Annex 2. Detailed discussion of methodology and data for estimating CO_2 emissions from fossil fuel combustion

Methods

CO_2 emissions from fuel combustion are in general calculated by using the methodology of the IPCC 1996 Guidelines. Different tiers (T1, T2 and T3) have been applied for different fuels according to the CO_2 EF used (default - D, country specific - CS or plant specific - PS).

$$Emissions_{fuel} = Fuel\ Consumption_{fuel} \times CO_2\ Emission\ Factor_{fuel} \times Oxidation\ Factor_{fuel}$$

Both, country specific and IPCC default CO_2 emission factors are used in GHG emission calculations. Since 2004, Estonia has developed country specific emission factors for the main domestic fuel- oil shale. There are two different carbon emission factors for oil shale according to the combustion technology: CO_2 for pulverized combustion of oil shale is - 28.85 tC/TJ and CEF for oil shale combustion in circulating fludised bed – 26.94 tC/TJ. There are also country specific carbon emission factors developed for shale oil (a liquid fuel made by thermal prosessing of oil shale) and for oil shale gases (by products of the oil shale thermal processing and have a different quality depending from technology used): semi-coke gas and generator gas (this two gases have different calorific value and carbon emission factor).

In order to improve the accuracy of the inventory, some of the CO_2 emission factors were checked and updated for the 2011 inventory (oil shale semi-coke, oil shale semi-coke gas and oil shale generator gas).

The Estonia's list of fuels, net calorific values by fuel and used CO_2 emission factors are included in the table A.2.1.

Table A.2.1. CO_2 emission factors from fossil Fuel ncombustion, oxidation factors and net caloric values by fuel

Fuels	NCV average	Unit	CEF (t C/TJ)	CO_2 EF (t CO_2/TJ)	Oxidation factor	Source
Liquid fuels						
LPG (Liquefied petrol Gas)	45.52	GJ/t	17.2	63.1	0.99	D, IPCC 2006
Gasoline	43.00	GJ/t	19.91	73	0.99	CS, LT (Lithuania)
Jet Kerosene	43.00	GJ/t	19.5	71.5	0.99	D, IPCC 2006
Aviation Gasoline	43.00	GJ/t	19.5	71.5	0.99	D, IPCC 2006
Gasoil (light fuel oil)	42.16	GJ/t	20.2	74.1	0.99	CS, LT (Lithuania)
Gasoil (for non-road use)	42.16	GJ/t	20.2	74.1	0.99	CS, LT (Lithuania)
Shale Oil	39.22	GJ/t	21.1	77.4	0.99	CS, MoE 2006
Diesel Oil	42.57	GJ/t	20.2	74.1	0.99	CS, LT (Lithuania)
Residual Fuel Oil (heavy fuel oil)	40.15	GJ/t	21.1	77.4	0.99	D, IPCC 2006
Recycled Waste Oil	20.18	GJ/t	20.2	74	1	PS, Kunda Nordic Cement
Solid fuels						

