Comitato Termotecnico Italiano Energia e Ambiente
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Iscritto c/o la Prefettura di Milano nel Registro delle Persone Giuridiche al n. 604
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Calculation of the greenhouse gas emissions of the cultivation of the main Italian oilseed pathways (Soybean, Sunflower, Rapeseed) for the definition of the NUTS II Areas under Directive 2009/28/EC "RED"

Methodology, Findings and Emission Values (e_{ec})

September 2013

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Calculation of the greenhouse gas emissions for the cultivation of the main Italian oilseed pathways (Soybean, Sunflower, Rapeseed) for the definition of the NUTS II Areas under Directive 2009/28/EC "RED". *Methodology, Findings and Emission Values (e_{ec})*

Introduction

The Study sets greenhouse gas emissions related to cultivation (e_{ec}) of the main Italian oilseed pathways (Soybean, Sunflower and Rapeseed), in order to determine the NUTS II Areas, for the implementation of Directive 2009/28/EC, RED.

The Report, drafted by the Italian Termotechnical Committee for Energy and Environment (CTI) on behalf of the Italian Association of Vegetable Oil Industry (ASSITOL), elaborates the results of a specific form submitted to the most representative regional operators in the field of oilseeds production, such as professionals, farmers, consortia and agricultural associations, to assess the amount of greenhouse gas emissions of cultivation (e_{ec}), using the RED-based methodology.

Data derive from:

- Questionnaires (factors of production and crops yields);
- European databanks, such as BioGrace and JRC (specific emission factors);
- AGEA (Italian Agency for disbursement of funds to agriculture) and ISTAT (National Institute of Statistics) databanks (official statistics on cultivated areas and on regional productions to be compared with the results collected with the questionnaires).

Setup of the Study and input data

Based on a LCA approach CTI, in cooperation with ASSITOL, prepared a questionnaire for collecting specific information of the agronomic inputs and the crop yields of the three main Italian oilseed pathways.

ASSITOL distributed the questionnaire to professionals, farmers, consortia, agricultural associations, companies and other local operators, which fill it and signed it, in order to assure the traceability of the data. At the end of the Study Assitol collected 134 questionnaires divided by region (**table 1)**.

The data from the questionnaires have been compared with information published by ISTAT and AGEA in their public Databanks to validate the reliability of data collected. Despite some gaps (for instance the lack of sunflower's data from Piemonte, Abruzzo and Lombardia), the CTI/ASSITOL report has a good coverage of the regions.

Comparing the results of the Study with AGEA and ISTAT data, it is clear their importance (**table 2):** the sample is representative of the national production for the three pathways; the areas analyzed represent 67% for soybean, 50% for sunflower and 41% for rapeseed of total surfaces investigated by ISTAT.

Table 1 – Questionnaires divided by region and production

Regione	Rape	Sunflower	Soy	Total
Friuli V.G.	1		11	12
Lazio	2	3		5
Lombardia	6		2	8
Marche	5	11		16
Emilia Romagna	10	5	3	18
Toscana	14	21		35
Umbria	3	4		7
Veneto	6	1	11	18
Molise	1	1		2
Puglia	2	1		3
Piemonte	5			5
Abruzzo	2			2
Basilicata	1			1
Campania	2			2
TOTAL	60	47	27	134

Table 2 – Comparison between surfaces analyzed and ISTAT and AGEA surfaces. (ISTAT and AGEA data elaborated by CTI)

Cultivation	Sample CTI/ASSITOL		ISTAT	AGEA
	ha	% on ISTAT Data	ha	ha
Soybean	112,293	67%	168,595	44,993
Sunflower	54,161	50%	107,940	5,636
Rapeseed	10,779	41%	26,009	33,657

Tables 3 and 4 show some differences between ASSITOL and AGEA data. For instance, ASSITOL Study shows 37,000 hectares cultivated with sunflower, whereas ISTAT data show only 16,800 hectares and AGEA data only 200 hectares.

With concern to regional productions, there is a gap between AGEA (which bases its data on the contracts of the oil used for biodiesel production or for electricity production) and ISTAT. **Table 4** represents the cultivated surfaces (ISTAT and AGEA), the total amount of productions (AGEA) and the crop yields (AGEA), divided by region and cultivation. **Table 4** also shows CTI/ASSITOL regional and cultivation data (in grey).

