



ENGIE DELIVERABLE 1.2

REPORT ON THE STATUS OF GEOSCIENCE EDUCATION IN EUROPE

Summary:

This deliverable reports the status of secondary and tertiary education in geoscience based on quantitative data. The first part concerns geoscience in secondary education in Europe from the perspective of teachers. The second part presents statistics of the gender distribution in tertiary education in Europe.

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1 EXECUTIVE SUMMARY

This report describes secondary and tertiary education in geoscience based on quantitative data. The first part of the report concerns geoscience in secondary education in Europe from the perspective of teachers, based on survey responses from 744 teachers across 20 European countries. The second part presents statistics of the gender distribution in tertiary education in Europe based on statistics data from Eurostat and the European Institute for Gender Equality (EIGE).

The survey data suggests that geology and geoscience is generally introduced in secondary education as a part of geography or natural sciences curricula. In protestant European countries, respondents, more than in other cultural contexts in Europe, describe that geology is taught as a separate subject. In these countries, gender distribution in tertiary education seems to be more equal according to statistics presented above. The potential connection between those results might be meaningful further in the project. Another issue from survey data might show a potential problem. Islamic European and especially Orthodox European countries seem to be using textbooks less in secondary education compared to other cultural contexts. Exploring whether the lack of relevant textbooks might be an issue can be recommended.

Data on the gender distribution in tertiary education in Europe based show that the representation of women varies both with respect to subfields and national context. Earth science tend to have an equal gender distribution. In most countries, the female - male ratio is 40%-60%, and in ten countries the proportion of women and men are close to 50-50%. The environmental sciences are more female dominated, in 11 countries, female participation is higher than 60%. The geo- and mining engineering field is more male dominated, female participation is below 45% in all reported countries, and less than 40% in 18 countries. This suggest that it is the field of geo-and mining engineering that girls in particular should be encouraged to embark on. It also suggests a need to encourage boys' interest in environmental science. The proportion of women tends to be higher in some countries (see Slovakia, Estonia and the Czech Republic) and lower in others (see France). It indicates that the conditions for empowering girls and increasing the number of women in geoscience education vary in different countries. These potential differences may be important to keep in mind during the activities in the ENGIE-project. Are there, for example, some countries that can be seen as inspiration to other countries? And are there countries in need of extra support?

2 REPORT ON THE STATUS OF GEOSCIENCE EDUCATION IN EUROPE

This report describes secondary and tertiary education in geoscience based on quantitative data. The first part of the report concerns geoscience in secondary education in Europe from the perspective of teachers, based on survey responses from 744 teachers from 20 European countries. The second part presents statistics of the gender distribution in tertiary education in Europe based on data from Eurostat and the European Institute for Gender Equality (EIGE).

2.1 GEOSCIENCE IN SECONDARY EDUCATION IN EUROPE

A questionnaire designed to identify obstacles impending girls to embark on a career in geoscience was sent to teachers in 20¹ European countries (Johansson, 2020). The data, consisting of 774 responses, also include general information that relates to the status of geoscience in secondary education in Europe.

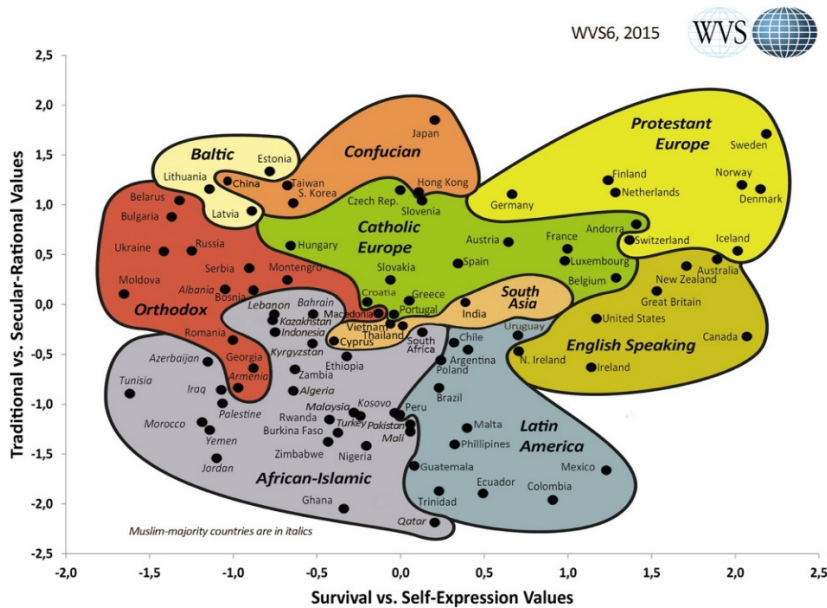
As the number of replies per country and differences in selection method affected the survey, the decision was made to aggregate the analysis and presentation of the results in the way that allows grouping European countries by context. Participating countries were divided into following categories: Catholic Europe, Protestant Europe, Orthodox Europe, Islamic Europe and Baltic Europe. The division corresponds to the World Values Survey Cultural Map that places countries on a cultural map based on their position on Survival versus self-expression values as well as traditional versus secular-rational values. Due to similarities in the gender division in geoscience education in tertiary education, as well as reasons of cultural proximity in line with world view survey, United Kingdom was grouped with protestant, rather than catholic countries².

According to the results on the ENGIE survey of secondary education teachers, the majority of those teaching geoscience are teachers of geography.