Fuels	NCV average	Unit	CEF (t C/TJ)	CO_2 EF (t CO_2/TJ)	Oxidation factor	Source
Coal	27.16	GJ/t	26.8	98.3	0.98	D, IPCC 2006
Coke Oven Coke	28.50	GJ/t	29.18	107.0	0.98	D, IPCC 2006
Oil Shale $_{PC}$*	8.87	GJ/t	27.85	102.1	0.98	CS, MoE 2006
Oil Shale $_{FBC}$**	8.87	GJ/t	26.94	98.8	0.98	CS, MoE 2006
Milled Peat	8.7	GJ/t	28.9	106.0	0.98	CS, FI (Finland)
Sod Peat	11.998	GJ/t	27.82	102.0	0.98	CS, FI (Finland)
Peat Briquette	16.0	GJ/t	26.45	97.0	0.98	CS, FI (Finland)
Oil Shale Semi-Coke (SHC technology)		GJ/t	13.14	56.7	0.7	CS, Martins, A., Roos, I. 2011
Oil Shale Semi-Coke (gas generators technology)	4.0	GJ/t	28.25	103.58	1	CS, Martins, A., Roos, I. 2011
Oil Shale Semi-Coke Gas (SHC technology)	35.94	GJ/1000 m^3	16.13	59.14	0.995	CS, Martins, A., Roos, I. 2011
Oil Shale Generator Gas (in VKG plant)	2.67	GJ/1000 m^3	34.43	126.24	0.995	CS, Martins, A., Roos, I. 2011
Oil Shale Generator Gas (in Kiviõli plant)	2.01	GJ/1000 m^3	33.03	121.11	0.995	CS, Martins, A., Roos, I. 2011
Other Fossil based Waste (MSW)	15.20	GJ/t	21.8	80.0	1	PS, Kunda Nordic Cement
Plastic Waste	17.74	GJ/t	20.5	75	1	PS, Kunda Nordic Cement
Gaseous fuels						
Natural Gas	33.6	GJ/1000 m^3	15.3		0.995	CS, FI (Finland)
Biomass fuels						
Solid Biomass (solid, includes e.g. firewood, bark, chips, sawdust and other industrial wood residues, pellets and briquettes)	6.13 – 16.92	GJ/m^3s	29.9		0.98	D, IPCC 2006
Black Liquors	10	GJ/t	29.9	109.6	0.98	D, IPCC1996
Biogas (landfill gas and biogas from wastewater treatment)	19.73	GJ/1000 m^3	14.89	56.1	0.995	D, IPCC2006

* Oil Shale PC - pulverised combustion of oil shale

** Oil Shale FBC - fluidised bed combustion of oil shale

*** D - IPCC default value; CS - country specific, PS - plant specific

Sources:

IPCC 1996: Greenhouse Workbook, Vol. 2, 1996.
MoE 2006: Method for determining the amount of carbon dioxide discharged into the atmosphere. The Regulation of the Minister of the Environment. State Gazette No 22, 11.2006, 85, 1546 (in Estonian).
FI (Finland) – Greenhouse Gas Emissions in Finland 1990-2008 (2010).
LT (Lithuania)) – Greenhouse Gas Emissions in Lithuania 1990-2008 (2010).

The source of calorific values of different fuels is the Statistics Estonian (SE).

Activity data

Activity data for GHG emission calculations from fuel combustion are collected from several data sources. The main fuel consumption data by fuel types and final consumption sectors, including sub-sectors are received from the Energy Department of the Statistics Estonia. Those data are available in the electronic database of the Statistics Estonian *www.stat.ee*. Some detailed data (i.e. technology specific oil shale and semi-coke gas consumption in Narva Power Plants and shale oil production by the Narva Oil Plant) are obtained from the energy company Eesti Energia AS. The road, aviation tranport and waste fuel consumption data are obtained from the Estonian Environment Information Centre.

In the Chapter 3.2 of the NIR 2011 *Emissions From Fuel Combustion* activity data are given by main fuel groups: solid, liquide, gaseous fuels, biomass and other fuels. In the tables A.2 activity data are presented by fuels in PJ-s.