In order to stress the relevance of the information directly collected through the questionnaires, **table 8, 9** and **10** (see below) show different crop yields compared with AGEA data shown in **Table 4.**

Table 3 –Surfaces surveyed by CTI/ASSITOL divided by region.

Region	Rapeseed (ha)	Sunflower (ha)	Soybean (ha)
Abruzzo	50		
Basilicata	12		
Campania	32		
Emilia Romagna	910	362	11,125
Friuli V.G.	3		5,926
Lazio	408	1,553	
Lombardia	433		21,000
Marche	396	1,084	
Molise	12	28	
Piemonte	728		3,000
Puglia	797	147	
Toscana	2,832	12,760	
Umbria	2,307	37,027	
Veneto	1,859	1,200	71,242
TOTAL	10,779	54,161	112,293

Table 4 – Surfaces used and annual productions divided by cultivation and region (ISTAT and AGEA data, elaborated by CTI). In grey ASSITOL data on regional cultivation.

	Rapeseed				Sunflower				Soybean			
Region	**ISTAT (ha)**	**AGEA (ha)**	**AGEA Prod. (t)**	**AGEA Yield (t/ha)**	**ISTAT (ha)**	**AGEA (ha)**	**AGEA Prod. (t)**	**AGEA Yield (t/ha)**	**ISTAT (ha)**	**AGEA (ha)**	**AGEA Prod. (t)**	**AGEA Yield (t/ha)**
Abruzzo	**25**	**109**	116	1.07	2,981	55	63	1.16	41			
Basilicata	**770**	**636**	1,294	2.03	54				1			
Bolzano Trento		1	1	1.20	1				32	9	37	3.98
Calabria	5				6				2			
Campania	**39**	**121**	193	1.59	268	8	9	1.19	3			
Emilia-Romagna	**2,583**	**4,649**	11,451	2.46	**5,475**	**1,121**	3,234	2.89	**21,975**	**4,219**	13,632	3.23
Friuli-V.G.	**1,799**	**2,796**	7,761	2.78	807	1	3	2.65	**40,333**	**21,086**	74,865	3.55
Lazio	**2,352**	**5,559**	9,349	1.68	**4,426**	**153**	269	1.77	103	475	1,982	4.17
Liguria		63	117	1.87	4	23	25	1.12	5	11	46	4.35
Lombardia	**4,618**	**5,187**	13,610	2.62	1,050	43	76	1.78	**21,526**	**878**	2,802	3.19
Marche	**603**	**925**	1,988	2.15	**40,111**	**2,665**	6,599	2.48	658	2	7	4.40
Molise	**71**	**83**	174	2.09	**7,991**	**65**	273	4.23	23			
Piemonte	**3,154**	**3,134**	7,924	2.53	3,004	494	1,065	2.16	**8,935**	**34**	146	4.29
Puglia	**728**	**1,386**	2,800	2.02	**4,776**	**127**	150	1.18	24			
Sardegna	185	91	108	1.18	1				33			
Sicilia	56				76				27			
Toscana	**2,197**	**1,867**	10,450	5.60	**18,551**	**533**	1,397	2.62	414	7	26	3.58
Umbria	**1,281**	**1,703**	3,879	2.28	**16,860**	**219**	358	1.63	269			
Valle d'Aosta												
Veneto	**5,541**	**5,347**	17,168	3.21	**1,498**	**130**	334	2.56	**74,190**	**18,273**	72,498	3.97
TOTALE	**26,007**	**33,657**	88,383	2.63	**107,940**	**5,636**	13,856	2.46	**168,595**	**44,994**	166,042	3.69

Questionnaires considered irregular compared with official statistics have not been considered. In order to elaborate data close to reality, it has been considered the average value of data collected for each region and each parameter, weighted on the surface declared by the operator. The average values are reported in **tables 5, 6** and **7.**

