How-To-Guide

Carbon and primary energy calculation





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EMD International A/S Niels Jernes vej 10 9220 Aalborg Ø Denmark Phone: +45 9635 44444 e-mail: emd@emd.dk web: <u>www.emd.dk</u>

About energyPRO

energyPRO is a Windows-based modeling software package for combined techno-economic analysis and optimisation of complex energy projects with a combined supply of electricity and thermal energy from multiple different energy producing units. The unique programming in energyPRO optimises the operations of the plant including energy storage (heat, fuel, cold and electrical storages) against technical and financial parameters to provide a detailed specification for the provision of the defined energy demands, including heating, cooling and electricity use.energyPRO also provides the user with a detailed financial plan in a standard format approved by international banks and funding institutions. The software enables the user to calculate and produce a report of the emissions by the proposed project.energyPRO is very user-friendly and is the most advanced and flexible software package for making a combined technical and economic analysis of multidimensional energy projects.For further information concerning the applications of energyPRO please visit www.emd.dk.

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Content

This How-To-Guide is giving an overview about the new features in energyPRO 4.7.282 regarding carbon and primary energy calculations. All possibilities and methods will be explained in detail and should allow every user to set up carbon and primary energy calculations in every energyPRO project.

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1 Introduction

A huge reduction of greenhouse gas emissions in a short period is essential to meet the Paris agreement. As a result, calculating carbon emissions and saving potentials is becoming more and more important. This How-To-Guide explains the different options for accessing emission calculations in energyPRO. Further it focusses the different methods to allocate the combined heat and power production of units, which is necessary to calculate the intensity of CO_2 or primary energy factors.

Based on the guidelines of the European Union (EU) all member states must set up country specific CO_2 calculations. Those calculations need a standard for how cogeneration of heat and power is divided and normalized.

The EU Directive on energy efficiency (2012/27/EU) [1] is using the **reference efficiency method** for determining the efficiency of cogeneration processes. The reference values were set out in an updated EU regulation 2015/2402 [2]. Another method for the allocation of CHP is the **Carnot method** [3]. This method is used in Germany in a working paper (FW 309 part 6) of the German district heating association AGFW [4] to set up specific CO₂ emission factors for district heating. More relevant in Germany is the "electricity credit method" which is used for calculating the primary energy factor (PEF) of heating systems. Electricity generated is subtracted from the primary energy demand of the fuels. For district heating systems the method is also used in working papers (FW 309 part 1) of the German district heating association AGFW [4] and you can also find it in the German norm DIN V 18599 [5] which is relevant for the German building energy regulation (GEG) [6]. The GEG regulates by law that new buildings must have a primary energy demand less than a reference value. The energy demand for heating and cooling is multiplied with a specific primary energy factor based on the fuel which is used. If the dwelling is connected to district heating, the energy demand is multiplied with an individual primary energy factor of the heating network. The German district heating association provides a list with all district heating systems [7]. If there is a CHP unit in the building itself the DIN V 18599 is used for calculating the primary energy factor.

2 Input data

Depending on the purpose it is possible to define emissions and carbon calculations in different ways. These are detailed below.

2.1 Fuels and markets

The input of emission data in energyPRO can now be done in fuels and markets. Adding a fuel to a project gives the possibility to define a CO_2 factor beside the heat value. This specific factor can be defined as a pure CO_2 factor or for CO_2 equivalents. The units can be selected by the user, so it is possible to base it on the upper or lower heating value for example.

Name:	Natural gas						
Unit	Nm3	Heat value	11,0000	kWh	۷		11,0000 kWh/Nm3
		CO ₂ -factor	240,0	g	\sim	1	kwn 🗸
		Primary energy factor	1,1				



The primary energy factor (PEF) is only visible if the user is adding a specific primary energy calculation to the project. For further information please check chapter 2.3.

Regarding the markets it is possible to define emission factors for imported and exported electricity of the market. There is no difference between fixed value markets and spot markets. In contrast to the fuels, it is also possible to define **dynamic time series** as emission factors for the electricity.

CO ₂ emission factor for imported electricity	500		- I	kwb.	4
Replaced CO2 emission factor for exported electricity	800	g	× /	KVVII	*

Figure 2: Market input data

These emission factors and the resulting carbon emissions are presented in different reports. See chapter 3 for more information.

The user can also define **payments relating to the emissions of fuels or electricity**. If "Imported fuel", "Exported electricity" or "Imported electricity" is chosen in "payment concerns" it is possible to choose between the energy amount and the defined CO_2 emissions. This is also possible if "fuel consumption" is chosen for a specific production unit.

With this option a payment could be directly defined on the emissions in ϵ /tonne or the currency which is chosen on the economy form.

Payment concerns	-	Fuel	
Imported fuel	~	Natural gas 🗸 🗸	
		Quantified by	
		CO2 emission	
Formula selecting monthly amounts			
ImportedFuel(Natural gas)*CO2FactorFue	el(Natural gas)		
ImportedFuel(Natural gas)*CO2FactorFue	el(Natural gas)		
ImportedFuel(Natural gas)*CO2FactorFue	el(Natural gas)		

Figure 3: Payment input data

Please be aware of that the CO_2 emission formula does not include the heat value as a denominator. This may have an impact if the relationship is not 1 to 1 defined in the fuel (1 MWh/MWh for instance). The specific CO_2 -factor in the fuel should be defined accordingly. Please check the examples below:

Example of the formula when choosing "amount":

ImportedFuel(Natural gas)/HeatValue(Natural gas)

Example of the formula when choosing "CO2 emission":

ImportedFuel(Natural gas)*C02FactorFuel(Natural gas)

2.2 User-defined emissions

In the tree structure under "Environment" it is possible to define user-defined emissions and to set up specific CO_2 and PEF calculations to calculate the intensity of a system. For these calculations see the following chapter 2.3.

To add new user-defined emissions it is first necessary to add subfolders as emission types. For this please right-click on the environment folder and choose "Add emission type". You can rename the emission types like CO₂, NO_x, SO₂ or any emissions you want to define.

By right-clicking on this new emission type it is possible to define user-defined emissions. The user-defined emissions can be defined in the same way as in the payment structure of energyPRO.

There is no limit in defining emissions and emission types. By double-clicking on the emission type, it is possible to define the unit of the input and the unit of the reports for this type.



Figure 4: Adding an emission type

Production unit	Ga	s engine 1
Гуре		
Electricity production	~	
Formula selecting monthly amounts		
Formula selecting monthly amounts EP(Gas engine 1;All Periods)		
Formula selecting monthly amounts EP(Gas engine 1;All Periods) mount per unit		

Figure 5: User-defined emission input data

2.3 CO₂ and PEF intensity calculation

In energy systems with several energy conversion units, it is often required that specific key figures be calculated out of the emission data. Beside the calculation of emission key figures,

it is possible to calculate key figures based on primary energy factors (PEF) of fuels and of imported or exported electricity. These calculations can be done in the subfolder "CO₂ and PEF intensity calculation" in the "Environment" folder.

Basically, in those calculations all fuels and all electricity entering a system are multiplied with a specific CO_2 or PEF factor and divided by a heat or cooling demand to get a specific key figure for a system:

(fuel + electricity consumption) · CO2/PEF factor heat / cold demand



Figure 6: Type and method of CO_2 and PEF calculations resulting in six different possibilities

Right-clicking on the subfolder creates a new calculation wizard which can be opened by double-clicking on it. First the user needs to choose the type and the method of the calculation.

There are three different methods to choose from to calculate the allocation of CHP units. If there is no CHP unit in the project, there is no difference between the methods. The key figures to calculate are normalizing the emissions or the primary energy by a heat or cooling demand. Therefore, the electricity production of a CHP unit must be somehow considered.

Two types (CO_2 and primary energy) and three different methods result in six possible default calculations.

Detailed information about the allocation methods and their differences are given in chapter 4.

Once the dropdown is chosen the user can select all units which should be considered.

lame:	PEF calculation credit method]	
	PEF calculation Credit method		~
C C F F	CO2 calculation Carnot method CO2 calculation Reference method CO2 calculation Credit method PEF calculation Carnot method PEF calculation Reference method		
	PEF calculation Credit method		

Figure 7: All methods listed in a dropdown menu in the wizard

When selecting a unit, the formula in the bottom of the wizard is instantly updated. Further the user can select any heat, process heat or cold demand defined in the project. Every chosen demand is summed up in the end of the formula below the fraction line.

The specific factors of fuel consuming units are taken from the input in the fuel components, see chapter 2.1. When having an electricity consumption unit (e.g. a heat pump) in the project it is necessary to define the specific factor for importing electricity directly in the wizard. The emission factors defined in a market are not considered as they might contain dynamic time series.

When a CHP unit is chosen, more parameters must be defined. These parameters depend on the method which is chosen above and are described in detail in chapter 4.

The formula which is automatically created depending on the selection above is editable. Double-clicking in the field of the formula opens the function editor where it is possible to adapt the formula manually.