¹ Full list: Bulgaria, Croatia, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Poland, Portugal, Romania, Serbia, Slovenia, Spain, Turkey, UK, Ukraine

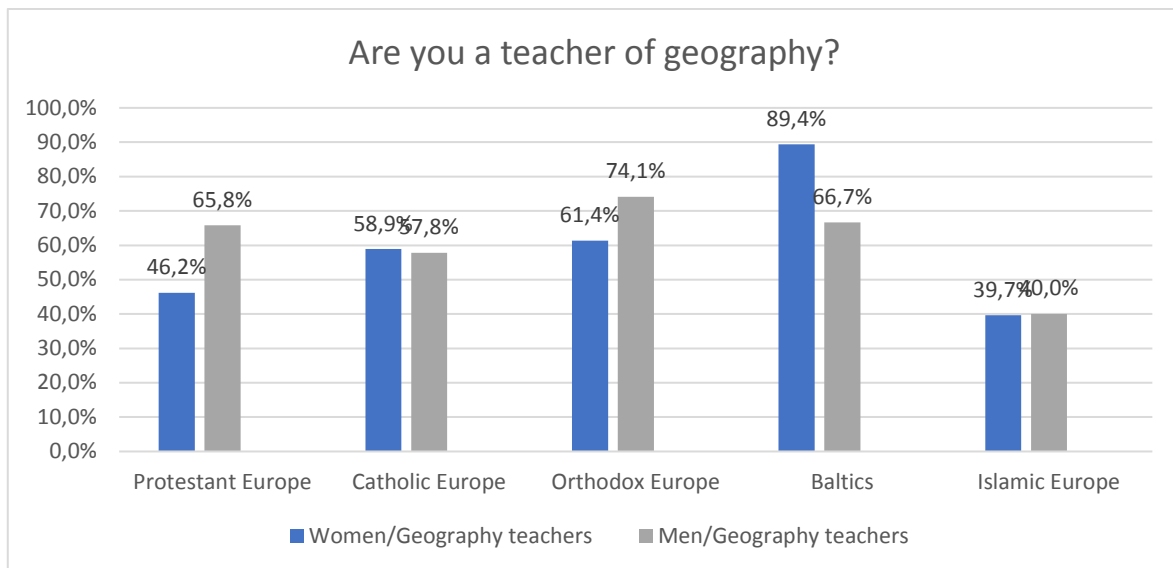
² Division into categories. **Catholic**: Croatia, Czech Republic, Greece, Hungary, Italy, Poland, Portugal, Slovenia, Spain; **Orthodox**: Bulgaria, Romania, Serbia, Ukraine. **Protestant**: Finland, Germany, Netherlands, UK. **Islamic**: Turkey. **Baltic**: Estonia

Figure 1: World View Survey Cultural Map 2015



As shown in figure 2, Over 50% of the responding teachers in orthodox, catholic and Baltic countries are geography teachers, and fewer although still significant share in protestant and Islamic countries.

Figure 2: Share of geography teachers among those teaching geosciences according to survey results