Table 5 – Values based on questionnaires used for the Soybean e_{ec} calculation

SOYBEAN	Yield (t/ha)	Humidity (%)	Diesel (MJ/ha)	Nitrogen (kg N/ha)	Phosphorum (kg P_2O_5/ha)	Potassium (kg K_2O/ha)	Seed (kg/ha)	Pesticides (kg a.i./ha)
Emilia Romagna	3.22	15.0	4,750	19	109	0	72	1.4
Friuli V.G.	3.45	14.0	6,422	24	27	54	70	1.3
Lombardia	4.10	15.7	5,434	18	92	0	78	2.5
Piemonte	4.10	16.5	3,600	15	45	90	75	1.0
Veneto	3.98	14.6	5,504	27	82	80	79	2.2

Table 6 - Values based on questionnaires used for sunflower e_{ec} calculation

SUNFLOWER	Yield (t/ha)	Humidity (%)	Diesel (MJ/ha)	Nitrogen (kg N/ha)	Phosphorum (kg P_2O_5/ha)	Potassium (kg K_2O/ha)	Seed (kg/ha)	Pesticides (kg a.i./ha)
Emilia Romagna	3.36	9.0	4,140	105	92	0	6.0	2.0
Lazio	2.77	12.1	3,804	79	46	0	6.0	0.5
Marche	3.27	9.4	3,941	109	46	14	6.0	1.9
Molise	3.00	9.0	4,140	105	92	0	6.0	2.0
Puglia	3.00	9.0	4,140	105	92	0	6.0	2.0
Toscana	2.66	9.9	5,056	101	56	34	6.2	1.1
Umbria	2.11	9.0	5,368	96	48	0	6.0	1.5
Veneto	3.00	9.0	n.d.	69	0	0	6.6	2.4

Table 7 - Values based on questionnaires used for rapeseed e_{ec} calculation

RAPESEED	Yield (t/ha)	Humidity (%)	Diesel (MJ/ha)	Nitrogen (kg N/ha)	Phosphorum (kg P_2O_5/ha)	Potassium (kg K_2O/ha)	Seed (kg/ha)	Pesticides (kg a.i./ha)
Abruzzo	2.64	9.5	4,860	74	0	0	4.0	0.9
Basilicata	2.60	9.5	4,860	74	0	0	4.0	0.9
Campania	2.87	9.5	4,860	74	0	0	4.0	0.9
Emilia Romagna	3.68	9.5	4,196	92	0	0	4.0	1.8
Friuli V.G.	3.70	9.5	4,320	92	0	0	4.0	1.8
Lazio	2.80	9.5	2,555	51	9	0	5.0	1.0
Lombardia	3.66	9.5	4,099	92	0	0	4.0	1.8
Marche	3.04	9.6	4,493	83	0	0	4.0	1.9
Molise	2.60	9.5	4,860	74	0	0	4.0	0.9
Piemonte	2.41	9.2	4,814	47	0	0	4.3	1.7
Puglia	2.51	9.5	4,813	73	0	0	4.0	0.9
Toscana	2.53	10.2	4,530	98	38	2	4.5	1.3
Umbria	2.57	10.0	3,930	110	0	0	3.6	1.7
Veneto	3.41	9.1	4,005	112	0	0	2.6	1.0

Before the final calculation, it has been necessary to define the emission factors.

In this perspective, references have been made to the values provided by authoritative sources, such as the BioGrace database, with the use of the "*BioGrace biofuel GHG calculation tool Version 4b*", and the related suggestions of the JEC consortium (JRC, EUCAR and CONCAWE). The values used are reported in **figures 1** and **2**, sourced from the BioGrace Calculation Tool.

With regard to the Global Warming Potential (GWP), in line with the BioGrace Tool, the value adopted is the one provided by JEC, which suggested 25 for CH_4 and 298 for N_2O.