Table A.2.2. Fuel combustion by fuel, PJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Solid fuels	**237.99**	**215.36**	**172.68**	**131.02**	**137.48**	**126.93**	**131.64**	**128.31**	**114.81**	**108.37**	**109.23**	**107.33**	**104.58**	**122.83**	**122.55**	**116.54**	**110.00**	**135.19**	**124.23**	**107.60**
Oil Shale	215.38	195.44	159.23	121.33	128.04	115.20	118.47	116.97	106.76	101.54	100.49	97.13	94.99	113.56	113.37	107.38	99.57	123.70	112.97	95.37
Peat (milled)	1.81	1.13	1.17	1.12	1.22	1.81	1.32	1.35	0.99	0.76	0.69	1.17	1.22	1.19	0.97	1.01	1.22	1.60	1.26	1.44
Peat (sod)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.85	0.87	0.68	0.69	0.60	0.75	0.76	0.78	0.59	0.57	0.61	0.59	0.57
Peat Briquette	3.59	3.34	2.61	2.03	1.58	2.15	2.00	1.10	0.55	0.51	0.47	0.27	0.30	0.33	0.24	0.21	0.19	0.21	0.27	0.16
Coal	9.29	9.00	5.71	2.93	2.19	2.50	2.80	2.41	1.83	1.95	2.29	2.96	1.61	1.19	1.56	1.50	1.89	3.54	3.48	2.35
Oil shale semi-coke gas	0.70	0.70	0.70	0.70	0.91	0.90	1.00	1.05	0.92	0.79	1.04	1.26	1.26	1.32	1.48	1.59	1.62	1.53	2.00	2.19
Oil shale generator gas	6.80	5.43	3.17	2.83	3.50	4.33	5.01	4.57	2.86	2.10	3.51	3.81	4.42	4.47	4.14	4.24	4.92	4.00	3.64	5.52
Coke	0.41	0.32	0.09	0.08	0.05	0.03	0.03	0.02	0.03	0.03	0.05	0.13	0.03	0.02	0.01	0.01	0.01	0.00	0.01	0.01
Liquid fuels	**121.83**	**110.96**	**61.57**	**59.81**	**58.33**	**46.79**	**49.91**	**48.53**	**48.32**	**43.72**	**36.11**	**42.16**	**43.28**	**42.23**	**42.32**	**42.43**	**42.77**	**44.78**	**42.01**	**38.98**
Heavy fuel oil	67.84	61.69	26.86	28.66	23.40	14.41	15.72	13.05	13.52	10.98	3.73	3.34	2.38	1.21	0.67	0.51	0.23	0.26	0.20	0.19
Light fuel oil	5.05	3.69	1.60	0.86	0.73	0.97	1.69	1.96	2.23	2.69	3.21	4.88	4.73	4.70	4.34	4.00	2.56	2.89	2.81	2.14
Motor gasoline	22.84	20.26	9.85	10.10	12.49	10.72	12.07	13.14	12.67	12.02	12.13	14.40	13.35	12.99	12.39	12.46	13.52	14.20	14.10	12.91
Diesel Oil	24.44	23.77	14.40	13.26	14.31	12.99	14.19	14.12	15.13	12.66	12.43	14.18	17.70	18.23	19.50	20.39	22.23	24.06	21.58	20.70
Shale oil	0.00	0.00	8.37	6.57	6.90	7.35	5.86	5.86	4.37	5.01	4.25	4.97	4.83	4.78	5.09	4.73	3.95	3.02	2.94	2.74
LPG	1.58	1.47	0.48	0.31	0.47	0.32	0.33	0.35	0.38	0.32	0.33	0.36	0.27	0.29	0.29	0.31	0.27	0.34	0.36	0.28
Aviation gasoline	0.08	0.08	0.03	0.04	0.03	0.04	0.04	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.04	0.02	0.02	0.02	0.03	0.02
Gaseous fuels	**43.46**	**44.21**	**26.41**	**13.41**	**16.54**	**19.37**	**21.93**	**21.23**	**19.88**	**19.45**	**23.58**	**25.35**	**23.81**	**25.10**	**27.93**	**28.55**	**28.98**	**29.00**	**27.43**	**20.94**
Natural gas	43.46	44.21	26.41	13.41	16.54	19.37	21.93	21.23	19.88	19.45	23.58	25.35	23.81	25.10	27.93	28.55	28.98	29.00	27.43	20.94
Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.01**	**0.13**	**0.33**	**0.34**	**0.78**	**0.62**	**0.70**	**0.87**	**1.11**	**0.64**
MSW, etc	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	0.13	0.33	0.34	0.78	0.62	0.70	0.87	1.11	0.64
Biomass	**8.63**	**8.47**	**7.82**	**7.64**	**12.54**	**20.35**	**24.28**	**24.78**	**21.12**	**21.27**	**21.43**	**22.56**	**22.89**	**23.99**	**24.89**	**24.46**	**21.94**	**24.85**	**26.55**	**29.22**
Solid biomass	8.37	8.21	7.55	7.37	12.25	20.00	23.22	24.27	20.71	20.51	20.63	21.75	21.72	22.72	23.65	22.92	20.32	23.19	25.05	27.90
Black liquor	0.26	0.26	0.26	0.26	0.26	0.26	1.00	0.45	0.34	0.66	0.73	0.73	1.06	1.15	1.16	1.39	1.47	1.48	1.42	1.20
Biogas	0.00	0.00	0.00	0.00	0.02	0.09	0.06	0.06	0.07	0.11	0.08	0.08	0.11	0.11	0.08	0.15	0.15	0.18	0.08	0.12