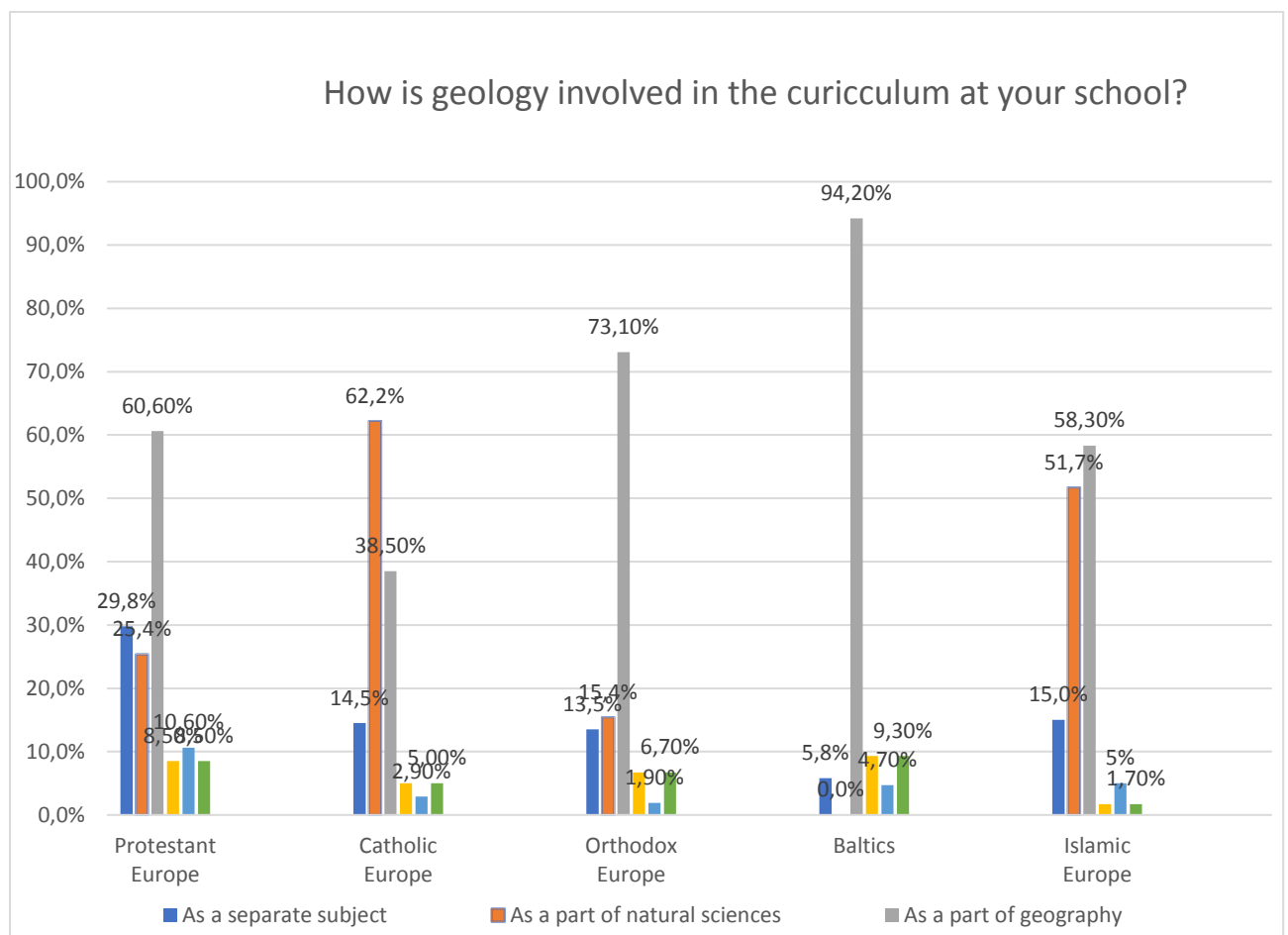


More male teachers replied that they were geography teachers in protestant countries compared to female teachers. Similar difference can be observed in orthodox countries

while in Baltics female geography teachers prevail. The results of the survey should be interpreted with caution due to the character of the data.

According to survey results shown in Figure 3, in most of the countries geology is included in the curriculum as a part of geography (except for catholic countries, even though 40% of the respondents in those chose geography option). In catholic and Islamic countries geology is taught as a part of natural sciences. Only protestant countries seem, according to those results, to include geology as a separate subject in about 30% of the replies. All the other options in all the replying countries are below 20%. The question on the way of including geology was multiple choice, hence the sum over 100% for many groups of countries.

Figure 3: The way geology is involved in school curriculum according to survey results

