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On-line tool for the comparison of GHG-impacts of alternative energy solutions

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IMPAWATT

IMPlementAtion Work and Actions To change the energy culTure

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Date	Version	Prepared by	Approved by	Notes
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Add date				

Contents

1 Executive summary

The objective of work package 4 was to:

- § Support corporate policy towards sustainable supply-chain management
- § Support for the consideration of sustainability aspects when implementing energy-efficiency measures

The objective of Task 4.2 was to prepare an easy-to-use tool and database for the comparison of GHG-impacts of alternative energy solutions.

IMPAWATT tool helps to assess the GHG savings because of alternative measures that improve energy-efficiency and/or because of shifting to lower carbon fuels and renewable energy carriers.

2 Introduction

In accordance with the work plan, Task 4.2 will develop an on-line tool that enables the assessment of greenhouse gas impacts of energy use in manufacturing. The tool is not an LCA tool for product manufacturing assessment but supports SMEs to assess the benefits of energy-efficiency improvements in manufacturing process in terms of GHGs. The tool includes a database of current carbon data of different fuels and average carbon data of electricity in European countries. The default values can be replaced with values that are more accurate when more information is available. The tool also includes data about embodied carbon of different kinds of renewable energy solutions. The default values will be based on current knowledge and can be replaced with more accurate information in time when those are available.

2.1 Purpose of this document

The purpose of the document is to introduce the tool.

2.2 Relation to other activities in the project

The specific idea of the On-line tool for the comparison of GHG-impacts of alternative energy solutions is to enable the energy managers of companies to consider GWP impact of energy decisions.

2.3 Partners´ contribution

The tool was made at VTT. All participants were able to comment the draft versions. The received comment were considered and the final version was prepared by VTT.

3 Description of the tool

3.1 GWP calculation background

The method for greenhouse gas assessment bases on global warming potential (GWP). The calculation uses 100 years' time horizon and the result is expressed as CO_2 equivalent. Carbon dioxide (CO_2) has a GWP of exactly 1 and it is the baseline unit to which all other greenhouse gases are compared by using characterization factors.

Table 1 shows some emission components and their characterisation factors used for GWP calculation. All background data based on GWP values and 100-year lifetime according to Intergovernmental Panel on Climate Change (IPCC) Assessment Report 4 (IPCC 2007). IPCC's Fifth Assessment Report introducing new updated characterization factors, and according to that for an example methane got higher impact factor than in previous Report AR4 (in 2007 report the factor for methane was 25 while in 2013 report it is 34). However, those new factors are not used in the current tool for GWP default values. Those default values (GWPs for energy carrier and fuels are calculated according to IPCC 2007) can be

replaced with information that is more accurate (after those will be publicly available for all energy carriers and fuel types).

Table 1. GWP characterisation factors for selected emissions.

Emission factors	GWP (IPCC 2007) estimate for 100 years	GWP (IPCC 2013) estimate for 100 years
Carbon dioxide (CO_2)	1	1
Methane (CH_4)	25	34
Nitrous oxide (N_2O)	298	298
HFC-134a (hydrofluorocarbon)	1 430	1 550
…		

GWP calculation is expressed as CO_2equivalent (CO_2e) and it is calculated using emissions having impacts to the global warming. The emission content (kg) multiplied with the emission factors (100-year estimate) and finally the sum of those multiplications will be the GWP result.

GWP calculation is given as an example for the emission components carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) as follows: (characterization factors were presented in a Table 1) but:

$CO_2e = CO_2 + 25*CH_4 + 298* N_2O$

3.2 Purpose of the tool

IMPAWATT tool calculates the greenhouse gas emissions (GHG) because of energy use in defined manufacturing / assembly / production systems. Calculation method considers GHG emissions caused by combustion and pre-combustion because of the acquisition of fuels. Tool contains already predefined default GWP values for included fuel- and energy types. The method takes into account also embodied emissions of renewable energy technologies.

Tool enables to compare your current case with the possible alternatives (for consider savings). There are many possibilities for comparison:

- the savings could be based on improved energy-efficiency,
- or because of shifting to lower carbon fuels,
- or taking use of renewable energy carriers.

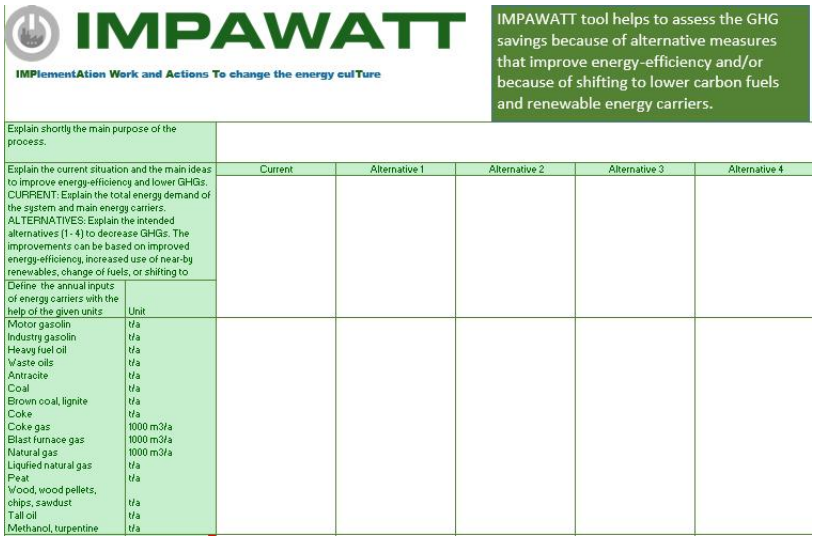
3.3 User guide

IMPAWATT tool has four pages. First page, called 'INPUTS' and it is for the data submission; second page is 'RESULTS' and it shows your assessment result; third page is 'BACKGROUND' in which all default GWP values are provided; fourth pages is for the user guide and data sources.