Table A.2.3. CO_2 emissions from fuel combustion, Tg

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Solid fuels	**23.69**	**21.49**	**17.13**	**12.85**	**13.48**	**12.47**	**12.93**	**12.56**	**11.23**	**10.58**	**10.58**	**10.36**	**10.07**	**11.84**	**11.72**	**11.03**	**10.42**	**12.94**	**11.62**	**9.87**
Oil Shale	21.34	19.44	15.76	11.86	12.50	11.24	11.55	11.36	10.40	9.89	9.67	9.31	9.06	10.86	10.77	10.07	9.33	11.77	10.50	8.60
Peat (milled)	0.19	0.12	0.12	0.12	0.13	0.19	0.14	0.14	0.10	0.08	0.07	0.12	0.12	0.12	0.10	0.10	0.13	0.16	0.13	0.15
Peat (sod)	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.08	0.09	0.07	0.07	0.06	0.07	0.07	0.08	0.06	0.06	0.06	0.06	0.06
Peat Briquette	0.34	0.31	0.25	0.19	0.15	0.20	0.19	0.10	0.05	0.05	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.01
Coal	0.89	0.87	0.55	0.28	0.21	0.24	0.27	0.23	0.18	0.19	0.22	0.28	0.15	0.11	0.15	0.14	0.18	0.34	0.34	0.23
Oil shale semi-coke gas	0.04	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.05	0.05	0.06	0.07	0.07	0.08	0.09	0.09	0.10	0.09	0.12	0.13
Oil shale generator gas	0.85	0.68	0.40	0.35	0.44	0.54	0.63	0.57	0.36	0.26	0.44	0.48	0.55	0.56	0.52	0.53	0.62	0.50	0.46	0.69
Coke	0.04	0.03	0.01	0.01	0.005	0.003	0.004	0.002	0.003	0.003	0.005	0.013	0.003	0.002	0.001	0.001	0.001	0.00	0.001	0.001
Liquid fuels	**9.13**	**8.31**	**4.62**	**4.49**	**4.37**	**3.50**	**3.72**	**3.61**	**3.59**	**3.25**	**2.67**	**3.11**	**3.19**	**3.11**	**3.11**	**3.12**	**3.14**	**3.29**	**3.08**	**2.86**
Heavy fuel oil	5.20	4.72	2.06	2.20	1.79	1.10	1.20	1.00	1.04	0.84	0.29	0.26	0.18	0.09	0.05	0.04	0.02	0.02	0.02	0.01
Light fuel oil	0.37	0.27	0.12	0.06	0.05	0.07	0.12	0.14	0.16	0.20	0.24	0.36	0.35	0.34	0.32	0.29	0.19	0.21	0.21	0.16
Motor gasoline	1.67	1.48	0.72	0.74	0.91	0.78	0.88	0.96	0.92	0.88	0.89	1.05	0.97	0.95	0.90	0.91	0.99	1.04	1.03	0.94
Diesel Oil	1.79	1.74	1.06	0.97	1.05	0.95	1.04	1.04	1.11	0.93	0.91	1.04	1.30	1.34	1.43	1.49	1.63	1.76	1.58	1.52
Shale oil	0.00	0.00	0.64	0.50	0.53	0.56	0.45	0.45	0.34	0.38	0.33	0.38	0.37	0.37	0.39	0.36	0.30	0.23	0.23	0.21
LPG	0.10	0.09	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Aviation gasoline	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gaseous fuels	**2.38**	**2.42**	**1.45**	**0.73**	**0.91**	**1.06**	**1.20**	**1.16**	**1.09**	**1.07**	**1.29**	**1.39**	**1.30**	**1.37**	**1.53**	**1.56**	**1.59**	**1.59**	**1.50**	**1.17**
Natural gas	2.38	2.42	1.45	0.73	0.91	1.06	1.20	1.16	1.09	1.07	1.29	1.39	1.30	1.37	1.53	1.56	1.59	1.59	1.50	1.17
Other	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.03**	**0.03**	**0.06**	**0.05**	**0.05**	**0.07**	**0.09**	**0.05**
MSW, etc	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.03	0.06	0.05	0.05	0.07	0.09	0.05