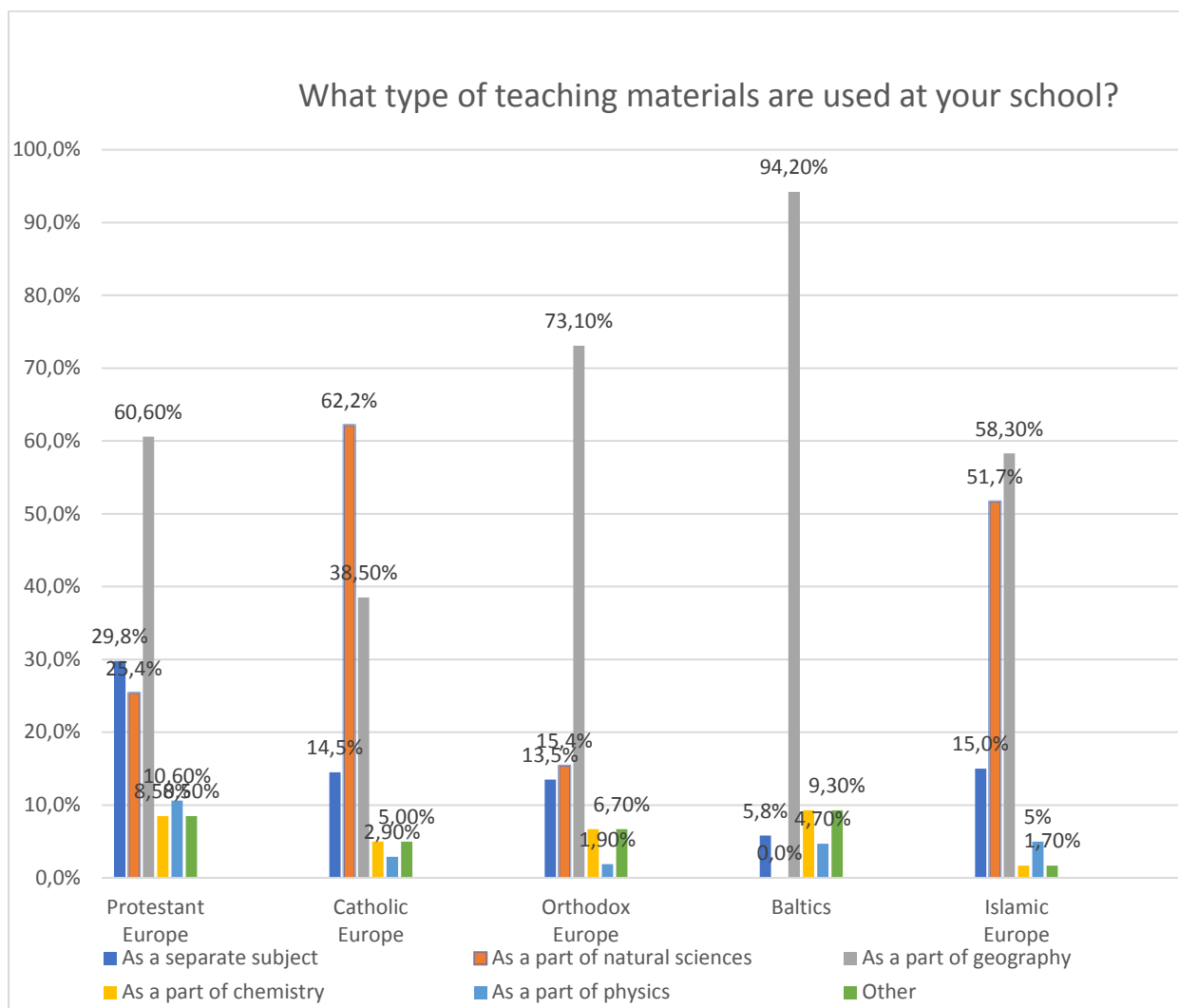


Another aspect of geoscience education available to explore in the project teacher survey is the type of materials used at the respective schools by the responding teachers. As shown in figure 4, the textbooks seem to be the main teaching material used in all the groups of countries. Worksheets are widely used as well, although less so in orthodox

Europe. Guides for practical exercise are mentioned by about 30% of the respondents in protestant, catholic and Baltic European countries. Qualitative comments that online videos and documents predominates in the category “other materials”, repeatedly mentioned by Baltic respondents, and popular among respondents from protestant and catholic European countries as well.

As textbooks seem to be the main teaching material according to these results, access to relevant textbooks should be explored in orthodox and islamic european countries where textbooks seem to be less used in teaching geology in secondary education. The data character requires that the results are used as a suggestion rather than a sharp indicator.

Figure 4: Types of teaching materials used for teaching geology



2.2 GENDER COMPOSITION IN TERTIARY GEOSCIENCE EDUCATION

Geoscience is a broad area with many subfields that tend to have different gender compositions. To further explore these differences, statistics on earth science, environmental science, mining engineering and geo-engineering have been collected and analyzed.

2.2.1 EARTH SCIENCE

Of the fields chosen for further investigation, earth science has the most equal gender distribution in 2018 (Table 1). Most countries are in the 40%-60% ratio, and in ten countries the proportion of women and men are close to 50-50%. These countries are Denmark (609), Estonia (117), Croatia (860), Cyprus (2), Latvia (151), Lithuania (190), Luxembourg (16), Malta (60), Sweden (1368) and the United Kingdom (15555). However, the number of students vary a lot between countries and therefore the number of women differs between 2 and 15,555 women. Belgium (499), Hungary (869), Turkey (19744), France (1465) and Austria (1660) have a lower proportion of women in comparison. Lastly, Iceland stands out with a higher female ratio, 61%, which equals 126 women, compared to the other countries.

Over a timeline of six years (Table 2), the distribution of women in earth science follows a quite stable pattern in the individual countries. However, a few countries stand out as they show a decrease or an increase of female students. The Czech Republic shows a steady decrease of women from 48 % in 2013 to 43 % in 2018 which in numbers equals from 2233 to 845 women. It entails a step further away from a gender equal distribution. The number of female students also decreased in Estonia, from 62 % or 323 women in 2013 to 51 % or 117 women in 2018, and in Lithuania from 59 % or 301 women to 52 % or 190 women in the same years. Those countries moved towards a more gender equal distribution during these years. An increase of female participation is also visible in some countries. In Switzerland the number of women rose towards an equal distribution from 1694 women in 2015 to 2142 women in 2018, it equals an increase from 43 % to 47 %. In Iceland, on the other hand, female participation rose from 108 (or 51%) in 2016 to 126 (or 61 %) moving away from a gender equal distribution. In sum, just as the table above (table 1), the timeline from 2013-2018 suggests that similar country specific patterns are visible over time. However, some countries are either moving closer to or further away from a gender equal distribution.

Table 1: Number of earth science students in different European countries in 2018

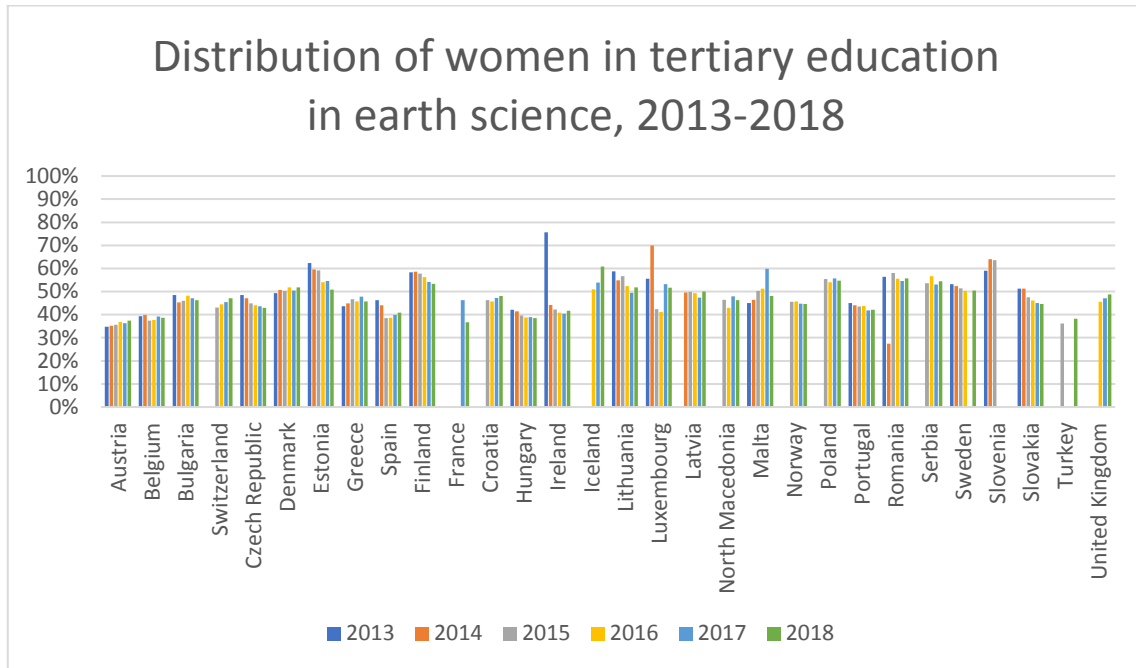
	Earth science			
	Female	Male	Total	Female ratio in %
Belgium	499	793	1292	39
Bulgaria	488	567	1055	46
Czechia	845	1124	1969	43
Denmark	609	565	1174	52
Estonia	117	113	230	51
Ireland	271	378	649	42
Greece	3704	4406	8110	46
Spain	3720	5376	9096	41
France	1465	2522	3987	37
Croatia	860	930	1790	48
Cyprus	2	2	4	50
Latvia	151	151	302	50
Lithuania	190	177	367	52
Luxembourg	16	15	31	52
Hungary	869	1385	2254	39
Malta	60	65	125	48
Austria	1660	2771	4431	37
Poland	4906	4050	8956	55
Portugal	1226	1683	2909	42
Romania	4244	3386	7630	56
Slovakia	575	715	1290	45
Finland	926	812	1738	53
Sweden	1368	1343	2711	50
United Kingdom	15555	16354	31909	49
Iceland	126	81	207	61
Norway	727	902	1629	45
Switzerland	2142	2411	4553	47
North Macedonia	214	248	462	46
Serbia	2069	1730	3799	54
Turkey	19744	31991	51735	38