Finally, following the BioGrace tool's indications, the emissions have been allocated to the expeller on the basis of their different energetic potential:

- Sunflower: 65.8% Oil – 34.2% Expeller
- Rapeseed: 61.3% Oil – 38.7% Expeller
- Soybean: 34.4% Oil – 65.6% Expeller

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Figure 1 – Emission Factors used for the calculation of e_{ec} (Source: BioGrace biofuel GHG calculation tool Version 4b)

Version 4 - Public

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
STANDARD VALUES parameter:	**GWP**	**GHG emission coefficient**								**Fossil energy input**		**Density**	**LHV** MJ/kg	**Fuel efficiency**	**Transport exhaust gas emissions**		**Source**
unit:	$gCO_{2,eq}$ / g	gCO_2/kg	gCH_4/kg	gN_2O/kg	gCO_{2-eq}/kg	gCO_2/MJ	gCH_4/MJ	gN_2O/MJ	gCO_{2-eq}/MJ	MJ_{fossil}/kg	MJ_{fossil}/MJ	kg/m^3	(at 0% water, unless otherwise stated)	MJ/t.km	gCH_4/t.km	gN_2O/t.km	
Global Warming Potentials (GWP's)																	
CO_2	1																RED Annex V.C.5
CH_4	25																RED Annex V.C.5
N_2O	298																RED Annex V.C.5
Agro inputs																	
N-fertiliser (kg N)		2827,0	8,68	9,6418	5917,2					48,99							JEC E3-database (version 31-7-2008)
P_2O_5-fertiliser (kg P_2O_5)		964,9	1,33	0,0515	1013,5					15,23							JEC E3-database (version 31-7-2008)
K_2O-fertiliser (kg K_2O)		536,3	1,57	0,0123	579,2					9,68							JEC E3-database (version 31-7-2008)
CaO-fertiliser (kg CaO)		119,1	0,22	0,0183	130,0					1,97							JEC E3-database (version 31-7-2008)
Pesticides		9886,5	25,53	1,6814	11025,7					268,40							JEC E3-database (version 31-7-2008)
Seeds- corn		0,0	0,00	0,0000	0,0					0,00							JEC E3-database (version 31-7-2008)
Seeds- rapeseed		412,1	0,91	1,0028	733,7					7,87							JEC E3-database (version 31-7-2008)
Seeds- soy bean		0,0	0,00	0,0000	0,0					0,00							JEC E3-database (version 31-7-2008)
Seeds- sugarbeet		2187,7	4,60	4,2120	3557,9					36,29							JEC E3-database (version 31-7-2008)
Seeds- sugarcane		1,6	0,00	0,0000	1,6					0,02							JEC E3-database (version 31-7-2008)
Seeds- sunflower		412,1	0,91	1,0028	733,7					7,87							JEC E3-database (version 31-7-2008)
Seeds- wheat		151,1	0,28	0,4003	277,3					2,61							JEC E3-database (version 31-7-2008)
Residues (feedstock or input)																	
EFB compost (palm oil)		0,0	0,00	0,0000	0,0					0,00							
Filter mud cake		0,0	0,00	0,0000	0,0					0,00							
Manure		0,0	0,00	0,0000	0,0					0,00			10,0				JEC E3-database (version 31-7-2008)
Vinasse		0,0	0,00	0,0000	0,0					0,00							
Fuels- gasses																	
Natural gas (4000 km, Russian NG quality)						61,58	0,1981	0,0002	66,59		1,1281						JEC E3-database (version 31-7-2008)
Natural gas (4000 km, EU Mix quality)						62,96	0,1981	0,0002	67,98		1,1281						JEC E3-database (version 31-7-2008)
Methane													50,0				JEC E3-database (version 31-7-2008)
Fuels- liquids (also conversion inputs)																	
Diesel						87,64	0,0000	0,0000	87,64		1,1600	832	43,1				JEC E3-database (version 31-7-2008)
Gasoline												745	43,2				JEC E3-database (version 31-7-2008)
HFO						84,98	0,0000	0,0000	84,98		1,0880	970	40,5				JEC E3-database (version 31-7-2008)
HFO for maritime transport						87,20	0,0000	0,0000	87,20		1,0880	970	40,5				JEC E3-database (version 31-7-2008)
Ethanol												794	26,81				JEC E3-database (version 31-7-2008)
Methanol						92,80	0,2900	0,0003	100,15		1,6594	793	19,9				JEC E3-database (version 31-7-2008)
FAME												890	37,2				JEC E3-database (version 31-7-2008)
Syn diesel (BtL)												780	44,0				JEC E3-database (version 31-7-2008)
HVO												780	44,0				JEC E3-database (version 31-7-2008)
PVO													36,0				