PEF calculation Credit method	✓ Total sale of heat
Gas engine 2 Boilers Elec Heatpump	Network loss
PEF factor importing electricity	1,8
max(0;(FC(Boilers)*PEFfactorFuel(N periods)*PEFfacImpElec))/HD(Total s	atural gas)+EC(Elec Heatpump;All sale of heat)

Figure 8: Wizard when PEF calculation method is chosen

3 Output data

The resulting emissions are shown in the energy conversion and the environmental reports. In the **"Energy conversion, annual**" report there is a section at the end of the report which shows all emissions grouped by the fuels, the units and the electricity markets.

CO2: By fuel

bylaci	CO2 emission
Natural gas	5.556,4 tonne
By energy unit	
Gas engine 1	1.697,7 tonne
Gas engine 2	1.642,6 tonne
Boilers	2.216,1 tonne
Total	5.556,4 tonne
By Electricity market	
Spot market	
Imported electricity	0,0 tonne
Exported electricity	-4.584,7 tonne
Total	-4.584,7 tonne

Figure 9: Energy conversion, annual report

In the "**Energy conversion, monthly**" report the emissions are also shown for all markets, units and fuels - always in the bottom line.

	Total	Jan	Feb	Mar
Heatdemand[wwwn]	15.032,9	2.093,2	1.642,2	1.617,9
Electricity produced by energy units [MWh]	628.4	70.9	00.0
	5.750,9	636,4	79,0	00,2
Exported electricity, Spot market [MW	[h]	628.4	70.9	00.0
Peak [MW]	5.730,9	4 200	79,8 4 200	4 200
AvoidedCO2emission[tonne]	4.584,7	510,7	63,8	70,6
Energy unit: Gas engine 1				
Fuelconsum.[Nm3]	643.063,6	70.472,7	8.809,1	9.736,4
Fuelconsum. [MWh]	7.073,7	775,2	96,9	107,1
Heat prod. [MWh]	3.190,1	349,6	43,7	48,3
Elec. prod. [MWh]	2.912,7	319,2	39,9	44,1
Turn ons	225	23	6	7
Operatinghours	1.387	152	19	21
Full load operating hours	1.387	152	19	21
Utilization factor [%]	15,83	20,43	2,83	2,82
Totalefficiency [%]	86.27	86.27	86.27	86.27
CO2emission[tonne]	1.697,69	186,05	23,26	25,70
Energy unit: Gas engine 2				
Fuelconsum.[Nm3]	622.200,0	70.472,7	8.809,1	9.736,4
Fuelconsum.[MWh]	6.844,2	775,2	96,9	107,1
Heat prod. [MWh]	3.086,6	349,6	43,7	48,3
Elec. prod. [MWh]	2.818,2	319,2	39,9	44,1
Turn ons	217	23	6	7
Operatinghours	1.342	152	19	21
Full load operating hours	1.342	152	19	21
Utilization factor [%]	15,32	20,43	2,83	2,82
Totalefficiency [%]	86.27	86.27	86.27	86.27
CO2emission[tonne]	1.642,61	186,05	23,26	25,70

Figure 10: Energy conversion, monthly report

The "**Environment, summary**" report shows a short overview about the yearly sum of the emissions and all specific CO_2 or PEF factors defined. The "**Environment, monthly**" report is basically the same report with an additional monthly overview of the emissions and factors.

CalculatedPeriod: 01.2019 - 12.2019						
202	Total	Jan	Feb	Mar	Apr	Мау
	[tonne]	600	270	274	240	050
All production units	4.778	623	378	374	310	258
CO2 Total	4.778	623	378	374	310	258
NOx	[kg]					
Engines	9.350	1.025	128	142	0	135
Existing boilers	5.028	800	893	871	818	571
NOx Total	14.378	1.824	1.021	1.013	818	706
SO2	[kg]					
All production units	21	3	2	2	1	1
SO2 Total	21	3	2	2	1	1
CO2 and PEF factors						
PEF factor credit method	0,78	0,83	1,27	1,28	1,40	1,37
CO2 factor carnot method	228	223	284	288	306	312

Figure 11: Environment, monthly report

4 Calculation methodology

As mentioned in chapter 2.3 the user can choose between different methods of allocating CHP units. In the following all methods are mathematically described in detail.

First **systems without CHP units.** These are calculated in the same way, irrespective of the chosen method:

Specific CO₂ factor:
$$\frac{\sum_{i} (FC \cdot CO_2)_i + \sum_{j} (EC \cdot CO_2)_j}{\sum_{x} HD_x + \sum_{y} (PHD)_y + \sum_{z} (CD)_z}$$

or specific PE factor

 $\frac{\sum_{i} (FC \cdot PEF)_{i} + \sum_{i} (EC \cdot PEF)_{i}}{\sum_{x} HD_{x} + \sum_{y} (PHD)_{y} + \sum_{z} (CD)_{z}}$

i for all chosen fuel consuming (FC) units

j for all chosen electricity consuming (EC) units

x for all chosen heat demands (HD)

y for all chosen process heat demands (PHD)

z for all chosen cold demands (CD)

For **balancing groups including CHP units** the calculation is different depending on the method which is chosen.

4.1 The electricity credit method:

This method subtracts the CO_2 related to the electricity produced in a CHP plant from the CO_2 related to the fuel consumption. The electricity generated is multiplied by a specific factor. This factor might be different from the factor for imported electricity as it might be assumed that the exported electricity is replacing a more carbon intensive energy mix than imported.

Normally this value is regulated by law. As this factor might be so high that the whole expression could become negative, in the default equation in energyPRO the minimum value is fixed to zero. If this is not the case, the user may edit the equation to the remove this limit. The default equation is shown below:

CO₂-factor:

$$\max\left(0; \frac{\sum_{i;j}(FC \cdot CO_2)_{i;j} + \sum_j(EC \cdot CO_2)_j - \sum_k(EP \cdot CO_2)_k}{\sum_x HD_x + \sum_y (PHD)_y + \sum_z (CD)_z}\right)$$

- i for all chosen fuel consuming units
- j for all chosen electricity consuming units
- k for all chosen CHP units
- x for all chosen heat demands
- y for all chosen process heat demands
- z for all chosen cold demands

4.2 The carnot method:

First the Carnot factor (CF) must be calculated out of the three temperatures which are to be defined in the wizard:

$$CF = 1 - \frac{T_A}{T_m}$$
 with $T_m = \frac{(T_{supply} - T_{return})}{\ln(\frac{T_{supply}}{T_{return}})}$

With

- T_A: ambient temperature in Kelvin [K]
- T_m: average temperature of the system in Kelvin [K]
- T_{supply}: supply temperature of the system in Kelvin [K]
- Treturn: return temperature of the system in Kelvin [K]

In energyPRO the user inputs the value above in Celsius (or Fahrenheit) and the values are adjusted accordingly.

With the Carnot factor the specific CO_2 factor can be calculated. The specific primary energy factor is calculated in the same way.

$$CO_{2}-factor: \frac{\sum_{i} (FC \cdot CO_{2})_{i} + \sum_{j} (EC \cdot CO_{2})_{j} + \sum_{k} \left(FC \cdot \frac{(HP + PHP) \cdot CF}{EP + (HP + PHP) \cdot CF} \cdot CO_{2} \right)_{k}}{\sum_{x} HD_{x} + \sum_{y} (PHD)_{y} + \sum_{z} (CD)_{z}}$$

- i for all chosen fuel consuming units without CHP
- j for all chosen electricity consuming units
- k for all chosen CHP units
- x for all chosen heat demands
- y for all chosen process heat demands
- z for all chosen cold demands

4.3 The reference efficiency method:

The reference efficiency values can be found in EU 2015/2402 [2], the related values can be found directly in the annex. The thermal and electrical efficiency of the CHP unit is the ratio between the electricity/heat production and the fuel consumption of the CHP. The primary energy saving because of the combined production is calculated as follows:

Primary energy saving (PES):
$$1 - \frac{1}{\frac{\eta_{th}}{\eta_{th,REF}} + \frac{\eta_{el}}{\eta_{el,REF}}}$$

Using this primary energy saving the specific CO₂-factor is calculated as follows:

Specific CO₂ factor:

$$\frac{\sum_{i} (FC \cdot CO_2)_i + \sum_{j} (EC \cdot CO_2)_j + \sum_{k} \left(FC \cdot \left((1 - PES) \cdot \frac{\eta_{th}}{\eta_{th,REF}} \right) \cdot CO_2 \right)_k}{\sum_{x} HD_x + \sum_{y} (PHD)_y + \sum_{z} (CD)_z}$$

i for all chosen fuel consuming units without CHP

j for all chosen electricity consuming units

k for all chosen CHP units

x for all chosen heat demands

y for all chosen process heat demands

z for all chosen cooling demands

5 Bibliography

- [1] Directive 2012/27/EU, "EUR-Lex," [Online]. Available: https://eur-lex.europa.eu/legalcontent/EN/TXT/?qid=1399375464230&uri=CELEX%3A32012L0027.
- [2] Commission Delegated Regulation (EU) 2015/2402, "EUR-Lex," [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32015R2402.
- [3] Wikipedia, "Carnot method," 01 03 2021. [Online]. Available: https://en.wikipedia.org/wiki/Carnot_method.
- [4] AGFW, "FW 309 part 6," 01 03 2021. [Online]. Available: https://www.agfw.de/techniksicherheit/erzeugung-sektorkopplung-speicher/energetische-bewertung/geg-undfernwaerme/.
- [5] Wikipedia, "DIN V 18599," 01 03 2021. [Online]. Available: https://de.wikipedia.org/wiki/DIN_V_18599.
- [6] BfJ, "Bundesamt für Justiz," 01 03 2021. [Online]. Available: https://www.gesetze-iminternet.de/geg/.
- [7] AGFW, "District Energy Systems," [Online]. Available: https://www.district-energysystems.info/. [Accessed 01 03 2021].
- [8] "BRE Garston," [Online]. Available: https://www.bregroup.com/wpcontent/uploads/2019/10/SAP-10.1-01-10-2019.pdf.
- [9] Energiewirtschaftliche Tagesfragen 55.Jg. Heft 9, 2010.

