCES `refscheme` (`refscheme_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `savingscalculationapproachFK` FOREIGN KEY (`Savings_Calculation_Approach_N`) REFERENCES `savingscalculationapproach` (`savingscalculationapproach_n`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `taxonomyGAFK` FOREIGN KEY (`L3A_Generic_N`) REFERENCES `taxonomy` (`l3`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `taxonomyGBFK` FOREIGN KEY (`L3B_Generic_N`) REFERENCES `taxonomy` (`l3`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `taxonomySAFK` FOREIGN KEY (`L3A_Specific_N`) REFERENCES `taxonomy` (`l3`) ON DELETE NO ACTION ON UPDATE NO ACTION,

  CONSTRAINT `taxonomySBFK` FOREIGN KEY (`L3B_Specific_N`) REFERENCES `taxonomy` (`l3`) ON DELETE NO ACTION ON UPDATE NO ACTION

) ENGINE=InnoDB AUTO_INCREMENT=4800004 DEFAULT CHARSET=greek;


CREATE TABLE `repositoryb1` (

  `ID` int(11) NOT NULL,

  `ID_ORGANISATION` varchar(255) DEFAULT NULL,

  `Source_DB` varchar(50) DEFAULT NULL,

  `Source_DB_Key` varchar(255) DEFAULT NULL,
```

```
`Location_NUTS` varchar(5) DEFAULT NULL,
`NACE_Code_Level_1` smallint(6) DEFAULT NULL,
`NACE_Code_Level_2` smallint(6) DEFAULT NULL,
`NACE_Code_Level_3` int(11) DEFAULT NULL,
`Company_Size` varchar(50) DEFAULT NULL,
`Company_Size_N` smallint(6) DEFAULT NULL,
`Implementation_Status` varchar(50) DEFAULT NULL,
`Implementation_Status_N` smallint(6) DEFAULT NULL,
`Implementation_year` smallint(6) DEFAULT NULL,
`Technical_Life_time` decimal(18,2) DEFAULT NULL,
`L1_Process_Service` varchar(255) DEFAULT NULL,
`L1_Process_Service_N` int(11) DEFAULT NULL,
`L2_System_level_Generic` varchar(255) DEFAULT NULL,
`L2_System_level_Generic_N` varchar(255) DEFAULT NULL,
`L2_System_level_Specific` varchar(255) DEFAULT NULL,
`L2_System_level_Specific_N` varchar(255) DEFAULT NULL,
`L3_Generic_Main` varchar(255) DEFAULT NULL,
`L3_Generic_Main_N` varchar(255) DEFAULT NULL,
`L3_Generic_Main_NRM` varchar(1) DEFAULT NULL,
`L3_Generic_Main_NRM_N` varchar(255) DEFAULT NULL,
`L3_Generic_Secondary` varchar(255) DEFAULT NULL,
`L3_Generic_Secondary_N` varchar(255) DEFAULT NULL,
`L3_Generic_Secondary_NRM` varchar(255) DEFAULT NULL,
`L3_Generic_Secondary_NRM_N` varchar(255) DEFAULT NULL,
`L3_Sector_Specific_Main` varchar(255) DEFAULT NULL,
`L3_Sector_Specific_Main_N` varchar(255) DEFAULT NULL,
`L3_Sector_Specific_Main_NRM` varchar(1) DEFAULT NULL,
`L3_Sector_Specific_Main_NRM_N` varchar(255) DEFAULT NULL,
`L3_Sector_Specific_Secondary` varchar(255) DEFAULT NULL,
`L3_Sector_Specific_Secondary_N` varchar(255) DEFAULT NULL,
`L3_Sector_Specific_Secondary_NRM` varchar(255) DEFAULT NULL,
`L3_Sector_Specific_Secondary_NRM_N` varchar(255) DEFAULT NULL,
`Measure_Description_Original` mediumtext,
`Measure_Description_Translated` mediumtext,
`CASE50` varchar(50) DEFAULT NULL,
`Case_N` smallint(6) DEFAULT NULL,
`energy_carrier_before_1` varchar(50) DEFAULT NULL,
`energy_carrier_before_1_M` decimal(18,2) DEFAULT NULL,
`energy_carrier_before_2` varchar(50) DEFAULT NULL,
`energy_carrier_before_2_N` decimal(18,2) DEFAULT NULL,
`energy_carrier_before_3` varchar(50) DEFAULT NULL,
`energy_carrier_before_3_N` decimal(18,2) DEFAULT NULL,
`energy_carrier_after_1` varchar(50) DEFAULT NULL,
```

