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LIFE09 ENV/FI/575 ABSOILS

Final Report/ Annex 33

LIFE + ABSOILS

CARBON FOOTPRINT FINAL REPORT

2015





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Supplement 1. Detailed Carbon footprint calculations



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1. Introduction

This carbon footprint report sets out the results of the carbon footprint monitoring done so far in the ABSOILS project. The Carbon footprint monitoring is done in order to keep track of the greenhouse gas emissions developed by the project. The results of the ABSOILS carbon footprint are compared with the carbon footprint of a similar project, OSAMAT LIFE+ 09/ENV/EE/227 in Estonia. The OSAMAT project has similar actions as ABSOILS and in both projects there are material testing and pilots related to the road and field construction. In OSAMAT only two pilots were made as in ABSOILS the amount of pilots is higher.

With the help of the carbon footprint report the project can point out actions or working methods that consume too much energy or create too much greenhouse gas emissions compared with how much results can be achieved by the action. The overall point of this carbon footprint reporting is to observe the emissions created by this project. The final carbon footprint report will present the total carbon footprint of the project. In the following carbon footprint reports evaluation and comparison between different project periods can be made. The first Carbon footprint report will be updated as new results are gathered.

The methodology of the carbon footprint calculation and the assumptions made in the calculation are presented in chapters 2 and 3. The results of the carbon footprint calculation as well as the evaluation and comparison of the results are presented in chapter 4.

2. Methodology

The carbon footprint monitoring was performed on the basis of the documented hours of work, kilometres and vehicle travelled. Each partner documented the driven kilometres to meetings and the emission producing actions on the piloting site were evaluated and documented.

The deskwork in the project is normal deskwork and the greenhouse gas emissions from the deskwork can be calculated on the basis of the deskwork hours documented on the timesheets. The emissions from the laboratory work are also calculated on the basis of the work hours. The additional energy consumption related to the refrigerators and other equipment needed for the material tests are calculated in the consumption of energy on hourly basis, which is thus included to the carbon footprint of the work.



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3. Assumptions

The following assumptions were made in the carbon footprint calculation.

- The laboratory and deskwork facilities in Luopioinen office consume about 75000 kWh per year and the total working hours of the office are 21000 h per year. The approximate energy consumption of a working hour is 3,6 kW and the CO_{2ekv} emissions are 800 g CO_{2ekv} per working hour. Assumption that the laboratory work and desk work consume the same amount of energy as the energy consumption is difficult to allocate to different kinds of work. However a normal office with no laboratory consumes lower amount of energy and therefore the following assumption is made.
- In the other offices with only deskwork facilities the energy consumption is estimated to be 2,6 kW per hour and the CO_{2ekv} emissions are 580 gCO_{2ekv} per working hour.
- The emissions of vehicles are assumed to be the same as the manufacturer declares (gCO_{2ekv}/km) multiplied by the kilometres travelled. For those with no manufacturer information the data was taken from www.ilmastolaskuri.fi webpages.
- The factors affecting the emissions from the piloting are assumed to be the transportation of the materials (volume of transported material and vehicle type), the fuel consumption of the equipment used in the piloting site, the moving of the stabilisation equipment and the trips from the office to the piloting site (these trips are not calculated in the business trip section). Also the emissions from the production of the binders are calculated.
- The emissions of cement production are assumed to be 690 kgCO_{2ekv} / ton of cement. The emissions of KC production are assumed to be 850 kgCO_{2ekv} / ton. The emissions from the ash "production" are assumed to be zero and the emissions of the process are allocated to the energy production which is the real product of the process. Also the emissions from sulphur removal by-product are assumed to be zero as well as the emissions of gypsum as they both are created as a by-product the actual product being energy and phosphorous acid. Actually the sulphur removal product reduces the environmental burden of energy production.



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- The emissions from the use of office supplies such as paper, pens, pencils, plastic products (binders, folders) etc. are assumed to be zero as the emissions would be too difficult to evaluate correctly and on the other hand the emissions would be so small that compared to other activities it isn't in any key role considering the total emissions of the project.

4. Results

4.1 Absoils

The results of the Absoils project are calculated on the basis of the information given by the partners.

The total carbon footprint from the beginning of the project till the end of May 2015 is 18 644 tonnes of CO₂ equivalent. The carbon footprint is divided on travelling, piloting and deskwork according to the following table. The detailed calculations can be found as a supplement of the report. The Table 1 presents the generated CO₂ emissions during the first, second and third reporting period.