Legend	<40 %
	40-60%
	>60%

Table 2: Distribution of women in tertiary education in earth science, 2013-2018

Distribution of women in tertiary education, earth science, 2013-2018						
Geographic region\Time	2013	2014	2015	2016	2017	2018
Austria	35%	35%	36%	37%	36%	37%
Belgium	39%	40%	37%	38%	39%	39%
Bulgaria	49%	45%	46%	48%	47%	46%
Switzerland	0%	0%	43%	44%	45%	47%
Cyprus						
Czech Republic	48%	47%	45%	44%	44%	43%
Germany	0%	0%	0%	45%	0%	0%
Denmark	49%	51%	50%	52%	50%	52%
Estonia	62%	60%	59%	54%	55%	51%
Greece	44%	45%	47%	46%	48%	46%
Spain	46%	44%	39%	39%	40%	41%
Finland	58%	59%	58%	56%	54%	53%
France	0%	0%	0%	0%	46%	37%
Croatia	0%	0%	46%	46%	47%	48%
Hungary	42%	41%	40%	39%	39%	39%
Ireland	76%	44%	42%	41%	41%	42%
Iceland	0%	0%	0%	51%	54%	61%
Italy	0%	35%	0%	0%	0%	0%
Liechtenstein						
Lithuania	59%	55%	57%	52%	49%	52%
Luxembourg	56%	70%	42%	41%	53%	52%
Latvia	0%	50%	50%	49%	47%	50%
North Macedonia	0%	0%	46%	43%	48%	46%
Malta	45%	46%	50%	51%	60%	48%
Netherlands	0%	32%	0%	0%	0%	0%
Norway	0%	0%	46%	46%	45%	45%
Poland	0%	0%	55%	54%	56%	55%
Portugal	45%	44%	43%	44%	42%	42%
Romania	56%	27%	58%	56%	55%	56%
Serbia	0%	0%	54%	57%	53%	54%
Sweden	53%	52%	51%	50%	0%	50%
Slovenia	59%	64%	64%	0%	0%	0%
Slovakia	51%	51%	47%	46%	45%	45%
Turkey	0%	0%	36%	0%	0%	38%
United Kingdom	0%	0%	0%	46%	47%	49%

Figure 5: Distribution of women in tertiary education in earth science, 2013-2018



2.2.2 ENVIRONMENTAL SCIENCE

The environmental sciences field is the most “female dominated” of the investigated fields (Table 3). The data show that within 11 countries, female participation is higher than 60%. The highest proportion of women is found in Croatia 72% (which equals 214 women), Latvia 69% (107), Lithuania 68% (116), Slovakia 68% (103) and Sweden 69% (1571). Only six countries; Greece (713), Cyprus (75), Portugal (406), Switzerland (2002), Spain (5528) and North Macedonia (12) have a gender distribution between 48-52%. In this context, France stands out because they have a lower proportion of women compared to the other countries. The proportion of women is 40% which equals 2433 women.

The distribution of women in environmental sciences over time mostly follows a steady pattern for the individual country (Table 4). Though, in a few countries the distribution moved towards a more equal distribution either through an increase or through a decrease in the proportion of women. On Cyprus and in Estonia women participation fell from 61% to 49% and from 76% to 63% respectively during the six-year timeline. In numbers it equals a drop from 114 to 75 women for Cyprus and 142 to 104 for Estonia. In Austria the proportion of women increased from 45%-53%, from 45 to 398 women. At the same time as the proportion of women increased in Ireland from 28%-46%, the number of women actually decreased from 661 women 2013 to 584 in 2018. Drawing on the patterns of gender distribution in environmental science it seems likely that the “female domination” in the subfield will continue.