HOW TO GET START?

- Define the system and its purpose. Explain the current energy demand and the main energy carriers.
- Explain the main ideas to improve. Give alternatives if relevant.
- Define annual energy consumptions by energy carrier type considering the given units for the current situation and alternatives into the white cells ('INPUT' sheet).

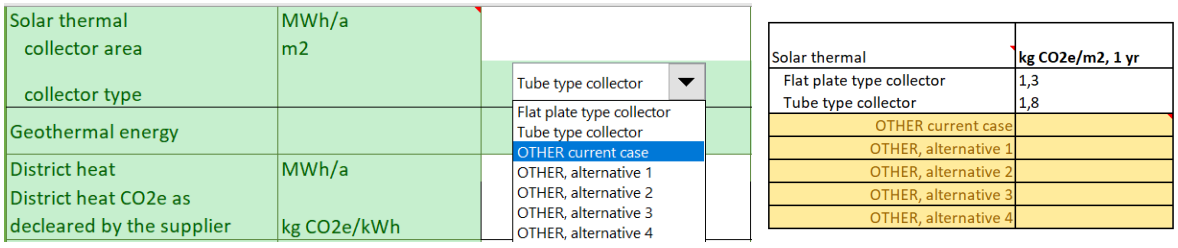
Energy consumption supply for Solar thermal, Electricity, Geothermal, Green electricity and District heat described below.



SOLAR THERMAL

Defining annual energy consumptions for solar thermal assessment define also collector area and type. For the collector type drop -down list should be used.

> *Solar thermal assessment contains two pre-defined collector types with their embodied GWP values: 'Flat plate collector' and 'Tube type collectors'.*
>
> *This drop-down list allows you to choose also 'OTHER' for current case and alternative cases (Alternative 1-4).*
>
> *In this later case ('OTHER'), you should provide this GWP value into the 'Background' sheet yellow cells (see below). The value should be supplied with the unit kgCO_2e/m^2, yr. (kg GWP per one 1m^2 of collector divided with the service life of the collector (years)). The value for flat type collector is 1.3 kg CO_2e/m^2, yr. was first calculated for the 1 m^2 of collector (it was 39 kg CO2e/m2) and then divided to the collector service life (in our case it is 30 year), thus total embodied value was 39/30= 1.3 kg CO_2e/m^2, year.*



ELECTRICITY

If you use electricity from national grid, define the consumption and the country from provided drop-down list. GHGs of electricity are then based on national average values. In case you have relevant GHG information available, choose OTHER and go to BACKGROUND sheet to provide data (kg CO_2e/kWh) into the yellow cells.

Electricity	MWh/a	1
Country		Cyprus
Green /distributed electricity	MWh/a	
based on wind	%	
based on solar energy	%	
based on hydropower	%	
Total should be 100 %		

Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece

Finland	0,200
France	0,096
Germany	0,640
Greece	0,851
Hungary	0,358
Ireland	0,549
Italy	0,457
Latvia	0,153
Lithuania	0,155
Luxembourg	0,149
Malta	1,113
Netherlands	0,491
Poland	1,109
Portugal	0,393
Romania	0,665
Slovak Republik	0,263
Slovenia	0,443
Spain	0,392
Sweden	0,038
United Kingdom	0,600
EU-28	0,460
OTHER current case	1
OTHER, alternative 1	1
OTHER, alternative 2	1
OTHER, alternative 3	1
OTHER, alternative 4	1

GEOTHERMAL

If you use / plan to use geothermal energy, tick YES. Make sure that the right country is chosen from the drop-down list for Electricity. The emissions will be based on the GHG of chosen electricity.

DISTRICT HEAT

For district heat, provide supplier-specific GHG emissions.

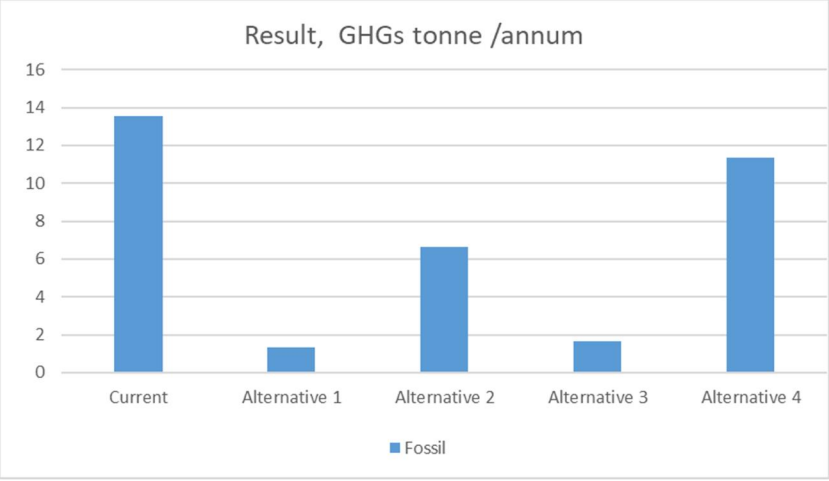
GREEN ELECTRICITY

If you use green electricity, give the annual consumption (MWh/a) and define the source of energy (%). The sum must be 100%.

Green /distributed electricity	MWh/a	10	2000
based on wind	%	100 %	1,0 %
based on solar energy	%		90,0 %
based on hydropower	%		9,0 %
Total should be 100 %		100 %	100 %

HOW TO COMPARE RESULTS?

Open 'RESULTS' sheet. It shows calculated the GHGs and the differences between alternatives. Results are given in table by energy carrier type but also in the Figure. Compare the alternatives.



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