Table 1. CO₂ emissions generated during the project.

	Tonnes of CO ₂ equivalent					Total
	1.9.2010-31.8.2011	1.9.2011-31.8.2012	1.9.2012-31.8.2013	1.9.2013-31.8.2014	1.9.2014-30.5.2015	
Travelling	3,1	4,1	3,9	8,5		19,60
Piloting work	2169,5	6175,6	4805,8	5453,2	-	18604,1
Deskwork	3,6	2,3	3,2	6,8	4,6	20,5
TOTAL	2176,2	6181,9	4812,92	5468,5	4,6	18644,2

The most of the emissions were generated from the piloting which was evaluated also beforehand to be the greatest emission source. The emissions generated from the deskwork are small and the travelling during the project is kept minimal. The emissions of the travelling could be even lower if the public transportation systems were developed so that the connections from Ramboll Finland Luopioinen office would be better. The number of phone meetings could be increased to further decrease the carbon footprint of travelling. The increased emissions from travelling in 2013-2014 emissions are due to flying abroad to



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conferences etc. dissemination events. The emissions of the piloting work are difficult to reduce without reducing the amount of work done with the machines. The piloting involves the utilisation of the stabilisation machines as well as excavators etc., which consume a lot of fuel. In addition, the transportation of the materials to and from the pilot site consumes fuel. During the last year (2014-2015) only deskwork hours were set.

The biggest amount of emissions created by a single, so called, process was the utilisation of cement in stabilisation. The emissions created by the cement production process are about 11 813 tonnes of CO₂ equivalent during the project period. If fly ash could have been utilised at the sites, most of the emissions could have been avoided. As long as fly ash is considered to be a waste, no emissions will be calculated for the fly ash, as the main product of the process is the energy produced.

4.2 Comparison with Osamat

The difference in the calculation methods at this point is that the OSAMAT project has not considered the effect of the fuel consumption of different vehicles to the generation of CO₂ emissions as in ABSOILS it has been taken in to account. That means that in OSAMAT it is assumed that all cars create the same amount of carbon dioxide emissions although the cars utilise different amounts of fuel. This might have a small impact on the outcome of the calculations but the impact on the total CO₂ footprint is insignificant.

Tonnes of CO ₂ Equivalent	1.9.2010-31.8.2011		1.9.2011-31.8.2012		1.9.2012-31.8.2013		1.9.2013-30.5.2015	
	ABSOILS	OSAMAT	ABSOILS	OSAMAT	ABSOILS	OSAMAT	ABSOILS	OSAMAT*
Travelling	3,1	3,5	4,1	4,5	3,9	5,6	8,5	N/A
Piloting work	2169,5	N/A	6175,6	166,7	4805,8	687,3	5453,2	N/A
Deskwork	3,6	2,8	2,3	3,0	3,2	4,9	11,4	N/A
TOTAL	2176,2	6,3	6181,9	7,0	4812,9	697,8	5473	N/A

*The Carbon Footprint will be updated for OSAMAT in the end of 2015.

The emissions from the travelling are bigger in OSAMAT project than in ABSOILS, but the difference is not big. The emissions from the deskwork are little less in the OSAMAT project during the first project year but during the second year the emissions are less in the ABSOILS



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project. This trend continues in the third reporting period. In fourth reporting period the comparison has not been done as the OSAMAT Carbon Footprint report will be updated in 2015.

The emissions from the pilot works were not calculated by the OSAMAT project in the first reporting period as there were no piloting activities yet. They were reported for the second and third reporting period and turn out to be the biggest difference between these two projects.

The total emissions from piloting in Absoils reach 18 604 tonnes of CO₂ equivalent. This difference can only be explained by the considerably higher amount of cement used for the pilots and the length of the cement transportation to the pilot site. More cement was used in Absoils as the project has so far carried out 4 pilot applications instead of 2 pilots in OSAMAT.

When the distances are compared that tank trucks have driven it can be seen that the difference is more than 5 times.

- OSAMAT - 14 562 km driven for binder components transportation to site
- ABSOILS – 132 983 km driven for binder components transportation to site

When calculating piloting activities CO₂ values the binders production CO₂ is also included. The binders in this project consist of oil shale ash (OSA) and cement. In the case of Absoils it has been mainly cement with some exception of the limited amounts of ash and FGD.

The use of cement in both of the projects has been as follows.

- OSAMAT – all together on both sites 941 t of cement was used
- ABSOILS – all together on both sites 16 490 t of cement was used