```
 `energy_carrier_after_1_N` decimal(18,2) DEFAULT NULL,
 `energy_carrier_after_2` varchar(50) DEFAULT NULL,
 `energy_carrier_after_2_N` decimal(18,2) DEFAULT NULL,
 `energy_carrier_after_3` varchar(50) DEFAULT NULL,
 `energy_carrier_after_3_N` decimal(18,2) DEFAULT NULL,
 `baseline_category` varchar(50) DEFAULT NULL,
 `baseline_category_N` smallint(6) DEFAULT NULL,
 `baseline_consumption_carrier_1` decimal(18,3) DEFAULT NULL,
 `baseline_consumption_carrier_2` decimal(18,3) DEFAULT NULL,
 `baseline_consumption_carrier_3` decimal(18,3) DEFAULT NULL,
 `Final_energy_saving_carrier_1` decimal(18,3) DEFAULT NULL,
 `Final_energy_saving_carrier_2` decimal(18,3) DEFAULT NULL,
 `Final_energy_saving_carrier_3` decimal(18,3) DEFAULT NULL,
 `Total_Final_Energy_savings` decimal(18,3) DEFAULT NULL,
 `Savings_calculation_approach` varchar(50) DEFAULT NULL,
 `Savings_calculation_approach_N` smallint(6) DEFAULT NULL,
 `Overall_Cost_of_implementation_EUR` decimal(18,3) DEFAULT NULL,
 `Investment_Subsidy_Qualitative` varchar(50) DEFAULT NULL,
 `Investment_Subsidy_Qualitative_N` smallint(6) DEFAULT NULL,
 `Investment_Subsidiy_Quantitative` decimal(18,2) DEFAULT NULL,
 `Energy_Price_Carrier_1` decimal(18,2) DEFAULT NULL,
 `Energy_Price_Carrier_2` decimal(18,2) DEFAULT NULL,
 `Energy_Price_Carrier_3` decimal(18,2) DEFAULT NULL,
 `Ref_Scheme` varchar(50) DEFAULT NULL,
 `Ref_Scheme_N` smallint(6) DEFAULT NULL,
 `EED_Article_8` varchar(50) DEFAULT NULL,
 `EED_Article_8_N` smallint(6) DEFAULT NULL,
 `Energy_Consumption_Improvement` decimal(10,2) DEFAULT NULL,
 `Total_Energy_Savings_toe_primary` decimal(18,1) DEFAULT NULL,
 `Annual_Carbon_Reductions` decimal(18,2) DEFAULT NULL,
 `toe_Saved` decimal(18,3) DEFAULT NULL,
 `Simple_Payback` decimal(5,1) DEFAULT NULL,
 `Consumption_reduction_per_unit_product` decimal(10,1) DEFAULT NULL,
 `Renewable_energy_use_pct` smallint(6) DEFAULT NULL,
 `Cumulative_Cash_Flow` decimal(18,1) DEFAULT NULL,
 `Share_of_Project_Cost_Subsidized` smallint(6) DEFAULT NULL,
 PRIMARY KEY (`ID`),
 KEY `baselinecategory_fk_idx` (`baseline_category_N`),
 CONSTRAINT `baselinecategory_fk` FOREIGN KEY (`baseline_category_N`) REFERENCES `0baselinecategory` (`baselinecategory_n`) ON DELETE NO ACTION
ON UPDATE NO ACTION
) ENGINE=InnoDB DEFAULT CHARSET=greek;


CREATE TABLE `savingscalculationapproach` (
```

```
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `savingscalculationapproach_n` varchar(2) NOT NULL,
  `savingscalculationapproach_descr` varchar(60) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `savingscalculationapproach_n_UNIQUE` (`savingscalculationapproach_n`)
) ENGINE=InnoDB AUTO_INCREMENT=4 DEFAULT CHARSET=greek;