Annex

		Primären	ergiefaktoren f _p	CO ₂ -Äquivalent x _{CO2} g/kWh	
Energieträger	Energieträger ^a		nicht erneuerbarer Anteil	nicht erneuerbarer Anteil	
	AE		В	С	
	Heizöl	1,1	1,1	310	
	Erdgas	1,1	1,1	240	
Fossile	Flüssiggas	1,1	1,1	270	
Dicilistone	Steinkohle	1,1	1,1	400	
	Braunkohle	1,2	1,2	430	
	Biogas	1,4	0,4	120	
Biogene	Bioöl	1,4	0,4	190	
Brennstone	Holz	1,2	0,2	40	
	aus KWK ^b , fossiler Brennstoff bzw. Energieträger	0,7	0,7	C, e	
Nah-/ Fernwärme	aus KWK ^b , erneuerbarer Brennstoff bzw. Energieträger	0,7	0,0	C, e	
reniwarine	aus Heizwerken, fossiler Brennstoff bzw. Energieträger	1,3	1,3	c, e	
	allgemeiner Fall	c	c	c	
Fernkälte	allgemeiner Fall	c	c	c	
Strom	allgemeiner Strommix	2,8	1,8	550	
	innerhalb der Bilanzgrenzen	nutzbar gemacht	e Endenergien (Index "f,p	orod")	
	Wärme (Erdwärme, Geothermie, Solarthermie, Umgebungswärme)	1,0	0,0	0	
Umwelt- energie	Kälte (Erdkälte, Umgebungskälte)	1,0	0,0	0	
	Strom (aus Photovoltaik, Windkraft)	1,0	0,0	0	
Abwärme	aus Prozessen, siehe 3.1.32	1,0	0,0	40	
	aus dem Bilanzraum	abgeführte Ender	nergien (Index "f,out")		
Stream	Verdrängungsstrommix für KWK	2,8	2,8	860	
Strom	Verdrängungsstrommix für PV, WEA	2,8	1,8	550	
thermische	Wärme für andere Verbraucher	d	d	đ	
Energien	Kälte für andere Verbraucher	d	d	đ	
Abwärme	aus Prozessen, siehe 3.1.32	1,0	0,0	40	
a Bezugsgröß b Angaben sin	Se Endenergie: Heizwert H _i . nd typisch für durchschnittliche Nah-/F	ernwärme mit eine	m Anteil der KWK von 70 %		

$Tabelle\,A.1-Primärenergiefaktoren\,und\,CO_2\text{-}\ddot{A}quivalente^a$

c Individuelle Berechnung für das Netz, aus dem der Bezug erfolgt, siehe A.4.

^d Individuelle Berechnung für das Netz, in welches die Einspeisung erfolgt, siehe A.4.

e Eine Angabe von Standardwerten ist aufgrund der unterschiedlichen Energieträgermixe nicht möglich.

Figure 12: Primary energy and CO₂ emission factors according to DIN V 18599

Table 12: Fuel prices,	emission	factors and	primary	energy	factors
------------------------	----------	-------------	---------	--------	---------