Table A.2.4. CH_4 emissions from fuel combustion, Gg $CO_{2\ eqv.}$

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Solid fuels	**28.52**	**29.29**	**11.93**	**6.99**	**3.36**	**7.47**	**10.64**	**9.95**	**7.19**	**7.87**	**6.51**	**5.96**	**6.92**	**5.07**	**7.29**	**6.46**	**5.58**	**3.83**	**3.32**	**3.14**
Oil Shale	0.07	0.04	0.05	0.09	0.10	0.09	0.10	0.11	0.09	0.09	0.12	0.13	0.14	0.16	0.17	0.19	0.18	0.17	0.23	0.27
Peat (milled)	1.15	0.71	0.74	0.74	0.79	1.15	0.86	0.88	0.65	0.48	0.43	0.73	0.77	0.75	0.61	0.64	0.77	1.01	0.80	0.91
Peat (sod)	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.55	0.55	0.44	0.44	0.38	0.48	0.48	0.50	0.37	0.36	0.39	0.37	0.36
Peat Briquette	3.74	3.46	2.73	2.05	1.54	2.15	2.04	1.11	0.56	0.54	0.49	0.28	0.31	0.32	0.23	0.22	0.18	0.21	0.28	0.15
Coal	23.46	24.99	8.36	4.05	0.84	4.00	6.90	7.20	5.26	6.27	4.93	4.32	5.11	3.24	5.66	4.92	3.95	1.94	1.54	1.29
Oil shale gas	0.10	0.08	0.05	0.06	0.08	0.09	0.11	0.10	0.07	0.06	0.10	0.11	0.12	0.12	0.12	0.12	0.14	0.12	0.11	0.16
Coke	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquid fuels	**26.18**	**23.98**	**12.08**	**11.94**	**13.10**	**11.79**	**12.10**	**13.41**	**10.46**	**11.86**	**10.55**	**12.36**	**11.00**	**9.93**	**9.06**	**8.71**	**8.39**	**8.08**	**7.16**	**6.16**
Heavy fuel oil	4.85	4.31	1.73	1.97	1.49	0.90	0.99	0.82	0.86	0.69	0.23	0.21	0.15	0.08	0.04	0.03	0.01	0.02	0.01	0.01
Light fuel oil	0.71	0.52	0.25	0.10	0.07	0.09	0.18	0.19	0.23	0.29	0.36	0.71	0.65	0.57	0.51	0.46	0.30	0.32	0.32	0.21
Motor gasoline	18.40	17.01	8.32	8.24	9.83	9.06	9.29	10.77	7.68	9.34	8.52	9.82	8.34	7.43	6.57	6.32	6.23	5.98	5.19	4.54
Diesel Oil	1.94	1.86	1.16	1.14	1.21	1.24	1.23	1.23	1.35	1.17	1.11	1.25	1.52	1.50	1.57	1.57	1.56	1.53	1.41	1.17
Shale oil	0.00	0.00	0.53	0.43	0.44	0.45	0.34	0.34	0.28	0.32	0.27	0.31	0.30	0.30	0.32	0.29	0.25	0.19	0.18	0.18
LPG	0.27	0.28	0.10	0.06	0.06	0.05	0.06	0.06	0.07	0.06	0.06	0.06	0.03	0.04	0.04	0.03	0.03	0.04	0.04	0.04
Aviation gasoline	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Gaseous fuels	**1.02**	**1.06**	**0.66**	**0.39**	**0.47**	**0.49**	**0.53**	**0.51**	**0.49**	**0.48**	**0.57**	**0.61**	**0.59**	**0.62**	**0.68**	**0.70**	**0.71**	**0.74**	**0.72**	**0.56**
Natural gas	1.02	1.06	0.66	0.39	0.47	0.49	0.53	0.51	0.49	0.48	0.57	0.61	0.59	0.62	0.68	0.70	0.71	0.74	0.72	0.56
Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.003**	**0.007**	**0.008**	**0.016**	**0.013**	**0.015**	**0.018**	**0.023**	**0.014**	**0.003**
MSW, etc	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.003	0.007	0.008	0.016	0.013	0.015	0.018	0.023	0.014	0.003
Biomass	**8.00**	**7.76**	**7.19**	**7.19**	**11.49**	**19.28**	**23.29**	**23.57**	**19.48**	**19.59**	**19.81**	**20.43**	**20.80**	**21.87**	**22.55**	**21.52**	**19.88**	**23.21**	**24.44**	**26.39**
Solid biomass	7.67	7.43	6.86	6.86	11.16	18.95	22.03	23.01	19.06	18.76	18.89	19.52	19.47	20.42	21.09	19.77	18.03	21.35	22.65	24.87
Black liquor	0.17	0.17	0.17	0.17	0.17	0.17	0.63	0.28	0.21	0.41	0.46	0.46	0.67	0.73	0.73	0.88	0.92	0.93	0.90	0.76
Biogas	0.17	0.17	0.17	0.17	0.17	0.17	0.63	0.28	0.21	0.41	0.46	0.46	0.67	0.73	0.73	0.88	0.92	0.93	0.90	0.76