CREATE TABLE `sector` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `sector_n` varchar(2) NOT NULL,
  `sector_descr` varchar(60) DEFAULT NULL,
  `nace_division1` varchar(2) DEFAULT NULL,
  `nace_division2` varchar(2) DEFAULT NULL,
  `nace_division3` varchar(2) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `sector_n_UNIQUE` (`sector_n`)
) ENGINE=InnoDB AUTO_INCREMENT=13 DEFAULT CHARSET=greek;

CREATE TABLE `taxonomy` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `sector_n` varchar(2) DEFAULT NULL,
  `l1` varchar(5) DEFAULT NULL,
  `l1_descr` varchar(100) DEFAULT NULL,
  `l2` varchar(8) DEFAULT NULL,
  `l2_descr` varchar(100) DEFAULT NULL,
  `l3` varchar(12) NOT NULL,
  `l3_descr` varchar(100) DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `l3_UNIQUE` (`l3`),
  KEY `sectorFK_idx` (`sector_n`),
  CONSTRAINT `sectorFK` FOREIGN KEY (`sector_n`) REFERENCES `sector` (`sector_n`) ON DELETE NO ACTION ON UPDATE NO ACTION
) ENGINE=InnoDB AUTO_INCREMENT=1995 DEFAULT CHARSET=greek;
```

8 ANNEX 4 - Source code files statistics

Overall		
Symbol	**Count**	**Definition**
Source Files	172	Source Files
Directories	36	Directories
LOC	30195	Lines of Code
BLOC	2356	Blank Lines of Code
SLOC-P	24469	Physical Executable Lines of Code
SLOC-L	10072	Logical Executable Lines of Code
MVG	1559	McCabe VG Complexity
C&SLOC	105	Code and Comment Lines of Code
CLOC	3370	Comment Only Lines of Code
CWORD	16450	Commentary Words
HCLOC	205	Header Comment Lines of Code
HCWORD	1271	Header Commentary Words

FOLDERS

Folder	Files	LOC	SLOC Physical	SLOC Logical	MVG	BLOC	C&SLOC	CLOC	CWORD	HCLOC	HCWORD
Total	172	30195	24469	10072	1559	2356	105	3370	16450	205	1271
eumerci-source-files	172	30195	24469	10072	1559	2356	105	3370	16450	205	1271
eumerci-source-files	163	29204	23521	10012	1559	2352	99	3331	16369	205	1271
src	76	17747	14725	7716	1558	1758	76	1264	3939	205	1271
src\conf	2	40	36	0	0	4	0	0	0	0	0
src\java	74	17707	14689	7716	1558	1754	76	1264	3939	205	1271
src\java\beans	7	1892	801	625	95	245	21	846	1746	30	186
src\java\entities	22	4432	3472	2053	408	735	0	225	1163	90	558
src\java\entities\exceptions	3	43	36	25	2	7	0	0	0	0	0
src\java\entities\util	1	70	58	41	8	12	0	0	0	0	0
src\java\jpa	20	4319	3921	3092	616	245	0	153	629	85	527
src\java\jpa\exceptions	3	43	36	25	2	7	0	0	0	0	0
src\java\jsf	19	3197	2640	1946	439	517	55	40	401	0	0
src\java\jsf\util	2	129	102	72	17	27	0	0	0	0	0
web	87	11457	8796	2296	1	594	23	2067	12430	0	0
web\META-INF	1	9	8	0	0	1	0	0	0	0	0
web\WEB-INF	2	126	79	0	0	1	1	46	45	0	0
web\final	64	5277	4831	12	0	446	0	0	0	0	0
web\final\baselinecategory	4	155	134	0	0	21	0	0	0	0	0
web\final\companysize	4	154	133	0	0	21	0	0	0	0	0
web\final\country	4	180	157	0	0	23	0	0	0	0	0
web\final\energycarrier	4	169	145	0	0	24	0	0	0	0	0
web\final\exceptions	2	63	49	0	0	14	0	0	0	0	0
web\final\externalaudit	4	155	134	0	0	21	0	0	0	0	0

web\final\goodpractice	4	155	134	0	0	21	0	0	0	0	0