Fuel charge, \tilde{E} (9) price (9) COse (7, 6, 6, 6, 7, 9) code (7, 6, 6, 6, 7, 9) Gas: 38 3.93 0.210 1.130 1 balk LPG 58 6.59 0.241 1.141 2 botted LPG (for secondary heating) 10.71 0.241 1.141 3 botted LPG (for secondary heating) 10.71 0.241 1.133 5 Dispas (including anaerobic digestion) 70 6.59 0.024 1.286 7 Oit 6.11 0.018 1.0427 73 appliances able to use mineral oil or biodiesel 4.35 0.298 1.180 4 B30K ⁽⁷⁾ 488 0.220 1.257 75 biodicisel from any biomass source 4.7 0.105 1.472 76 Sold fue: 9.9 0.024 1.281 1.232 22 wood pellets (in bags for secondary heating) 6.09 0.053 1.325 22 sold fue: 9.9 0.241 1.241 1.261 12 wood pellets (in bags for secondary hea		Standing	Unit	Emissions kg	Primary	E.J.
rue (i) prkWh per kWh (i) factor iv Code Gas: mains gas 88 3.93 0.210 1.130 1 bulk LPC for main heating system) 58 6.59 0.241 1.141 3 butted LPG (for scondary heating) 10.71 0.241 1.133 5 LPG subject to Special Condition 11F ⁽ⁱ⁾ 95 3.93 0.241 1.163 9 biogas (including anaerobic digestion) 70 6.59 0.024 1.286 7 heating oil 4.35 0.298 1.180 4 biodisel from any biomass source ⁽ⁱ⁾ 6.11 0.018 1.042 73 appliances able to use mineral oil or biodiesel 4.35 0.298 1.180 74 biod fuel ⁽ⁱ⁾ 4.88 0.220 1.257 75 biodineal from any biomass source 4.18 0.395 1.064 11 nathracite 4.18 0.395 1.064 11 maturfactured snokcless fuel <td< th=""><th>East</th><th>charge, £</th><th>price</th><th>CO_{2e}</th><th>energy</th><th>Fuel</th></td<>	East	charge, £	price	CO _{2e}	energy	Fuel
Gas: second state	ruel	(a)	p/kWh	per kWh (b) (s)	factor (t)	code
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Gas:					
bulk LPG 58 6.59 0.241 1.141 2 bottled LPG (for main heating system) 7.85 0.241 1.141 3 bulke LPG (for secondary heating) 10.71 0.241 1.133 5 LPG subject to Special Condition 11F (*) 95 3.93 0.241 1.286 7 Oil:	mains gas	88	3.93	0.210	1.130	1
bottled LPG (for main heating system) 7.85 0.241 1.133 3 bottled LPG (for secondary heating) 10.71 0.241 1.133 5 LPG subject to Special Condition 11F $^{(n)}$ 95 3.93 0.241 1.163 9 biogas (including anaerobic digestion) 70 6.59 0.024 1.286 7 Oil: 11 0.038 1.437 71 biodicsel from any biomass source $^{(h)}$ 6.11 0.018 1.437 71 biodicsel from vegetable oil only $^{(n)}$ 6.11 0.018 1.437 71 biodicsel from vegetable oil only $^{(n)}$ 6.11 0.018 1.437 71 biodicsel from vegetable oil only $^{(n)}$ 6.11 0.018 1.437 71 biodicsel from any biomass source 47 0.105 1.257 75 bioethanol from any biomass source 47 0.105 1.257 75 bioethanol from any biomass source 41 0.015 1.257 75 bioethanol from any biomass source 41 0.028 1.046 1.11 anthracite 4.14 0.395 1.064 1.15 manufactured smokless fuel 5.17 0.366 1.261 1.2 wood logs 4.65 0.028 1.046 20 wood pellets (in bags for secondary heating) 5.51 0.053 1.325 22 wood pellets (in bags for secondary heating) 5.51 0.053 1.325 23 wood chips 3.48 0.023 1.046 21 dual fuel appliance (mineral and wood) 4.53 0.087 1.049 10 Electricity $^{(n)}$ standard tariff 7 72 17.56 0.136 1.501 30 7-hour tariff (high rate) $^{(h)}$ 8 2.072 0.136 1.501 31 10-hour tariff (high rate) $^{(h)}$ 10.68 0.136 1.501 33 18-hour tariff (hor rate) $^{(h)}$ 10.68 0.136 1.501 33 18-hour tariff (hor rate) $^{(h)}$ 10.68 0.136 1.501 33 18-hour tariff (hor rate) $^{(h)}$ 10.13 1.53 0.136 1.501 33 18-hour tariff (hor rate) $^{(h)}$ 11 1.573 0.136 1.501 33 18-hour tariff (hor rate) $^{(h)}$ 10.136 1.501 33 18-hour tariff (hor rate) $^{(h)}$ 10.136 1.501 35 heat from boilers – nin sgas 4.79 0.210 1.130 51 heat from boilers – nin sgas 4.79 0.214 1.141 52 heat from boilers and spin spin source 4.79 0.335 1.180 53 heat from boilers - noil 4.79 0.335 1.180 53 heat from boilers - noil 4.79 0.335 1.180 53 heat from boilers - stain sgas 4.79 0.024 1.286 waste heat from power station 4.79 0.035 1.063 4.54 heat from boilers - noil 4.79 0.035 1.063 4.54 heat from boilers - biomass 4.79 0.024 1.286 waste heat from power station 4.7	bulk LPG	58	6.59	0.241	1.141	2
bottled LPG (for secondary heating) 10.71 0.241 1.133 5 LPG subject to Special Condition 11F 69 95 3.39 0.241 1.163 9 biogas (including anaerobic digestion) 70 6.59 0.024 1.286 7 Oli:	bottled LPG (for main heating system)		7.85	0.241	1.141	3
LPG subject to Special Condition 11F $^{(6)}$ 95 3.93 0.241 1.163 9 biogas (including anaerobic digestion) 70 6.59 0.024 1.286 7 Oil: 4.35 0.298 1.180 4 biodises from my biomass source $^{(d)}$ 6.11 0.018 1.437 71 biodises from vegtable oil only $^{(o)}$ 6.11 0.018 1.447 73 appliances able to use mineral oil or biodiesel 4.35 0.298 1.180 74 B30K $^{(f)}$ 4.88 0.202 1.257 75 bioethanol from any biomass source 4.18 0.395 1.064 11 anthracite 4.14 0.395 1.064 12 wood ogs 4.65 0.028 1.046 20 wood pdlets (in bags for secondary heating) 5.51 0.053 1.325 22 wood clips 5.51 0.053 1.325 22 wood pdlets (inb layphy for main heating) 5.51 0.063 1.501 30 7-hour tariff (high rate) $^{(h)}$ 7 7.766 0.136 1.50	bottled LPG (for secondary heating)		10.71	0.241	1.133	5
biogas (including anaerobic digestion) 70 6.59 0.024 1.286 7 Oh: heating oil 1.286 7 Oh: heating oil 4.15 0.298 1.180 4 biodicsel from any biomass source $^{(6)}$ 6.11 0.018 1.437 71 biodicsel from vegtable oil only $^{(6)}$ 6.11 0.018 1.442 73 appliances able to use mineral oil or biodiesel 4.35 0.298 1.180 74 B30K $^{(7)}$ 4.88 0.220 1.257 75 biotehanol from any biomass source 47 0.105 1.472 76 Solid fuel: $^{(6)}$ 4.88 0.395 1.064 11 antifractured smokeless fuel 5.17 0.366 1.261 12 wood logs or secondary heating) 6.09 0.053 1.325 22 wood pellets (in bags for secondary heating) 5.51 0.053 1.325 23 wood chips 3.48 0.023 1.046 21 wood chips 3.1325 23 wood chips 3.148 0.028 1.046 21 dual fuel appliance (mineral and wood) 4.53 0.087 1.049 10 Electricity: $^{(6)}$ 8 20.72 0.136 1.501 30 7-hour tariff (hor rate) $^{(6)}$ 8 20.72 0.136 1.501 31 10-hour tariff (hor rate) $^{(6)}$ 8.13 0.136 1.501 32 7-hour tariff (hor rate) $^{(6)}$ 11 15.73 0.136 1.501 33 18-hour tariff (hor rate) $^{(6)}$ 11 15.73 0.136 1.501 33 18-hour tariff (hor rate) $^{(6)}$ 87 $^{(7)}$ heat from boilers – mains gas 4.79 0.210 1.36 1.501 33 18-hour tariff (hor rate) $^{(6)}$ 87 $^{(7)}$ heat from boilers – mains gas 4.79 0.214 1.141 52 heat from boilers – coil 4.79 0.335 1.180 53 heat from boilers – biomass 4.79 0.038 1.437 heat from boilers – coil 4.79 0.355 1.180 53 heat from boilers – biomass 4.79 0.034 1.501 41 heat from	LPG subject to Special Condition 11F (c)	95	3.93	0.241	1.163	9
Oil: Issue of the second of the	biogas (including anaerobic digestion)	70	6.59	0.024	1.286	7
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Oil:					
biodiesel from any biomass source $^{(h)}$ 6.11 0.038 1.437 71 biodiesel from vegetable oil only $^{(i)}$ 6.11 0.018 1.042 73 appliances able to use mineral oil or biodiesel 4.35 0.298 1.180 74 B30K $^{(h)}$ 4.88 0.220 1.257 75 Solid fuel: $^{(i)}$ 75 Solid fuel: $^{(i)}$ 76 house coal 4.18 0.395 1.064 11 anthracite 4.14 0.395 1.064 15 manufactured snokeless fuel 5.17 0.366 1.261 12 wood logs 4.60 9.0053 1.325 22 wood pellets (in bags for secondary heating) 6.09 0.053 1.325 22 wood pellets (in bags for secondary heating) 5.51 0.053 1.325 23 wood chips 4.53 0.087 1.046 21 dual fuel appliance (mineral and wood) 4.53 0.087 1.049 10 Electricity: $^{(i)}$ 72 17.56 0.136 1.501 30 7-hour tariff (high rate) $^{(h)}$ 8 20.72 0.136 1.501 31 10-hour tariff (high rate) $^{(h)}$ 7 18.71 0.136 1.501 32 7-hour tariff (high rate) $^{(h)}$ 10 15.31 0.136 1.501 33 18-hour tariff (high rate) $^{(h)}$ 11 15.73 0.136 1.501 33 18-hour tariff (high rate) $^{(h)}$ 11 15.73 0.136 1.501 33 18-hour tariff (high rate) $^{(h)}$ 8 10.38 0.136 1.501 33 18-hour tariff (high rate) $^{(h)}$ 11 15.73 0.136 1.501 34 10-hour tariff (high rate) $^{(h)}$ 13 10.38 0.136 1.501 35 electricity sold to grid, other 5.3 $^{(h)}$ 0.136 0.501 40 24-hour heating tariff 31 10.38 0.136 1.501 35 electricity is old to grid, other 5.3 $^{(h)}$ 0.136 0.501 40 24-hour heating tariff 31 10.38 0.136 1.501 35 electricity sold to grid, other 5.3 $^{(h)}$ 0.136 0.501 40 24-hour heating tariff 31 10.38 0.136 1.501 35 electricity is old to grid, other 5.3 $^{(h)}$ 0.136 0.501 35 electricity is old to grid, other 5.3 $^{(h)}$ 0.136 0.501 35 electricity is old to grid, other 5.3 $^{(h)}$ 0.136 0.501 35 electricity is old to grid, other 5.3 $^{(h)}$ 0.136 0.501 35 heat from boilers - EAG 4.79 0.335 1.18 heat from boilers - was combustion 4.79 0.335 1.18 heat from boilers - was combustion 4.79 0.335 1.18 heat from boilers - 0.136 1.501 37 heat from boilers - 0.136 1.501 41 heat from boilers - 0.136 1.501 41 heat from boilers - biomas 4.79 0.024 1.286 was heat from boilers - b	heating oil		4.35	0.298	1.180	4
biodiesel from vegetable oil only $^{(b)}$ 6.11 0.018 1.042 73 appliances able to use mineral oil or biodiesel 4.35 0.298 1.180 74 B30K $^{(b)}$ 4.88 0.220 1.257 75 biotechanol from any biomass source 47 0.105 1.472 76 Solid fiel; $^{(0)}$	biodiesel from any biomass source (d)		6.11	0.038	1.437	71
appliances able to use mineral oil or biodiesel 4.35 0.298 1.180 74 B30K (0) 4.88 0.220 1.257 75 biotefanol from any biomass source 47 0.105 1.472 76 Solid fuel: (0)	biodiesel from vegetable oil only (c)		6.11	0.018	1.042	73
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	appliances able to use mineral oil or biodiesel		4.35	0.298	1.180	74
bioethanol from any biomass source 47 0.105 1.472 76 Solid fuel: ${}^{(0)}$ house coal 4.18 0.395 1.064 11 anthracite 4.14 0.395 1.064 15 manufactured snokeless fuel 5.1 0.053 1.325 22 wood pellets (in bags for secondary heating) 6.09 0.053 1.325 23 wood chips 3.48 0.023 1.046 21 dual fuel appliance (mineral and wood) 4.53 0.087 1.049 10 Electricity: ${}^{(0)}$ standard tariff 72 17.56 0.136 1.501 32 7-hour tariff (high rate) ${}^{(0)}$ 8 20.72 0.136 1.501 31 10-hour tariff (low rate) ${}^{(0)}$ 10.66 0.136 1.501 33 18-hour tariff (high rate) ${}^{(0)}$ 11 15.73 0.136 1.501 38 18-hour tariff (low rate) ${}^{(0)}$ 10.66 0.136 1.501 38 18-hour tariff (high rate) ${}^{(0)}$	B30K ^(f)		4.88	0.220	1.257	75
	bioethanol from any biomass source		47	0.105	1.472	76