Table A.2.5. N_2O emissions from fuel combustion, Gg $CO_{2\ eqv.}$

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Solid fuels	**15.49**	**14.05**	**9.13**	**6.78**	**5.89**	**7.93**	**9.22**	**7.70**	**5.64**	**5.12**	**5.56**	**6.24**	**6.16**	**5.79**	**8.90**	**12.09**	**12.49**	**13.52**	**13.73**	**12.56**
Oil Shale	0.10	0.05	0.08	0.15	0.16	0.14	0.14	0.16	0.14	0.13	0.18	0.19	0.21	0.24	3.28	6.74	6.64	6.94	7.65	6.25
Peat (milled)	2.25	1.41	1.45	1.39	1.52	2.24	1.64	1.68	1.23	0.95	0.85	1.44	1.51	1.47	1.20	1.25	1.52	1.99	1.56	1.78
Peat (sod)	0.00	0.00	0.00	0.00	0.00	0.00	1.24	1.05	1.08	0.85	0.85	0.75	0.93	0.94	0.97	0.73	0.70	0.76	0.73	0.71
Peat Briquette	4.45	4.14	3.24	2.52	1.96	2.67	2.48	1.37	0.69	0.64	0.59	0.34	0.37	0.40	0.29	0.27	0.24	0.26	0.34	0.19
Coal	7.06	7.13	3.56	1.78	1.05	1.59	2.10	1.97	1.47	1.65	1.65	1.89	1.36	0.94	1.41	1.29	1.35	1.87	1.80	1.24
Oil shale gas	1.44	1.16	0.77	0.90	1.18	1.27	1.60	1.47	1.03	0.90	1.41	1.57	1.76	1.80	1.74	1.81	2.03	1.71	1.65	2.39
Coke	0.19	0.15	0.04	0.04	0.02	0.01	0.02	0.01	0.01	0.01	0.02	0.06	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Liquid fuels	**83.25**	**79.63**	**49.45**	**45.89**	**35.54**	**32.14**	**35.05**	**34.88**	**32.21**	**25.93**	**26.43**	**31.07**	**37.76**	**43.80**	**44.43**	**42.53**	**38.02**	**39.78**	**37.99**	**39.12**
Heavy fuel oil	14.52	12.93	5.22	5.86	4.51	2.70	2.95	2.44	2.56	2.05	0.70	0.64	0.45	0.23	0.13	0.09	0.04	0.05	0.04	0.04
Light fuel oil	2.12	1.55	0.73	0.31	0.22	0.26	0.54	0.56	0.69	0.87	1.10	2.12	1.99	1.74	1.54	1.39	0.92	0.96	0.99	0.64
Motor gasoline	15.30	14.56	6.35	7.01	10.34	10.43	11.88	12.81	9.45	11.71	13.28	18.09	17.04	17.81	17.51	16.97	11.51	11.13	10.36	9.14
Diesel Oil	50.47	49.70	35.22	31.23	18.95	17.21	18.37	17.77	18.46	10.17	10.36	9.09	17.26	22.99	24.16	23.09	24.71	26.96	25.92	28.65
Shale oil	0.00	0.00	1.63	1.30	1.31	1.39	1.10	1.10	0.83	0.93	0.79	0.92	0.90	0.90	0.97	0.89	0.74	0.56	0.55	0.53
LPG	0.79	0.83	0.28	0.16	0.17	0.14	0.18	0.18	0.19	0.16	0.17	0.18	0.09	0.11	0.10	0.08	0.08	0.09	0.12	0.11
Aviation gasoline	0.06	0.06	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02