web\final\implementationstatus	4	155	134	0	0	21	0	0	0	0	0
web\final\investmentsubsidyqualitative	4	155	134	0	0	21	0	0	0	0	0
web\final\nace2	4	216	193	0	0	23	0	0	0	0	0
web\final\refscheme	4	155	134	0	0	21	0	0	0	0	0
web\final\repository	9	2868	2730	12	0	138	0	0	0	0	0
web\final\savingscalculationapproach	4	155	134	0	0	21	0	0	0	0	0
web\final\sector	4	204	181	0	0	23	0	0	0	0	0
web\final\taxonomy	5	338	305	0	0	33	0	0	0	0	0
web\resources	16	5645	3579	2281	1	45	22	2021	12385	0	0
web\resources\css	1	18	17	12	0	1	0	0	0	0	0
web\resources\js	1	9	8	7	1	1	0	0	0	0	0
web\resources\mmedia	14	5618	3554	2262	0	43	22	2021	12385	0	0

C:\Users\Elena\Desktop\test - FILES

File	LOC	SLOC Physical	SLOC Logical	MVG	BLOC	C&SLOC	CLOC	CWORD	HCLOC	HCWORD
LocMetrics.css	1	1	6	0	0	0	0	0	0	0
LocMetrics.html	1	1	0	0	0	0	0	0	0	0
LocMetricsCommentWords.csv	730	724	10	0	1	6	5	11	0	0
LocMetricsFiles.csv	70	69	0	0	1	0	0	0	0	0
LocMetricsFolders.csv	15	14	0	0	1	0	0	0	0	0
LocMetricsFunctions.csv	2	1	0	0	1	0	0	0	0	0
LocMetricsFunctions.html	1	1	0	0	0	0	0	0	0	0
LocMetricsPie.jpg	131	131	43	0	0	0	0	0	0	0
LocMetricsPie.png	40	6	1	0	0	0	34	70	0	0
src\conf\MANIFEST.MF	3	1	0	0	2	0	0	0	0	0
src\conf\persistence.xml	37	35	0	0	2	0	0	0	0	0

src\java\Bundle.properties	1354	1352	0	0	2	0	0	0	0	0
src\java\Bundle9.properties	672	670	0	0	2	0	0	0	0	0
src\java\Bundler.properties	1345	1343	0	0	2	0	0	0	0	0
src\java\BundleTaxonomy.properties	170	168	0	0	2	0	0	0	0	0
src\java\Bundlets.properties	170	168	0	0	2	0	0	0	0	0
src\java\BundleUsers.properties	156	154	0	0	2	0	0	0	0	0
src\java\beans\ApplicationBean.java	60	38	26	4	9	1	13	60	5	31
src\java\beans\CheckboxView.java	58	39	30	3	10	0	9	37	5	31
src\java\beans\ColumnsView.java	794	109	80	14	59	3	626	947	0	0
src\java\beans\EumerciWelcomeBean.java	27	9	6	1	6	0	12	46	5	31
src\java\beans\LimitCheckboxMenuValidator.java	48	32	21	1	7	0	9	37	5	31
src\java\beans\Query1bean.java	836	551	446	70	140	15	145	509	5	31
src\java\beans\userManagedBean.java	69	23	16	2	14	2	32	110	5	31
src\java\entities\Baselinecategory.java	118	89	55	11	18	0	11	61	5	31
src\java\entities\Casetype.java	110	81	50	10	18	0	11	61	5	31
src\java\entities\Companysize.java	124	94	58	11	19	0	11	61	5	31
src\java\entities\Country.java	135	103	63	12	21	0	11	61	5	31
src\java\entities\Energycarrier.java	223	175	103	20	37	0	11	61	5	31
src\java\entities\Externalaudit.java	124	94	58	11	19	0	11	61	5	31
src\java\entities\Goodpractice.java	124	94	58	11	19	0	11	61	5	31
src\java\entities\Implementationstatus.java	121	91	56	11	19	0	11	61	5	31
src\java\entities\Investmentsubsidyqualitative.java	121	91	56	11	19	0	11	61	5	31
src\java\entities\Nace2.java	171	133	80	17	27	0	11	61	5	31
src\java\entities\Refscheme.java	124	94	58	11	19	0	11	61	5	31
src\java\entities\Repository.java	1020	817	464	100	177	0	26	99	5	31
src\java\entities\Repositoryb1.java	996	798	448	90	178	0	20	93	5	31