house coal 4.18 0.395 1.064 11 anthracite 4.14 0.395 1.064 15 manufactured smokeless fuel 5.17 0.366 1.261 12 wood logs 4.65 0.028 1.046 20 wood pellets (in lags for secondary heating) 6.09 0.053 1.325 23 wood chips 3.48 0.027 1.046 21 dual fuel appliance (mineral and wood) 4.53 0.087 1.049 10 Electricity: ⁽ⁿ⁾ 72 17.56 0.136 1.501 30 7-hour tariff (low rate) ^(h) 8.13 0.136 1.501 32 7-hour tariff (low rate) ^(h) 7 18.71 0.136 1.501 33 10-hour tariff (low rate) ^(h) 11 15.73 0.136 1.501 33 18-hour tariff (low rate) ^(h) 11 15.73 0.136 1.501 35 electricity sold to grid, other 5.3 ^(h) 0.136 0.501 36 electricity sold to grid, other 5.3 ^(h) 0.136 0.501 36 <td>Solid fuel: (g)</td> <td></td> <td></td> <td></td> <td></td> <td></td>	Solid fuel: (g)					
anthracite4.140.3951.06415manufactured smokeless fuel5.170.3661.26112wood logs4.650.0281.04620wood pellets (in bags for secondary heating)6.090.0531.32523wood chips3.480.0231.04621dual fuel appliance (mineral and wood)4.530.0871.04910Electricity: $^{(0)}$ standard tariff7217.560.1361.501327-hour tariff (high rate) $^{(h)}$ 820.720.1361.5013110-hour tariff (low rate) $^{(h)}$ 718.710.1361.5013110-hour tariff (high rate) $^{(h)}$ 1115.730.1361.5013318-hour tariff (high rate) $^{(h)}$ 1115.730.1361.5013818-hour tariff (high rate) $^{(h)}$ 1110.380.1361.50135electricity sold to grid, PV5.3 $^{(0)}$ 0.1360.50160electricity sold to grid, PV5.3 $^{(0)}$ 0.1360.50160electricity sold to grid, other5.3 $^{(0)}$ 0.1360.50160electricity displaced from grid-0.1361.50137electricity displaced from grid-0.1361.50137heat from boilers - mains gas4.790.2101.13051heat from boilers - oil4.790.3351.18053heat from boilers - alog $^{(0)}$ 4.79 <td< td=""><td>house coal</td><td></td><td>4.18</td><td>0.395</td><td>1.064</td><td>11</td></td<>	house coal		4.18	0.395	1.064	11
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	anthracite		4.14	0.395	1.064	15
wood logs 4.65 0.028 1.046 20 wood pellets (in bas for secondary heating) 5.51 0.053 1.325 22 wood chips 3.48 0.023 1.046 21 dual fuel appliance (mineral and wood) 4.53 0.087 1.049 10 Electricity: (⁰) standard tariff 72 17.56 0.136 1.501 32 7-hour tariff (high rate) (^h) 8 20.72 0.136 1.501 32 7-hour tariff (low rate) (^h) 8.13 0.136 1.501 33 10-hour tariff (low rate) (^h) 11 15.73 0.136 1.501 33 18-hour tariff (low rate) (^h) 11 15.73 0.136 1.501 33 18-hour tariff (low rate) (^h) 11 15.73 0.136 1.501 35 18-hour tariff (low rate) (^h) 10.66 0.136 1.501 35 10-to traiff (low rate) (^h) 10.66 0.136 1.501 35 18-hour tariff (low rate) (^h) 1.038 0.136 0.501 36 electricity sold to grid, ot	manufactured smokeless fuel		5.17	0.366	1.261	12
wood pellets (in bags for secondary heating)6.090.0531.32522wood chips5.510.0531.32523wood chips3.480.0231.04621dual fuel appliance (mineral and wood)4.530.0871.04910Electricity: $^{(0)}$ standard tariff7217.560.1361.501307-hour tariff (high rate) $^{(0)}$ 820.720.1361.5013110-hour tariff (low rate) $^{(h)}$ 8.130.1361.5013410-hour tariff (low rate) $^{(h)}$ 10.680.1361.5013318-hour tariff (low rate) $^{(h)}$ 10.680.1361.5013318-hour tariff (low rate) $^{(h)}$ 10.660.1361.50135electricity sold to grid, PV5.3 $^{(i)}$ 0.1360.50136electricity sold to grid, PV5.3 $^{(i)}$ 0.1360.50136electricity displaced from grid-0.1361.50137electricity displaced from grid-0.1361.50137electricity asplate an use mineral oil or biodiesel4.790.3351.18heat from boilers – LPG4.790.2411.14152heat from boilers – coal4.790.3751.06454heat from boilers – coal4.790.0741.16942heat from boilers – coal4.790.0291.03743heat from boilers – coal4.790.0351.18	wood logs		4.65	0.028	1.046	20
wood pellets (bulk supply for main heating)5.510.0531.32523wood chips3.480.0231.04621dual fuel appliance (mineral and wood)4.530.0871.049Electricity: $^{(0)}$ 4.530.0871.049standard tariff7217.560.1361.5017-hour tariff (high rate) $^{(h)}$ 82.0720.1361.5017-hour tariff (low rate) $^{(h)}$ 8.130.1361.5013110-hour tariff (high rate) $^{(h)}$ 718.710.1361.5013318-hour tariff (low rate) $^{(h)}$ 1115.730.1361.5013818-hour tariff (low rate) $^{(h)}$ 1115.730.1361.5013818-hour tariff (low rate) $^{(h)}$ 3110.680.1361.5013818-hour tariff (low rate) $^{(h)}$ 3110.630.1360.50136electricity sold to grid, other5.3 $^{(0)}$ 0.1360.50136electricity displaced from grid-0.1361.50139Heat rom boilers – mains gas4.790.2101.13051heat from boilers – ails gas4.790.3351.18053heat from boilers – oil4.790.3351.18053heat from boilers – oil4.790.3351.18053heat from boilers – coal4.790.351.6454heat from boilers – solig biodiesel from wegetable oil only4.790.0741.169	wood pellets (in bags for secondary heating)		6.09	0.053	1.325	22
wood chips3.480.0231.04621dual fuel appliance (mineral and wood)4.530.0871.04910Electricity: $(^{0})$ standard tariff7217.560.1361.501307-hour tariff (high rate) $(^{0})$ 820.720.1361.5013110-hour tariff (low rate) $(^{0})$ 718.710.1361.5013410-hour tariff (low rate) $(^{0})$ 718.710.1361.5013318-hour tariff (low rate) $(^{0})$ 1115.730.1361.5013818-hour tariff (low rate) $(^{0})$ 1115.730.1361.5013818-hour tariff (low rate) $(^{0})$ 1110.660.1361.50135electricity sold to grid, other5.3 $(^{0})$ 0.1360.50136electricity sold to grid, other5.3 $(^{0})$ 0.1360.50160electricity applicated from grid-0.1361.50137electricity, any tariff $(^{0})$ -0.1361.50137heat from boilers – mains gas4.790.2101.13051heat from boilers – LPG4.790.3351.18053heat from boilers – solg biodiesel from any biomass source4.790.0381.437heat from boilers using biodiesel from any biomass source4.790.0351.18heat from boilers – coal4.790.3751.06454heat from boilers – solg glandfill or sewage gas)4.790.0741.	wood pellets (bulk supply for main heating)		5.51	0.053	1.325	23
dual fuel appliance (mineral and wood)4.53 0.087 1.049 10 Electricity: (i) 10 standard tariff72 17.56 0.136 1.501 30 7-hour tariff (low rate) (h)8 20.72 0.136 1.501 32 7-hour tariff (low rate) (h)8.13 0.136 1.501 31 10-hour tariff (low rate) (h)7 18.71 0.136 1.501 34 10-hour tariff (low rate) (h)11 15.73 0.136 1.501 33 18-hour tariff (low rate) (h)11 15.73 0.136 1.501 38 18-hour tariff (low rate) (h)11 15.73 0.136 1.501 38 24-hour heating tariff31 10.38 0.136 0.501 36 electricity sold to grid, other $5.3^{(0)}$ 0.136 0.501 36 electricity any tariff (h)- 0.136 1.501 37 electricity any tariff (h)- 0.136 1.501 37 heat from boilers - mains gas4.79 0.2210 1.130 51 heat from boilers - oil4.79 0.335 1.18 53 heat from boilers - oil4.79 0.335 1.18 53 heat from boilers - scal 4.79 0.335 1.18 1.47 heat from boilers - coal 4.79 0.074 1.69 4.79 heat from boilers - coal 4.79 0.35 1.64 4.79 heat from boilers - biogas (landf	wood chips		3.48	0.023	1.046	21
Electricity: ${}^{(a)}$ standard tariff (high rate) ${}^{(b)}$ 72 17.56 0.136 1.501 30 7-hour tariff (high rate) ${}^{(b)}$ 8 20.72 0.136 1.501 31 10-hour tariff (high rate) ${}^{(b)}$ 7 18.71 0.136 1.501 34 10-hour tariff (high rate) ${}^{(b)}$ 10.68 0.136 1.501 33 18-hour tariff (high rate) ${}^{(b)}$ 10 6 0.136 1.501 38 18-hour tariff (high rate) ${}^{(b)}$ 11 15.73 0.136 1.501 38 18-hour tariff (high rate) ${}^{(b)}$ 10.66 0.136 1.501 35 electricity sold to grid, PV 5.3 ${}^{(0)}$ 0.136 0.501 60 electricity displaced from grid - 0.136 1.501 37 electricity displaced from grid - 0.136 1.501 37 electricity any tariff ${}^{(0)}$ 87 ${}^{(0)}$ - 0.136 1.501 37 heat from boilers - LPG 4.79 0.210 1.130 51 heat from boilers - suig biodicsel from any biomas	dual fuel appliance (mineral and wood)		4.53	0.087	1.049	10
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Electricity: (a)					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	standard tariff	72	17.56	0.136	1.501	30
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	7-hour tariff (high rate) (h)	8	20.72	0.136	1.501	32
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	7-hour tariff (low rate) ^(h)		8.13	0.136	1.501	31
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	10-hour tariff (high rate) ^(h)	7	18.71	0.136	1.501	34
18-hour tariff (high rate) (h)1115.730.1361.5013818-hour tariff (low rate) (h)10.660.1361.5014024-hour heating tariff3110.380.1361.50135electricity sold to grid, other5.3 (h)0.1360.50160electricity displaced from grid-0.1361.50137electricity, any tariff (h)-0.1361.50137electricity, any tariff (h)-0.1361.50139Heat networks: (h)heat from boilers – mains gas4.790.2101.13051heat from boilers – IPG4.790.3351.1853heat from boilers – oil4.790.3351.1853heat from boilers – coal4.790.0381.437heat from boilers – B30D (h)4.790.0181.042heat from boilers – coal4.790.3751.06454heat from boilers – susing biodiesel from any biomass source4.790.3751.06454heat from boilers – B30D (h)4.790.02691.09055heat from boilers – coal4.790.0361.50141heat from boilers – biomass4.790.0241.286waste heat from boilers – biomass4.790.0241.286waste heat from boilers – biomass4.790.0241.286waste heat from power station3.350.0111.05146heat from CHP3.350	10-hour tariff (low rate) ^(h)		10.68	0.136	1.501	33
18-hour tariff (low rate) ^(h) 10.66 0.136 1.501 40 24-hour heating tariff 31 10.38 0.136 1.501 35 electricity sold to grid, PV 5.3 (i) 0.136 0.501 36 electricity displaced from grid - 0.136 1.501 37 electricity, any tariff (i) - 0.136 1.501 37 electricity, any tariff (i) - 0.136 1.501 37 heat from boilers – mains gas 4.79 0.210 1.130 51 heat from boilers – LPG 4.79 0.335 1.18 53 heat from boilers – oil 4.79 0.335 1.18 53 heat from boilers using biodiesel from vegetable oil only 4.79 0.038 1.437 heat from boilers using biodiesel from vegetable oil only 4.79 0.018 1.042 heat from boilers using biodiesel from vegetable oil only 4.79 0.136 1.501 41 heat from boilers – B30D (f) 4.79 0.136 1.501 41 heat from boilers – coal 4.79 0.136 1.501 41	18-hour tariff (high rate) (h)	11	15.73	0.136	1.501	38
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	18-hour tariff (low rate) ^(h)		10.66	0.136	1.501	40
electricity sold to grid, PV $5.3^{(i)}$ 0.136 0.501 36 electricity sold to grid, other $5.3^{(i)}$ 0.136 0.501 60 electricity displaced from grid- 0.136 1.501 37 electricity, any tariff $^{(i)}$ - 0.136 1.501 39 Heat networks: $^{(k)}$ $87^{(i)}$ heat from boilers – mains gas 4.79 0.210 1.130 51 heat from boilers – LPG 4.79 0.335 1.180 53 heat from boilers – oil 4.79 0.335 1.18 53 heat from boilers using biodiesel from any biomass source 4.79 0.038 1.437 heat from boilers using biodiesel from vegetable oil only 4.79 0.018 1.042 heat from boilers – B30D (the main sequence of the main seq	24-hour heating tariff	31	10.38	0.136	1.501	35