Table 3: Number of environmental science students in different European countries in 2018

	Environmental science			
	Female	Male	Total	Female ratio in %
Belgium	396	307	703	56
Bulgaria	917	545	1462	63
Czechia	753	421	1174	64
Denmark	0	0	0	0
Estonia	104	60	164	63
Ireland	584	675	1259	46
Greece	713	670	1383	52
Spain	5528	5985	11513	48
France	2433	3623	6056	40
Croatia	214	83	297	72
Cyprus	75	78	153	49
Latvia	107	47	154	69
Lithuania	116	54	170	68
Luxembourg	0	0	0	0
Hungary	277	241	518	53
Malta	7	8	15	47
Austria	398	354	752	53
Poland	2919	1642	4561	64
Portugal	406	419	825	49
Romania	1779	1299	3078	58
Slovakia	103	49	152	68
Finland	821	417	1238	66
Sweden	1571	701	2272	69
United Kingdom	0	0	0	0
Iceland	107	56	163	66
Norway	113	86	199	57
Switzerland	2002	1883	3885	52
North Macedonia	12	12	24	50
Serbia	374	251	625	60
Turkey	450	389	839	54

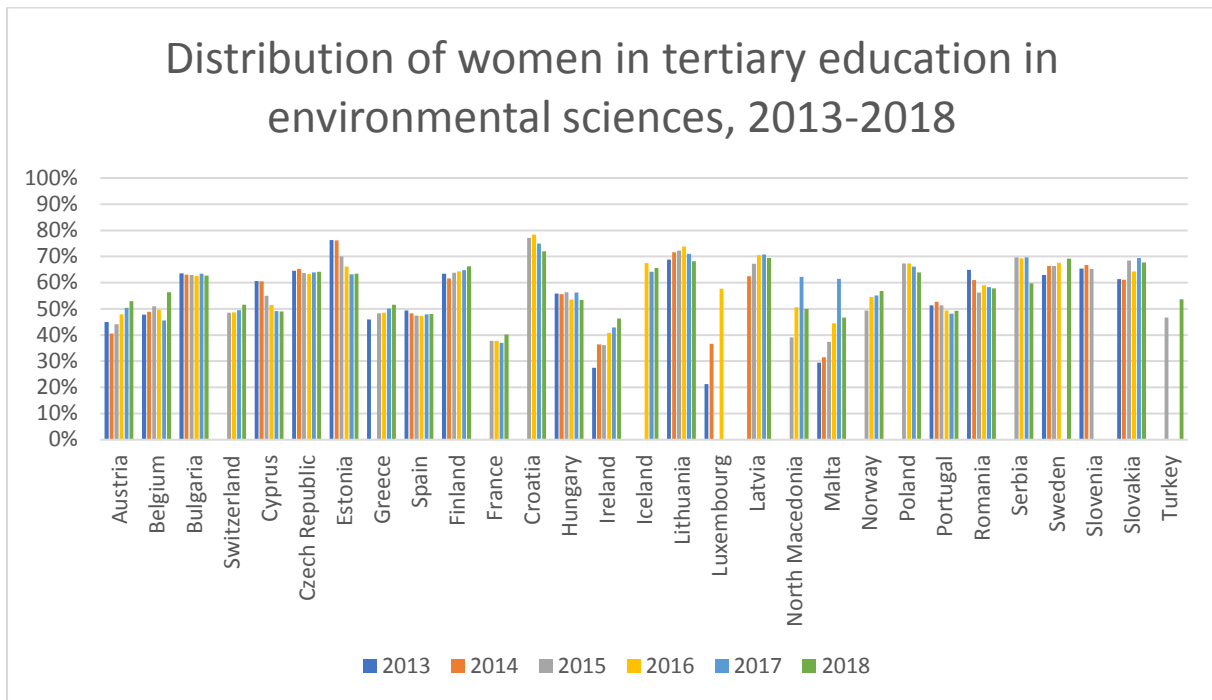
Legend	<40 %
	40-60%
	>60%

Table 4: Distribution of women in tertiary education in environmental sciences, 2013-2018

Distribution of women in tertiary education, environmental sciences, 2013-2018						
Geographic region\Time	2013	2014	2015	2016	2017	2018
Austria	45%	41%	44%	48%	50%	53%
Belgium	48%	49%	51%	50%	46%	56%
Bulgaria	64%	63%	63%	63%	64%	63%
Switzerland	0%	0%	49%	49%	50%	52%
Cyprus	61%	61%	55%	51%	49%	49%
Czech Republic	65%	65%	64%	63%	64%	64%
Germany	0%	0%	0%	0%	0%	0%
Denmark	0%	59%	0%	0%	0%	0%
Estonia	76%	76%	70%	66%	63%	63%
Greece	46%	0%	48%	48%	50%	52%
Spain	49%	48%	47%	47%	48%	48%
Finland	63%	62%	64%	64%	65%	66%
France	0%	0%	38%	38%	37%	40%
Croatia	0%	0%	77%	78%	75%	72%
Hungary	56%	56%	56%	54%	56%	53%
Ireland	28%	36%	36%	41%	43%	46%
Iceland	0%	0%	0%	67%	64%	66%
Italy	0%	37%	0%	0%	0%	0%
Liechtenstein	0%	0%	0%	0%	0%	0%
Lithuania	69%	72%	72%	74%	71%	68%
Luxembourg	21%	37%	0%	58%	0%	0%
Latvia	0%	63%	67%	70%	71%	69%
North Macedonia	0%	0%	39%	51%	62%	50%
Malta	30%	32%	37%	44%	62%	47%
Netherlands	0%	39%	0%	0%	0%	0%
Norway	0%	0%	49%	55%	55%	57%
Poland	0%	0%	67%	67%	66%	64%
Portugal	51%	53%	51%	49%	48%	49%
Romania	65%	61%	56%	59%	58%	58%
Serbia	0%	0%	70%	69%	70%	60%
Sweden	63%	66%	66%	68%	0%	69%
Slovenia	65%	67%	65%	0%	0%	0%
Slovakia	61%	61%	68%	64%	69%	68%
Turkey	0%	0%	47%	0%	0%	54%
United Kingdom	0%	0%	0%	0%	0%	0%