src\java\entities\Savingscalculationapproach.java	124	94	58	11	19	0	11	61	5	31
src\java\entities\Sector.java	157	121	73	14	25	0	11	61	5	31

src\java\entities\Taxonomy.java	221	173	104	20	36	0	12	68	5	31
src\java\entities\User.java	191	150	91	17	29	0	12	55	5	31
src\java\entities\UserRole.java	115	86	54	10	17	0	12	55	5	31
src\java\entities\exceptions\IllegalOrphanException.java	21	18	13	2	3	0	0	0	0	0
src\java\entities\exceptions\NonexistentEntityException.java	11	9	6	0	2	0	0	0	0	0
src\java\entities\exceptions\PreexistingEntityException.java	11	9	6	0	2	0	0	0	0	0
src\java\entities\util\JsfUtil.java	70	58	41	8	12	0	0	0	0	0
src\java\jpa\BaselinecategoryJpaController.java	191	168	133	23	14	0	9	37	5	31
src\java\jpa\CompanysizeJpaController.java	191	168	133	23	14	0	9	37	5	31
src\java\jpa\CountryJpaController.java	191	168	133	23	14	0	9	37	5	31
src\java\jpa\EnergycarrierJpaController.java	632	609	475	122	14	0	9	37	5	31
src\java\jpa\ExternalauditJpaController.java	191	168	133	23	14	0	9	37	5	31
src\java\jpa\GoodpracticeJpaController.java	191	168	133	23	14	0	9	37	5	31
src\java\jpa\ImplementationstatusJpaController.java	197	174	138	24	14	0	9	37	5	31
src\java\jpa\InvestmentsubsidyqualitativeJpaController.java	197	174	138	24	14	0	9	37	5	31
src\java\jpa\Nace2JpaController.java	197	174	138	24	14	0	9	37	5	31
src\java\jpa\RefschemeJpaController.java	191	168	133	23	14	0	9	37	5	31
src\java\jpa\Repositoryb1JpaController.java	145	122	97	13	14	0	9	37	5	31
src\java\jpa\RepositoryJpaController.java	825	802	634	156	14	0	9	37	5	31
src\java\jpa\SavingscalculationapproachJpaController.java	191	168	133	23	14	0	9	37	5	31
src\java\jpa\SectorJpaController.java	204	181	142	27	14	0	9	37	5	31
src\java\jpa\TaxonomyJpaController.java	169	146	116	18	14	0	9	37	5	31
src\java\jpa\UserJpaController.java	204	181	142	27	14	0	9	37	5	31
src\java\jpa\UserRoleJpaController.java	169	146	116	18	14	0	9	37	5	31
src\java\jpa\exceptions\IllegalOrphanException.java	21	18	13	2	3	0	0	0	0	0
src\java\jpa\exceptions\NonexistentEntityException.java	11	9	6	0	2	0	0	0	0	0
src\java\jpa\exceptions\PreexistingEntityException.java	11	9	6	0	2	0	0	0	0	0
src\java\jsf\BaselinecategoryController.java	166	140	103	24	26	3	0	16	0	0

src\java\jsf\CompanysizeController.java	167	141	104	24	26	3	0	16	0	0
src\java\jsf\CountryController.java	215	173	130	27	36	3	6	27	0	0
src\java\jsf\EnergycarrierController.java	167	141	104	24	26	3	0	16	0	0
src\java\jsf\ExternalauditController.java	167	141	104	24	26	3	0	16	0	0
src\java\jsf\GoodpracticeController.java	167	141	104	24	26	3	0	16	0	0
src\java\jsf\ImplementationstatusController.java	167	141	104	24	26	3	0	16	0	0
src\java\jsf\InvestmentsubsidyqualitativeController.java	167	141	104	24	26	3	0	16	0	0
src\java\jsf\Nace2Controller.java	166	140	103	24	26	3	0	16	0	0
src\java\jsf\RefschemeController.java	167	141	104	24	26	3	0	16	0	0
src\java\jsf\Repositoryb1Controller.java	174	140	103	24	32	5	2	21	0	0