electricity sold to grid, other $5.3^{(0)}$ 0.136 0.501 60 electricity displaced from grid- 0.136 1.501 37 electricity, any tariff $^{(0)}$ - 0.136 1.501 39 Heat networks: $^{(k)}$ $87^{(0)}$ heat from boilers – mains gas 4.79 0.210 1.130 51 heat from boilers – LPG 4.79 0.241 1.141 52 heat from boilers – oil 4.79 0.335 1.180 53 heat from boilers using biodiesel from any biomass source 4.79 0.038 1.437 heat from boilers – B30D $^{(0)}$ 4.79 0.018 1.042 heat from boilers – coal 4.79 0.375 1.064 54 heat from boilers – coal 4.79 0.136 1.501 41 heat from boilers – biomass 4.79 0.074 1.169 42 heat from boilers – biomass 4.79 0.029 1.037 43 heat from boilers – biogas (landfill or sewage gas) 4.79 0.024 1.286 waste heat from power station 3.35 0.011 1.051 46 heat from CHP 3.35 0.011 1.051 48 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 49	electricity sold to grid, PV		5.3 @	0.136	0.501	36
electricity displaced from grid-0.1361.50137electricity, any tariff $^{(0)}$ -0.1361.50139Heat networks: $^{(k)}$ 87 $^{(l)}$ heat from boilers – mains gas4.790.2101.13051heat from boilers – lPG4.790.3351.18053heat from boilers – oil4.790.3351.18053heat from boilers using biodiesel from any biomass source4.790.0381.437heat from boilers using biodiesel from vegetable oil only4.790.0181.042heat from boilers – coal4.790.3751.06454heat from boilers – coal4.790.3751.06454heat from boilers – biomass4.790.0741.16942heat from boilers – biomass4.790.0291.03743heat from boilers – biogas (landfill or sewage gas)4.790.0291.03743heat from power station3.350.0111.05146heat from CHP3.350.0111.05148electricity generated by CHP0.1361.50149electricity for pumping in distribution network0.1361.50150	electricity sold to grid, other		5.3 (i)	0.136	0.501	60
electricity, any tariff $^{(j)}$ -0.1361.50139Heat networks: $^{(k)}$ 87 $^{(l)}$ -0.1361.50139heat from boilers – mains gas4.790.2101.13051heat from boilers – LPG4.790.2411.14152heat from boilers – oil4.790.3351.18053heat from boilers using biodiesel from any biomass source4.790.0381.437heat from boilers using biodiesel from vegetable oil only4.790.0181.042heat from boilers – B30D $^{(l)}$ 4.790.2691.09055heat from boilers – coal4.790.3751.06454heat from boilers – coal4.790.0741.16942heat from boilers – biomass4.790.0221.03743heat from boilers – biomass4.790.0241.286waste heat from power station3.350.0111.05146heat from CHP3.350.0111.05148electricity generated by CHP0.1361.50149electricity for pumping in distribution network0.1361.50150	electricity displaced from grid		-	0.136	1.501	37
Heat networks: $87^{(l)}$ heat from boilers – mains gas 4.79 0.210 1.130 51 heat from boilers – LPG 4.79 0.241 1.141 52 heat from boilers – oil 4.79 0.335 1.180 53 heat from boilers that can use mineral oil or biodiesel 4.79 0.335 1.180 53 heat from boilers using biodiesel from any biomass source 4.79 0.038 1.437 heat from boilers using biodiesel from vegetable oil only 4.79 0.018 1.042 heat from boilers – B30D ^(f) 4.79 0.269 1.090 55 heat from boilers – coal 4.79 0.375 1.064 54 heat from boilers – waste combustion 4.79 0.074 1.169 42 heat from boilers – biomass 4.79 0.029 1.037 43 heat from boilers – biogas (landfill or sewage gas) 4.79 0.024 1.286 waste heat from power station 3.35 0.011 1.051 46 heat from CHP 3.35 0.011 1.051 48 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	electricity, any tariff (i)		-	0.136	1.501	39
heat from boilers - mains gas 4.79 0.210 1.130 51 heat from boilers - LPG 4.79 0.241 1.141 52 heat from boilers - oil 4.79 0.335 1.180 53 heat from boilers that can use mineral oil or biodiesel 4.79 0.335 1.18 heat from boilers using biodiesel from any biomass source 4.79 0.038 1.437 heat from boilers using biodiesel from vegetable oil only 4.79 0.018 1.042 heat from boilers - B30D ^(f) 4.79 0.269 1.090 55 heat from boilers - coal 4.79 0.375 1.064 54 heat from boilers - waste combustion 4.79 0.136 1.501 41 heat from boilers - biomass 4.79 0.029 1.037 43 heat from boilers - biomass 4.79 0.024 1.286 waste heat from power station 3.35 0.015 1.063 45 geothermal heat source 3.35 0.011 1.051 46 heat from CHP 3.35 0.011 1.051 48 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	Heat networks: (k)	87 ⁽¹⁾				
heat from boilers – LPG4.79 0.241 1.141 52 heat from boilers – oil4.79 0.335 1.180 53 heat from boilers that can use mineral oil or biodiesel 4.79 0.335 1.18 heat from boilers using biodiesel from any biomass source 4.79 0.038 1.437 heat from boilers using biodiesel from vegetable oil only 4.79 0.018 1.042 heat from boilers – B30D ^(f) 4.79 0.269 1.090 55 heat from boilers – coal 4.79 0.375 1.064 54 heat from boilers – coal 4.79 0.136 1.501 41 heat from boilers – biomass 4.79 0.074 1.169 42 heat from boilers – biomass 4.79 0.029 1.037 43 heat from boilers – biogas (landfill or sewage gas) 4.79 0.024 1.286 waste heat from power station 3.35 0.011 1.051 46 heat from CHP 3.35 0.011 1.051 48 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	heat from boilers - mains gas		4.79	0.210	1.130	51
heat from boilers – oil4.79 0.335 1.180 53 heat from boilers that can use mineral oil or biodiesel 4.79 0.335 1.18 heat from boilers using biodiesel from any biomass source 4.79 0.038 1.437 heat from boilers using biodiesel from vegetable oil only 4.79 0.018 1.042 heat from boilers – B30D ^(f) 4.79 0.269 1.090 55 heat from boilers – coal 4.79 0.375 1.064 54 heat from boilers – coal 4.79 0.136 1.501 41 heat from boilers – waste combustion 4.79 0.074 1.169 42 heat from boilers – biogas (landfill or sewage gas) 4.79 0.029 1.037 43 heat from power station 3.35 0.011 1.063 45 geothermal heat source 3.35 0.011 1.051 46 heat from CHP 0.136 1.501 49 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	heat from boilers – LPG		4.79	0.241	1.141	52
heat from boilers that can use mineral oil or biodiesel 4.79 0.335 1.18 heat from boilers using biodiesel from any biomass source 4.79 0.038 1.437 heat from boilers using biodiesel from vegetable oil only 4.79 0.018 1.042 heat from boilers – B30D ^(f) 4.79 0.269 1.090 55 heat from boilers – coal 4.79 0.375 1.064 54 heat from electric heat pump 4.79 0.136 1.501 41 heat from boilers – waste combustion 4.79 0.074 1.169 42 heat from boilers – biomass 4.79 0.029 1.037 43 heat from boilers – biogas (landfill or sewage gas) 4.79 0.024 1.286 waste heat from power station 3.35 0.011 1.051 46 heat from CHP 3.35 0.011 1.051 48 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	heat from boilers - oil		4.79	0.335	1.180	53
heat from boilers using biodiesel from any biomass source 4.79 0.038 1.437 heat from boilers using biodiesel from vegetable oil only 4.79 0.018 1.042 heat from boilers – B30D (f) 4.79 0.269 1.090 55 heat from boilers – coal 4.79 0.375 1.064 54 heat from electric heat pump 4.79 0.136 1.501 41 heat from boilers – waste combustion 4.79 0.074 1.169 42 heat from boilers – biomass 4.79 0.029 1.037 43 heat from boilers – biogas (landfill or sewage gas) 4.79 0.024 1.286 waste heat from power station 3.35 0.015 1.063 45 geothermal heat source 3.35 0.011 1.051 46 heat from CHP 0.136 1.501 49 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	heat from boilers that can use mineral oil or biodies	sel	4.79	0.335	1.18	
heat from boilers using biodiesel from vegetable oil only 4.79 0.018 1.042 heat from boilers – B30D (f) 4.79 0.269 1.090 55 heat from boilers – coal 4.79 0.375 1.064 54 heat from electric heat pump 4.79 0.136 1.501 41 heat from boilers – waste combustion 4.79 0.074 1.169 42 heat from boilers – biomass 4.79 0.029 1.037 43 heat from boilers – biogas (landfill or sewage gas) 4.79 0.024 1.286 waste heat from power station 3.35 0.015 1.063 45 geothermal heat source 3.35 0.011 1.051 46 heat from CHP 3.35 0.011 1.051 48 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	heat from boilers using biodiesel from any biomass	s source	4.79	0.038	1.437	
heat from boilers - $B30D^{(f)}$ 4.790.2691.09055heat from boilers - coal4.790.3751.06454heat from electric heat pump4.790.1361.50141heat from boilers - waste combustion4.790.0741.16942heat from boilers - biomass4.790.0291.03743heat from boilers - biogas (landfill or sewage gas)4.790.0241.286waste heat from power station3.350.0151.06345geothermal heat source3.350.0111.05146heat from CHP3.350.0111.05148electricity generated by CHP0.1361.50149electricity for pumping in distribution network0.1361.50150	heat from boilers using biodiesel from vegetable of	l only	4.79	0.018	1.042	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	heat from boilers – B30D (f)		4.79	0.269	1.090	55
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	heat from boilers - coal		4.79	0.375	1.064	54
heat from boilers – waste combustion 4.79 0.074 1.169 42 heat from boilers – biomass 4.79 0.029 1.037 43 heat from boilers – biogas (landfill or sewage gas) 4.79 0.024 1.286 waste heat from power station 3.35 0.015 1.063 45 geothermal heat source 3.35 0.011 1.051 46 heat from CHP 3.35 0.011 1.051 48 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	heat from electric heat pump		4.79	0.136	1.501	41
heat from boilers – biomass 4.79 0.029 1.037 43 heat from boilers – biogas (landfill or sewage gas) 4.79 0.024 1.286 waste heat from power station 3.35 0.015 1.063 45 geothermal heat source 3.35 0.011 1.051 46 heat from CHP 3.35 0.011 1.051 48 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	heat from boilers - waste combustion		4.79	0.074	1.169	42
heat from boilers - biogas (landfill or sewage gas) 4.79 0.024 1.286 waste heat from power station 3.35 0.015 1.063 45 geothermal heat source 3.35 0.011 1.051 46 heat from CHP 3.35 0.011 1.051 48 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	heat from boilers - biomass		4.79	0.029	1.037	43
waste heat from power station 3.35 0.015 1.063 45 geothermal heat source 3.35 0.011 1.051 46 heat from CHP 3.35 0.011 1.051 48 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	heat from boilers - biogas (landfill or sewage gas)		4.79	0.024	1.286	
geothermal heat source 3.35 0.011 1.051 46 heat from CHP 3.35 0.011 1.051 48 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	waste heat from power station		3.35	0.015	1.063	45
heat from CHP 3.35 0.011 1.051 48 electricity generated by CHP 0.136 1.501 49 electricity for pumping in distribution network 0.136 1.501 50	geothermal heat source		3.35	0.011	1.051	46
electricity generated by CHP0.1361.50149electricity for pumping in distribution network0.1361.50150	heat from CHP		3.35	0.011	1.051	48
electricity for pumping in distribution network 0.136 1.501 50	electricity generated by CHP			0.136	1.501	49
	electricity for pumping in distribution network			0.136	1.501	50