(Source: Eurostat's online database as dataset educ_uae_enrt03, downloaded from EIGE)

Figure 6: Distribution of women in tertiary education in environmental sciences, 2013-2018



2.2.3 GEO- AND MINING ENGINEERING

The geo- and mining engineering field is the most “male dominated” field of the investigated fields (Table 5). Even though data is missing from several countries it’s clear that the proportion of women in the field is significantly lower compared to earth science and environmental sciences. Female participation is less than 40% in 18 countries and it is nowhere higher than 45%. The highest proportion of women is reported in Slovakia (45%), which equals 362 women and the lowest female participation is reported in Finland with only 8% women. However, that only equals 2 women, so the number of students is very low. These results (female distribution) are equivalent with the oil- and gas engineering students.

Also, over time, the subfield of geo- and mining engineering stands out because of the low proportion of women in the field. There is also less data available and for 14 countries data is missing completely, or is only reported for one year, during this timeline. Just as noted in Table 5 above, the proportion of women is low and as can be seen in Table 6 the pattern is consistent during the timeline. An exception is Romania with a female participation of only 14 % in 2013 which slightly increased to 24 % in 2018, it equals an increase from 205 women to 380 women and might indicate a pattern in change. In Slovakia and in the Czech Republic where the female participation was 40% and 45% respectively in 2018 the Table 6 shows that the pattern in these countries are consistent over time.

Table 5: Number of students in tertiary education in geo- and mining engineering 2018

	Mining and extraction			
	Female	Male	Total	Female ratio in %
Belgium	16	55	71	23
Bulgaria	128	576	704	18
Czechia	377	520	897	42
Denmark	23	99	122	19
Estonia	2	4	6	33
Ireland	0	0	0	0
Greece	900	3205	4105	22
Spain	709	1899	2608	27
France	18	65	83	22
Croatia	236	527	763	31
Cyprus	0	0	0	0
Latvia	0	0	0	0
Lithuania	0	0	0	0
Luxembourg	0	0	0	0
Hungary	67	236	303	22
Malta	0	0	0	0
Austria	259	904	1163	22
Poland	1065	3656	4721	23
Portugal	127	250	377	34
Romania	380	1183	1563	24
Slovakia	362	449	811	45
Finland	2	22	24	8
Sweden	85	194	279	30
United Kingdom	0	0	0	0
Iceland	0	0	0	0
Norway	87	325	412	21
Switzerland	0	0	0	0
North Macedonia	71	188	259	27
Serbia	321	781	1102	29
Turkey	1600	8310	9910	16