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Figure 2 – Emission Factors used for the calculation of e_{ec} (Source: BioGrace biofuel GHG calculation tool Version 4b)

Fuels / feedstock / co-products - solids																	
	Hard coal						102,38	0,3835	0,0003	112,05		1,0886		26,5				JEC E3-database (version 31-7-2008)
	Lignite						116,76	0,0091	0,0001	117,00		1,0156		9,2				JEC E3-database (version 31-7-2008)
	Corn													18,5				JEC E3-database (version 31-7-2008)
	FFB													24,0				JEC E3-database (version 31-7-2008)
	Rapeseed													26,4				JEC E3-database (version 31-7-2008)
	Soybeans													23,5				JEC E3-database (version 31-7-2008)
	Sugar beet													16,3				JEC E3-database (version 31-7-2008)
	Sugar cane													19,6				JEC E3-database (version 31-7-2008)
	Sunflowerseed													26,4				JEC E3-database (version 31-7-2008)
	Wheat													17,0				JEC E3-database (version 31-7-2008)
	Waste vegetable / animal oil													37,1				JEC E3-database (version 31-7-2008)
	BioOil (co-product FAME from waste oil)													21,8				JEC E3-database (version 31-7-2008)
	Crude vegetable oil													36,0				JEC E3-database (version 31-7-2008)
	DDGS (10 wt% moisture)													16,0				JEC E3-database (version 31-7-2008)
	Glycerol													16,0				JEC E3-database (version 31-7-2008)
	Palm kernel meal													17,0				JEC E3-database (version 31-7-2008)
	Palm oil													37,0				JEC E3-database (version 31-7-2008)
	Rapeseed meal													18,7				JEC E3-database (version 31-7-2008)
	Soybean oil													36,6				JEC E3-database (version 31-7-2008)
	Soy bean meal													-				JEC E3-database (version 31-7-2008)
	Sugar beet pulp													15,6				JEC E3-database (version 31-7-2008)
	Sugar beet slops													15,6				JEC E3-database (version 31-7-2008)
	Wheat straw						1,75	0,0013	0,0001	1,80		0,0254		17,2				JEC E3-database (version 31-7-2008)
Electricity																		
	Electricity EU mix MV						119,36	0,2911	0,0054	128,25		2,6951						JEC E3-database (version 31-7-2008)
	Electricity EU mix LV						120,79	0,2946	0,0055	129,79		2,7275						JEC E3-database (version 31-7-2008)
Conversion inputs																		
	n-Hexane						80,08	0,0146	0,0003	80,53		0,3204		45,1				JEC E3-database (version 31-7-2008)
	Phosphoric acid (H_3PO_4)		2776,0	8,93	0,1028	3029,8					28,57							JEC E3-database (version 31-7-2008)
	Fuller's earth		197,0	0,04	0,0063	199,8					2,54							JEC E3-database (version 31-7-2008)
	Hydrochloric acid (HCl)		717,4	1,13	0,0254	753,2					15,43							JEC E3-database (version 31-7-2008)
	Sodium carbonate (Na_2CO_3)		1046,0	6,20	0,0055	1202,6					13,79							JEC E3-database (version 31-7-2008)
	Sodium hydroxide (NaOH)		438,5	1,03	0,0240	471,4					10,22							JEC E3-database (version 31-7-2008)
	Potassium hydroxide (KOH)		0,0	0,00	0,0000	0,0					0,00							
	Hydrogen (for HVO)						80,87	0,2765	0,0003	87,87		1,4835						JEC E3-database (version 31-7-2008)
	Pure CaO for processes		1013,0	0,65	0,0076	1031,5					4,60							JEC E3-database (version 31-7-2008)
	Sulphuric acid (H_2SO_4)		193,9	0,55	0,0045	208,8					3,90							JEC E3-database (version 31-7-2008)
	Ammonia		2478,0	7,84	0,0087	2676,5					44,39							JEC E3-database (version 31-7-2008)
	Cycle-hexane		723,0	0,00	0,0000	723,0					53,10							JEC E3-database (version 31-7-2008)
	Lubricants		947,0	0,00	0,0000	947,0					53,28							JEC E3-database (version 31-7-2008)
Transport efficiencies																		
	Truck for dry product (Diesel)														0,94	0,005	0,0000	JEC E3-database (version 31-7-2008)
	Truck for liquids (Diesel)														1,01	0,005	0,0000	
	Truck for FFB transport (Diesel)														2,01	0,005	0,0000	JEC E3-database (version 31-7-2008)
	Tanker truck MB2218 for vinasse transport														2,16	0,000	0,0000	JEC E3-database (version 31-7-2008)
	Tanker truck with water cannons for vinasse transport														0,94	0,000	0,0000	JEC E3-database (version 31-7-2008)
	Dumpster truck MB2213 for filter mud transport														3,60	0,000	0,0000	JEC E3-database (version 31-7-2008)
	Ocean bulk carrier (Fuel oil)														0,20	0,000	0,0007	JEC E3-database (version 31-7-2008)
	Ship /product tanker 50kt (Fuel oil)														0,12	0,000	0,0000	JEC E3-database (version 31-7-2008)
	Local (10 km) pipeline														0,00	0,000	0,0000	JEC E3-database (version 31-7-2008)
	Rail (Electric, MV)														0,21	0,000	0,0000	JEC E3-database (version 31-7-2008)
Emissions from steam production (per MJ steam or heat)																		
	CH_4 and N_2O emissions from NG boiler							0,0028	0,0011	0,40								JEC E3-database (version 31-7-2008)
	CH_4 and N_2O emissions from NG CHP							0,0000	0,0000	0,00								JEC E3-database (version 31-7-2008)
	CH_4 and N_2O emissions from Lignite CHP							0,0023	0,0126	3,82								JEC E3-database (version 31-7-2008)
	CH_4 and N_2O emissions from Straw CHP							0,0000	0,0000	0,00								JEC E3-database (version 31-7-2008)
	CH_4 and N_2O emissions from NG gas engine							0,0533	0,0000	1,33								JEC E3-database (version 31-7-2008)
Electricity production (reference for credit calculation)																		
	Electricity (NG CCGT)						114,48	0,3679	0,0050	125,16		2,0511						JEC E3-database (version 31-7-2008)
	Electricity (Lignite ST)						284,77	0,0259	0,0078	287,73		2,4770						JEC E3-database (version 31-7-2008)
	Electricity (Straw ST)						5,56	0,0042	0,0002	5,72		0,0806						JEC E3-database (version 31-7-2008)