Energy Cost Deflator (r) = 0.37

Figure 13: Primary energy and CO₂ emissions according to "The Government's Standard Assessment Procedure for Energy Rating of Dwellings" in the UK [7]

Emissionsfaktoren

Nummer	Kategorie	Energieträger	Emissionsfaktor [g CO ₂ -Äquivalent pro kWh]
1		Heizöl	310
2		Erdgas	240
3	Fossile Brennstoffe	Flüssiggas	270
4		Steinkohle	400
5		Braunkohle	430
6		Biogas	140
7		Biogas, gebäudenah erzeugt	75
8	Diagona Drannataffa	Biogenes Flüssiggas	180
9	biogene brennstolle	Bioöl	210
10		Bioöl, gebäudenah erzeugt	105
11		Holz	20
12		netzbezogen	560
13	Strom	gebäudenah erzeugt (aus Photovoltaik oder Windkraft)	0
14		Verdrängungsstrommix	860
15		Erdwärme, Geothermie, Solarthermie, Umgebungswärme	0
16		Erdkälte, Umgebungskälte	0
17		Abwärme aus Prozessen	40
18	Warme, Kalte	Wärme aus KWK, gebäudeintegriert oder gebäudenah	nach DIN V 18599-9: 2018-09
19		Wärme aus Verbrennung von Siedlungsabfällen (unter pauschaler Berücksichtigung von Hilfsenergie und Stützfeuerung)	20
20	Nah-/Fernwärme aus KWK mit Deckungsanteil	Brennstoff: Stein-/Braunkohle	300
21	der KWK an der Wärmeerzeugung von	Gasförmige und flüssige Brennstoffe	180
22	mindestens 70 Prozent	Erneuerbarer Brennstoff	40
23		Brennstoff: Stein-/Braunkohle	400
24	Nah-/Fernwärme aus Heizwerken	Gasförmige und flüssige Brennstoffe	300
25		Erneuerbarer Brennstoff	60

Figure 14: CO₂ emission factors according to the German Building Law (GEG)

Harmonised efficiency reference values for separate production of electricity

(referred to in Article 1)

In the table below the harmonised efficiency reference values for separate production of electricity are based on net calorific value and standard atmospheric ISO conditions (15 $^{\circ}$ C ambient temperature, 1,013 bar, 60 % relative humidity).