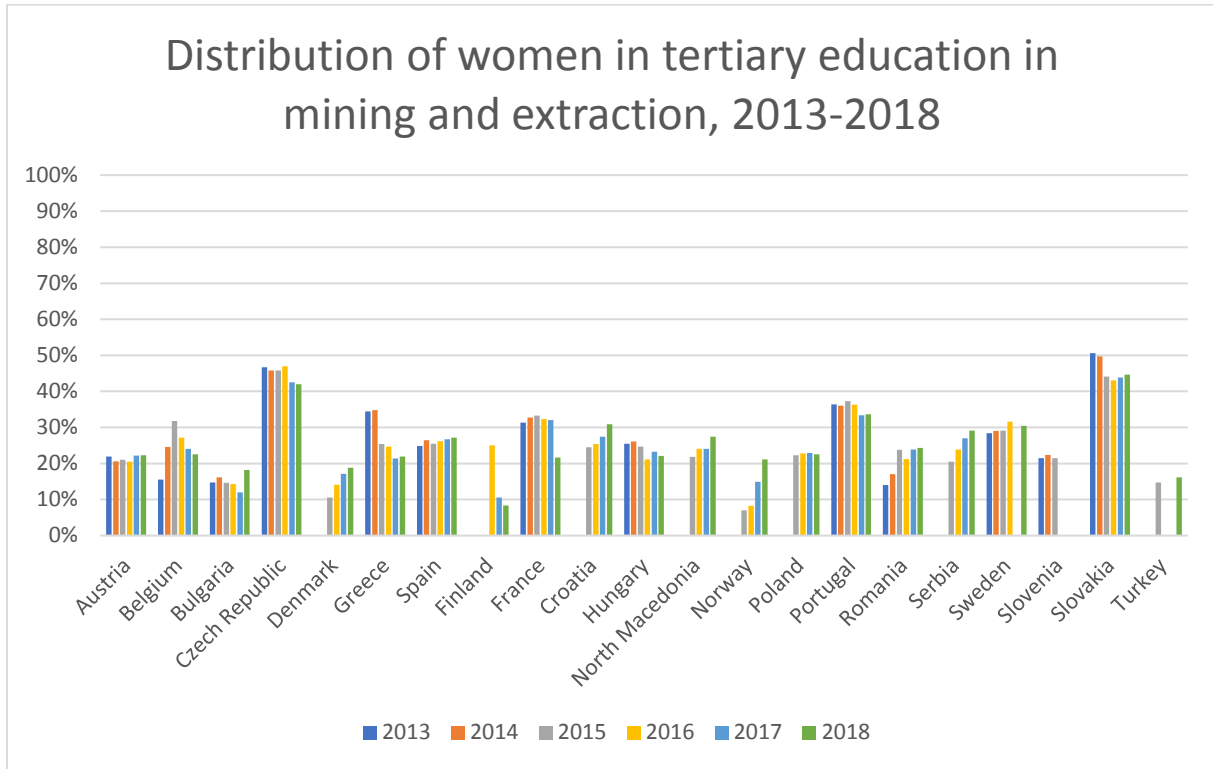
Legend	<40 %
	40-60%
	>60%

Table 6: Distribution of women in tertiary education in geo- and mining engineering, 2013-2018

Distribution of women in tertiary education, mining and extraction, 2013-2018						
Geographic region\Time	2013	2014	2015	2016	2017	2018
Austria	22%	21%	21%	21%	22%	22%
Belgium	16%	25%	32%	27%	24%	23%
Bulgaria	15%	16%	15%	14%	12%	18%
Switzerland	0%	0%	0%	0%	0%	0%
Cyprus	0%	0%	0%	0%	0%	0%
Czech Republic	47%	46%	46%	47%	43%	42%
Germany	0%	0%	0%	12%	0%	0%
Denmark	0%	0%	11%	14%	17%	19%
Estonia	0%	0%	0%	0%	0%	33%
Greece	34%	35%	25%	25%	21%	22%
Spain	25%	26%	25%	26%	27%	27%
Finland	0%	0%	0%	25%	11%	8%
France	31%	33%	33%	32%	32%	22%
Croatia	0%	0%	24%	25%	27%	31%
Hungary	25%	26%	25%	21%	23%	22%
Ireland	0%	0%	0%	0%	0%	0%
Iceland	0%	0%	0%	0%	0%	0%
Italy	0%	50%	0%	0%	0%	0%
Liechtenstein	0%	0%	0%	0%	0%	0%
Lithuania	0%	0%	0%	0%	0%	0%
Luxembourg	0%	0%	0%	0%	0%	0%
Latvia	0%	0%	0%	0%	0%	0%
North Macedonia	0%	0%	22%	24%	24%	27%
Malta	0%	0%	0%	0%	0%	0%
Netherlands	0%	16%	0%	0%	0%	0%
Norway	0%	0%	7%	8%	15%	21%
Poland	0%	0%	22%	23%	23%	23%
Portugal	36%	36%	37%	36%	33%	34%
Romania	14%	17%	24%	21%	24%	24%
Serbia	0%	0%	21%	24%	27%	29%
Sweden	28%	29%	29%	32%	0%	30%
Slovenia	21%	22%	22%	0%	0%	0%
Slovakia	51%	50%	44%	43%	44%	45%
Turkey	0%	0%	15%	0%	0%	16%
United Kingdom	0%	0%	0%	0%	0%	0%

(Source: Eurostat's online database as dataset educ_uoe_enrt03, downloaded from EIGE)

Figure 7: Distribution of women in tertiary education in geo- and mining engineering, 2013-2018



3 CONCLUSIONS

This report describes secondary and tertiary education in geoscience based on quantitative data. The first part of the report concerns geoscience in secondary education in Europe from the perspective of teachers, based on survey responses from 744 teachers across 20 European countries. The second part present statistics of the gender distribution in tertiary education in Europe based on statistical data from Eurostat and the European Institute for Gender Equality (EIGE).

The survey data suggest that geology and geoscience is generally introduced in secondary education as a part of geography or natural sciences curricula. In protestant European countries, respondents, more than in other cultural contexts in Europe, chose an option that indicates geology being taught as a separate subject. In these countries gender distribution in tertiary education seems to be more equal according to statistics presented above. The potential connection between those results might be meaningful further in the project. Another issue from survey data might show a potential problem. Islamic European and especially orthodox European countries seem to be using textbooks less in secondary education compared to other cultural contexts. Exploring whether the lack of relevant textbooks might be an issue can be recommended.

The data from Eurostat and EIGE presented in this report show that, to some extent, the proportion of women in the different subfields varies in different countries. For example, the rate of women tends to be higher in Slovakia, Estonia and the Czech Republic, and lower in France. This indicates that the conditions for empowering girls and increasing the number of women in geoscience education vary in different countries. These potential differences may be important to keep in mind during the activities in the ENGIE project. For example, some countries can be considered as inspiration to other countries and there are countries that need extra support.

The data also make visible a segregation across different subfields related to geoscience. These patterns of segregation are to a large extent consistent over time. While the data of Earth science points toward a close to gender equal field, the other investigated fields are either male- or female dominated. In the field of environmental science, the proportion of women is generally higher. Hence, in relation to this particular area, is it boys that should be encouraged rather than girls? On the other hand, the geo- and mining engineering field is dominated by men. It seems that activities to encourage girls to support an increase of the number of women is especially needed in this field. Interestingly, Slovakia and the Czech Republic stand out in geo- and mining engineering because they have a more equal gender disposition compared to the other countries. Perhaps they know something that the rest of us would benefit from learning?