Greenhouse Gas emissions of the cultivation (e_{ec}) of the main national oilseed pathways

As mentioned before, the final Greenhouse Gas emissions calculation of the cultivation (e_{ec}) of the main oilseeds pathways depended from the information directly provided by operators, not being based on statistic data. The methodology used complies with the one described under Annex V letter C of Directive 2009/28/EC (RED):

$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr} - e_{ee}$$

E = total emissions form the use of the fuel;
e_{ec} = emissions from extraction and cultivation of raw materials;
e_l = annualized emissions from carbon stock changes caused by land use change;
e_p = emissions caused by the processing phase;
e_{td} = emissions from transport and distribution;
e_u = emissions from the fuel in use;
e_{sca} = emission saving form soil carbon accumulation via improved agricultural management;
e_{ccs} = emission saving from carbon capture and geological storage
e_{ccr} = emission saving from carbon capture and replacement;
e_{ee} = emission saving from excess electricity from cogeneration.

Focusing only on the calculation of factor $e_{ec,}$ below are reported the values with some comments. Greenhouse gas emissions are expressed in terms of mass unit (**gCO_{2eq}**) multiplied by the units of energy contained in the final product "biodiesel" (**MJ_{FAME}**) or "oil" (**MJ_{OIL}**) for the production of electricity. Since RED does not provide any disaggregated value related to the transport of oil intended for electric production, it has been considered the ratio between the default values e_{ec} RED provided for the pure vegetable oil from rapeseed and the rapeseed biodiesel in order to set the emissions values with regard to **MJ_{OIL}**.

In the sunflower and soybean pathways this value has not been indicated, not being available the e_{ec} RED default value. Considering the conservative approach of the Study it must be highlighted that the final emissions referred to bioliquid are slightly higher than those ones referred to biodiesel because of the lack of emissions allocated to glycerin for the calculation of MJ_{OIL} .