Category				Year of construction			
		Type of fuel	Before 2012	2012- 2015	From 2016		
	S1	Hard coal including anthracite, bituminous coal, sub-bituminous coal, coke, semi-coke, pet coke	44,2	44,2	44,2		
	S2	Lignite, lignite briquettes, shale oil	41,8	41,8	41,8		
	S3	Peat, peat briquettes	39,0	39,0	39,0		
Solids	S 4	Dry biomass including wood and other solid biomass including wood pellets and briquettes, dried woodchips, clean and dry waste wood, nut shells and olive and other stones	33,0	33,0	37,0		
	S5	Other solid biomass including all wood not included under S4 and black and brown liquor.	25,0	25,0	30,0		
	S6	Municipal and industrial waste (non-renewable) and renewable/bio- degradable waste	25,0	25,0	25,0		
	L7	Heavy fuel oil, gas/diesel oil, other oil products		44,2	44,2		
quids	L8	Bio-liquids including bio-methanol, bioethanol, bio-butanol, biodiesel and other bio-liquids	44,2	44,2	44,2		
Γi	L9	Waste liquids including biodegradable and non-renewable waste (in- cluding tallow, fat and spent grain).	25,0	25,0	29,0		
	G10	Natural gas, LPG, LNG and biomethane	52,5	52,5	53,0		
51	G11	Refinery gases hydrogen and synthesis gas	44,2	44,2	44,2		
Gaseot	G12	Biogas produced from anaerobic digestion, landfill, and sewage treat- ment	42,0	42,0	42,0		
	G13	Coke oven gas, blast furnace gas, mining gas, and other recovered gases (excluding refinery gas)	35,0	35,0	35,0		
	014	Waste heat (including high temperature process exhaust gases, pro- duct from exothermic chemical reactions)			30,0		
	015	Nuclear			33,0		
Other	016	Solar thermal			30,0		
-	017	Geothermal			19,5		
	018	Other fuels not mentioned above			30,0		

Figure 15: Harmonised efficiency reference values for separate production of electricity according to "Commission delegated regulation (EU) 2015/2402"

Harmonised efficiency reference values for separate production of heat

(referred to in Article 1)

In the table below the harmonised efficiency reference values for separate production of heat are based on net calorific value and standard atmospheric ISO conditions (15 $^{\circ}$ C ambient temperature, 1,013 bar, 60 % relative humidity).

			Year of construction						
6	*	True of feel		Before 2016			From 2016		
g/		Type of fuer.	Hot water	Steam (*)	Direct use of exhaust gases (**)	Hot water	Steam (*)	Direct use of exhaust gases (**)	
	S1	Hard coal including anthracite, bitumi- nous coal, sub-bituminous coal, coke, semi-coke, pet coke	88	83	80	88	83	80	
	S2	Lignite, lignite briquettes, shale oil	86	81	78	86	81	78	
	S3	Peat, peat briquettes	86	81	78	86	81	78	
Solids	S4	Dry biomass including wood and other solid biomass including wood pellets and briquettes, dried woodchips, clean and dry waste wood, nut shells and ol- ive and other stones	86	81	78	86	81	78	
	S5	Other solid biomass including all wood not included under S4 and black and brown liquor.	80	75	72	80	75	72	
	<u>S6</u>	Municipal and industrial waste (non-re- newable) and renewable/bio-degradable waste	80	75	72	80	75	72	
	L7	Heavy fuel oil, gas/diesel oil, other oil products	89	84	81	85	80	77	
Liquids	L8	Bio-liquids including bio-methanol, bioethanol, bio-butanol, biodiesel and other bio-liquids	89	84	81	85	80	77	
	L9	Waste liquids including biodegradable and non-renewable waste (including tal- low, fat and spent grain).	80	75	72	75	70	67	

Figure 16: Harmonised efficiency reference values for separate production of heat according to "Commission delegated regulation (EU) 2015/2402"

Catagoria			Year of construction					
				Before 201	6	From 2016		
G	negory	Type of fuer.	Hot water	Steam (*)	Direct use of exhaust gases (**)	Hot water	Steam (*)	Direct use of exhaust gases (**)
	G10	Natural gas, LPG, LNG and biomethane	90	85	82	92	87	84
52	G11	Refinery gases hydrogen and synthesis gas	89	84	81	90	85	82
Gaseou	G12	Biogas produced from anaerobic diges- tion, landfill, and sewage treatment	70	65	62	80	75	72
	G13	Coke oven gas, blast furnace gas, mining gas, and other recovered gases (exclud- ing refinery gas)	80	75	72	80	75	72
	014	Waste heat (including high temperature process exhaust gases, product from exothermic chemical reactions)	_	_	-	92	87	_
-	015	Nuclear	-	-	-	92	87	_
Othe	016	Solar thermal	-	-	-	92	87	-
	017	Geothermal	-	-	_	92	87	_
	018	Other fuels not mentioned above	_	-	-	92	87	_

(*) If steam plants do not account for the condensate return in their calculation of CHP heat efficiencies, the steam efficiencies shown in the table above should be increased by 5 percentage points.
 (**) Values for direct use of exhaust gases should be used if the temperature is 250 °C or higher.

Figure 17: Harmonised efficiency reference values for separate production of heat according to "Commission delegated regulation (EU) 2015/2402" page 2

Zur CO ₂ -Dewi	ertung von Kwk-Ana	gen	
Allokationsmethoden	Brennstoffanteil A _{Br}	absolute CO_2 -Emissionen in g CO_2	spezifische CO ₂ - Emissionen in g CO ₂ /kWh
IEA-Methode*	$A_{Br,el} = \frac{\eta_{el}}{\eta_{el} + \eta_{th}}$	$CO_{2,el} = spez. CO_{2, Gas} \cdot A_{Br,el} \cdot W_{Gas}$	spez. $CO_{2,el} = \frac{CO_{2,el}}{W_{el}}$
	$A_{Br,th} = \frac{\eta_{th}}{\eta_{el} + \eta_{th}}$	$CO_{2,th}$ = spez. $CO_{2, Gas} \cdot A_{Br,th} \cdot W_{Gas}$	spez. $CO_{2,th} = \frac{CO_{2,th}}{W_{th}}$
Wirkungsgradmethode	$A_{Br,el} = \frac{\eta_{th}}{\eta_{el} + \eta_{th}}$	$CO_{2,el} = spez. CO_{2, Gas} \cdot A_{Br,el} \cdot W_{Gas}$	spez. $CO_{2,el} = \frac{CO_{2,el}}{W_{el}}$
	$A_{Br,th} = \frac{\eta_{el}}{\eta_{el} + \eta_{th}}$	$CO_{2,th}$ = spez. $CO_{2, Gas} \cdot A_{Br,th} \cdot W_{Gas}$	spez. $CO_{2,th} = \frac{CO_{2,th}}{W_{th}}$
Finnische Methode	$A_{Br,el} = (1 - PEE) \cdot \frac{\eta_{el}}{\eta_{el,REF}}$	$CO_{2,el} = spez. CO_{2, Gas} \cdot A_{Br,el} \cdot W_{Gas}$	spez. $CO_{2,el} = \frac{CO_{2,el}}{W_{el}}$
	$A_{Br,th} = (1 - PEE) \cdot \frac{\eta_{th}}{\eta_{th,REF}}$	$CO_{2,th}$ = spez. $CO_{2, Gas} \cdot A_{Br,th} \cdot W_{Gas}$	spez. $CO_{2,th} = \frac{CO_{2,th}}{W_{th}}$
	mit:		
	$PEE^{**} = 1 - \frac{1}{\frac{\eta_{th}}{\eta_{th,REF}} + \frac{\eta_{el}}{\eta_{el,REF}}}$		
Wärmegutschrift	A _{Br,el} = 0	$CO_{2,el} = spez. CO_{2, Gas} \cdot W_{Gas} - CO_{2,th}$ mit:	spez. $CO_{2,el} = \frac{CO_{2,el}}{W_{el}}$
	A _{Br,th} = 1	$CO_{2,th} = spez. CO_{2,Warme} \cdot W_{Gas} \cdot \eta_{th}$	spez. $CO_{2,th} = \frac{CO_{2,th}}{W_{th}}$
Stromgutschrift	A _{Br,el} = 1	$CO_{2,el} = spez. CO_{2,Strom} \cdot W_{Gas} \cdot \eta_{el}$	spez. $CO_{2,el} = \frac{CO_{2,el}}{W_{el}}$
	A _{Br,th} = 0	$CO_{2,th}$ = spez. $CO_{2,Gas} \cdot W_{Gas} - CO_{2,el}$	spez. $CO_{2,th} = \frac{CO_{2,th}}{W_{th}}$
* IEA = Internationale Energi	ieagentur (von engl. International Energy	Agency)	

Tab. 1: Übersicht der betrachteten Allokationsmethoden -----

* IEA = Internationale Energieagenti ** PEE = Primärenergieeinsparung

Figure 18: Overview of different allocation methods in German [8]