src\java\jsf\RepositoryController.java	197	157	118	24	33	4	7	40	0	0
src\java\jsf\SavingscalculationapproachController.java	167	141	104	24	26	3	0	16	0	0
src\java\jsf\SectorController.java	166	140	103	24	26	3	0	16	0	0
src\java\jsf\TaxonomyController.java	316	240	176	35	51	4	25	105	0	0
src\java\jsf\UserController.java	166	140	103	24	26	3	0	16	0	0
src\java\jsf\UserRoleController.java	166	140	103	24	26	3	0	16	0	0
src\java\jsf\util\JsfUtil.java	70	58	41	8	12	0	0	0	0	0
src\java\jsf\util\PaginationHelper.java	59	44	31	9	15	0	0	0	0	0
web\accessDenied.xhtml	40	29	0	0	11	0	0	0	0	0
web\index.xhtml	234	169	1	0	65	0	0	0	0	0
web\template.xhtml	86	72	2	0	14	0	0	0	0	0
web\underConstruction.xhtml	40	29	0	0	11	0	0	0	0	0
web\final\baselinecategory\Create.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\baselinecategory\Edit.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\baselinecategory\List.xhtml	66	57	0	0	9	0	0	0	0	0
web\final\baselinecategory\View.xhtml	29	25	0	0	4	0	0	0	0	0
web\final\companysize\Create.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\companysize\Edit.xhtml	30	26	0	0	4	0	0	0	0	0

web\final\companysize\List.xhtml	65	56	0	0	9	0	0	0	0	0
web\final\companysize\View.xhtml	29	25	0	0	4	0	0	0	0	0
web\final\country\Create.xhtml	32	28	0	0	4	0	0	0	0	0
web\final\country\Edit.xhtml	32	28	0	0	4	0	0	0	0	0
web\final\country\List.xhtml	85	74	0	0	11	0	0	0	0	0
web\final\country\View.xhtml	31	27	0	0	4	0	0	0	0	0
web\final\energycarrier\Create.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\energycarrier\Edit.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\energycarrier\List.xhtml	80	68	0	0	12	0	0	0	0	0
web\final\energycarrier\View.xhtml	29	25	0	0	4	0	0	0	0	0
web\final\exceptions\forbidden.xhtml	48	36	0	0	12	0	0	0	0	0
web\final\exceptions\session_expired.xhtml	15	13	0	0	2	0	0	0	0	0
web\final\externalaudit\Create.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\externalaudit\Edit.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\externalaudit\List.xhtml	66	57	0	0	9	0	0	0	0	0
web\final\externalaudit\View.xhtml	29	25	0	0	4	0	0	0	0	0
web\final\goodpractice\Create.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\goodpractice\Edit.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\goodpractice\List.xhtml	66	57	0	0	9	0	0	0	0	0
web\final\goodpractice\View.xhtml	29	25	0	0	4	0	0	0	0	0
web\final\implementationstatus\Create.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\implementationstatus\Edit.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\implementationstatus\List.xhtml	66	57	0	0	9	0	0	0	0	0
web\final\implementationstatus\View.xhtml	29	25	0	0	4	0	0	0	0	0
web\final\investmentsubsidyqualitative\Create.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\investmentsubsidyqualitative\Edit.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\investmentsubsidyqualitative\List.xhtml	66	57	0	0	9	0	0	0	0	0
web\final\investmentsubsidyqualitative\View.xhtml	29	25	0	0	4	0	0	0	0	0