E_{ec} RAPESEED emissions

The final greenhouse gas emissions of the rapeseed pathway is lower than the RED value. The Study shows higher values only in two regions because the cultural yields have been lower than those one considered in RED. For some regions, highlighted by one asterisk, data are not representative because based on one questionnaire.

Table 8 – Rapeseed greenhouse gas emissions.

RAPESEED	Greenhouse Gas	Greenhouse Gas	Resa

Comitato Termotecnico Italiano Energia e Ambiente
Ente Federato all'UNI per la normazione nel settore termotecnico
Iscritto c/o la Prefettura di Milano nel Registro delle Persone Giuridiche al n. 604
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cti@cti2000.it – www.cti2000.it

	Emissions (gCO_{2eq}/MJ_{FAME})	Emissions (gCO_{2eq}/MJ_{OLIO})	(t/ha)
Abruzzo	27.11	28.16	2.64
Basilicata*	27.44	28.50	2.60
Campania	25.41	26.39	2.87
Emilia Romagna	23.07	23.97	3.68
Friuli Venezia Giulia*	23.09	23.98	3.70
Lazio	18.84	19.57	2.80
Lombardia	23.06	23.95	3.66
Marche	25.57	26.56	3.04
Molise*	27.44	28.50	2.60
Piemonte	23.53	24.45	2.41
Puglia	28.02	29.11	2.51
Toscana**	33.47	34.77	2.53
Umbria	33.87	35.18	2.57
Veneto	27.02	28.06	3.41
DEFAULT e_{ec} RED	**29**	**30**	

* Not relevant because based on one questionnaire.
** One questionnaire not considered because irregular.

E_{ec} SOYBEAN emissions

Soybean pathway is the only production in the CTI/ASSITOL Study which registered lower greenhouse gas emission values in all the regions then the RED default values. For some regions, highlighted by one or two asterisks, data are not representative because are based on one questionnaire or on one fertilization datum.

Table 9 – SOYBEAN greenhouse gas emissions.

SOYBEAN	Greenhouse Gas Emissions (gCO_{2eq}/MJ_{FAME})	Greenhouse Gas Emissions (gCO_{2eq}/MJ_{OLIO})	Yield (t/ha)
Emilia Romagna	15.79	16.41	3.22
Friuli Venezia Giulia*	17.03	17.69	3.45
Lombardia*	13.59	14.12	4.10
Piemonte**	11.07	11.50	4.10
Veneto***	15.63	16.23	3.98
DEFAULT e_{ec} RED	**19**	**Unavailable**	

* One single datum on fertilization.
** based on one questionnaire.
*** Two questionnaires not considered because irregular.

E_{ec} SUNFLOWER emissions

The amount of greenhouse gas emissions for the sunflower production are higher than the RED default value. The cause is the different level of nitrogenous fertilization used for the calculation: RED hypothetical pathway (source JRC/BioGrace) suggests an average value of 39 kg N/ha, whereas the questionnaires show a result which exceeds 100 kg N/ha. Consequently Sunflower RED value is considered not representative of the European and the Italian situation because underestimated.

Table 10 – SUNFLOWER greenhouse gas emissions.

SUNFLOWER	Greenhouse Gas Emissions (gCO_{2eq}/MJ_{FAME})	Greenhouse Gas Emissions (gCO_{2eq}/MJ_{OLIO})	Yield (t/ha)
Emilia Romagna	26.57	27.60	3.36
Lazio	25.74	26.74	2.77
Marche	27.16	28.21	3.27
Molise*	29.23	30.36	3.00
Puglia*	29.23	30.36	3.00
Toscana**	32.64	33.91	2.66
Umbria	38.53	40.02	2.11
Veneto***	21.90	22.75	3.00
DEFAULT e_{ec} RED	**18**	**Unavailable**	

* Not relevant because based on one questionnaire.
** Two questionnaires are not considered because irregular.
*** Not relevant because based on an incomplete questionnaire which did not submitted the value related to the diesel consumption. The latter was obtained by the corresponding value of the neighboring region, Emilia Romagna.