Gaseous fuels	**2.06**	**2.25**	**1.52**	**1.15**	**1.31**	**1.16**	**1.11**	**1.09**	**1.13**	**1.09**	**1.23**	**1.28**	**1.37**	**1.40**	**1.50**	**1.56**	**1.60**	**1.80**	**1.83**	**1.48**
Natural gas	2.06	2.25	1.52	1.15	1.31	1.16	1.11	1.09	1.13	1.09	1.23	1.28	1.37	1.40	1.50	1.56	1.60	1.80	1.83	1.48
Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.08**	**0.22**	**0.24**	**0.48**	**0.39**	**0.43**	**0.54**	**0.69**	**0.40**
MSW, etc	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.08	0.22	0.24	0.48	0.39	0.43	0.54	0.69	0.40
Biomass	**7.02**	**7.02**	**6.52**	**6.16**	**10.38**	**15.70**	**19.06**	**19.19**	**17.17**	**17.56**	**17.73**	**19.25**	**19.67**	**20.57**	**21.58**	**22.24**	**19.28**	**20.64**	**22.68**	**25.32**
Solid biomass	6.69	6.69	6.20	5.84	10.05	15.37	17.81	18.63	16.75	16.74	16.82	18.35	18.36	19.14	20.15	20.51	17.46	18.79	20.91	23.82
Black liquor	0.33	0.33	0.33	0.33	0.33	0.33	1.24	0.55	0.42	0.81	0.90	0.90	1.31	1.43	1.44	1.72	1.82	1.84	1.76	1.49
Biogas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00

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March 14, 2011 nr

Subject: Possible methane emission from
Estonian oil shale mining

In reply to your question whether methane exists in Estonian oil shale mining and in which kinds of Estonian studies this topic is treated, our answer is the following:

Estonian underground mines are continually ventilated and quality of air inside the mines is controlled. Oil shale is a mixture of clay and kerogen matter, and does not emit methane. During the 90-year long period of mining in Estonia there have never been any problems related to methane. Methane is non-existent in Estonian oil shale.

Risk of fire is related only to the kerogen matter in the oil shale, which can ignite. While oil shale is being crushed, fine dust is produced and it may explode.

So as methane does not exist in Estonian mines, it has not been an issue for scientific studies and there are no related publications dealing with Estonia.

Sincerely

Prof. Ingo Valgma
Director

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