web\final\nace2\Create.xhtml	38	34	0	0	4	0	0	0	0	0
web\final\nace2\Edit.xhtml	38	34	0	0	4	0	0	0	0	0
web\final\nace2\List.xhtml	103	92	0	0	11	0	0	0	0	0
web\final\nace2\View.xhtml	37	33	0	0	4	0	0	0	0	0
web\final\refscheme\Create.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\refscheme\Edit.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\refscheme\List.xhtml	66	57	0	0	9	0	0	0	0	0
web\final\refscheme\View.xhtml	29	25	0	0	4	0	0	0	0	0
web\final\repository\Create.xhtml	284	280	0	0	4	0	0	0	0	0
web\final\repository\Edit.xhtml	310	306	0	0	4	0	0	0	0	0
web\final\repository\List.xhtml	228	217	0	0	11	0	0	0	0	0
web\final\repository\Query1.xhtml	597	543	12	0	54	0	0	0	0	0
web\final\repository\Query1_TABLE_ORIGINAL.xhtml	476	470	0	0	6	0	0	0	0	0
web\final\repository\Query1_View.xhtml	163	147	0	0	16	0	0	0	0	0
web\final\repository\TABLE_ORIGINAL.xhtml	476	470	0	0	6	0	0	0	0	0
web\final\repository\View.xhtml	173	151	0	0	22	0	0	0	0	0
web\final\repository\View_ELENA.xhtml	161	146	0	0	15	0	0	0	0	0
web\final\savingscalculationapproach\Create.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\savingscalculationapproach\Edit.xhtml	30	26	0	0	4	0	0	0	0	0
web\final\savingscalculationapproach\List.xhtml	66	57	0	0	9	0	0	0	0	0
web\final\savingscalculationapproach\View.xhtml	29	25	0	0	4	0	0	0	0	0
web\final\sector\Create.xhtml	36	32	0	0	4	0	0	0	0	0
web\final\sector\Edit.xhtml	36	32	0	0	4	0	0	0	0	0
web\final\sector\List.xhtml	97	86	0	0	11	0	0	0	0	0
web\final\sector\View.xhtml	35	31	0	0	4	0	0	0	0	0
web\final\taxonomy\Create.xhtml	44	40	0	0	4	0	0	0	0	0
web\final\taxonomy\Edit.xhtml	45	41	0	0	4	0	0	0	0	0
web\final\taxonomy\List.xhtml	112	101	0	0	11	0	0	0	0	0

web\final\taxonomy\List_original.xhtml	95	86	0	0	9	0	0	0	0	0
web\final\taxonomy\View.xhtml	42	37	0	0	5	0	0	0	0	0
web\META-INF\context.xml	9	8	0	0	1	0	0	0	0	0
web\resources\css\jsfcrud.css	18	17	12	0	1	0	0	0	0	0
web\resources\js\jsfcrud.js	9	8	7	1	1	0	0	0	0	0
web\resources\mmedia\acces_denied_al4lVy.gif	386	383	143	0	3	1	0	1	0	0
web\resources\mmedia\ajax-loader.gif	190	188	56	0	2	0	0	0	0	0
web\resources\mmedia\cres.jpg	21	21	9	0	0	0	0	0	0	0
web\resources\mmedia\csv.png	22	22	15	0	0	0	0	0	0	0
web\resources\mmedia\dl_please_wait6.gif	64	64	20	0	0	0	0	0	0	0
web\resources\mmedia\eu-merci_logo.gif	177	171	62	0	6	0	0	0	0	0
web\resources\mmedia\eumercilogo.jpg	13	11	31	0	2	1	0	4	0	0
web\resources\mmedia\excel.png	12	12	7	0	0	0	0	0	0	0
web\resources\mmedia\loading.gif	130	130	92	0	0	1	0	4	0	0
web\resources\mmedia\no-access.jpg	212	116	90	0	1	3	95	524	0	0
web\resources\mmedia\pdf.png	9	9	5	0	0	0	0	0	0	0
web\resources\mmedia\tumblr_m00vcqQIFL1qedb29o1_500.gif	4328	2374	1708	0	28	15	1926	11851	0	0
web\resources\mmedia\underConstrucrion.gif	35	34	7	0	1	1	0	1	0	0
web\resources\mmedia\xml.png	19	19	17	0	0	0	0	0	0	0
web\WEB-INF\faces-config.xml	66	65	0	0	1	0	0	0	0	0
web\WEB-INF\web.xml	60	14	0	0	0	1	46	45	0	0