THE FLEMISH ENERGY AGENCY

Report for the Flemish Region in application of Article 14(1) and (3) of Directive 2012/27/EU on energy efficiency

This report has been structured in accordance with Annex VIII and Part I of Annex IX to the Energy Efficiency Directive. These annexes describe the content of the reporting required in order to comply with Article 14(1) and (3).

1   ANNEX VIII POTENTIAL FOR EFFICIENCY IN HEATING AND COOLING

1.   The comprehensive assessment of national heating and cooling potentials referred to in Article 14(1) must include:

(a) a description of heating and cooling demand;

In this regard, you are referred to the report in Annex 1: *Heat in Flanders 2015*. Chapter 2 of Annex 1 describes the state of demand for heating and cooling in 2012, along with the spatial distribution thereof.

(b) a forecast of how this demand will change in the next 10 years, taking into account in particular the evolution of demand in buildings and the different sectors of industry;

Chapter 5 of Annex 1 sets out the forecast of how demand will change by 2035.

To derive the future evolution of demand for heat at Flanders level we utilise the WM scenario (the 'With Measures' scenario, also known as the BAU or 'Business As Usual' scenario) submitted to the Commission by the Flemish Department for the Environment, Nature and Energy (LNE) in 2015 in connection with the Monitoring Mechanism Regulation. These scenarios provide a recent reflection of the impact of current, known energy and climate policy, as well as independent developments, on the expected energy consumption in Flanders up to 2035.

In drawing up the WM scenario, the LNE used a simulation tool developed by VITO, together with the input of various government agencies, including the Flemish Energy Agency (VEA). The simulator tool enables forecasts to be simulated for greenhouse gases and air pollutants for the various CRF/NFR sectors (energy, industry, agriculture, service sector, households, etc.) up to 2035. The forecast for energy-related emissions in this connection is based on energy projections by sector (where appropriate by sub-sector) and energy source.

(c) a map of the national territory, identifying, while preserving commercially sensitive information:

(i) heating and cooling demand points, including:
— municipalities and conurbations with a plot ratio of at least 0.3, and
— industrial zones with a total annual heating and cooling consumption of more than

20 GWh.

The heating and cooling demand points are mapped in Chapter 2 of Annex 1. Depending on the type of demand, the map has been drawn with a grid distribution of 100 x 100 m to 1 200 x 1 200 m in order to take into account the data available and the commercial sensitivity of certain data.
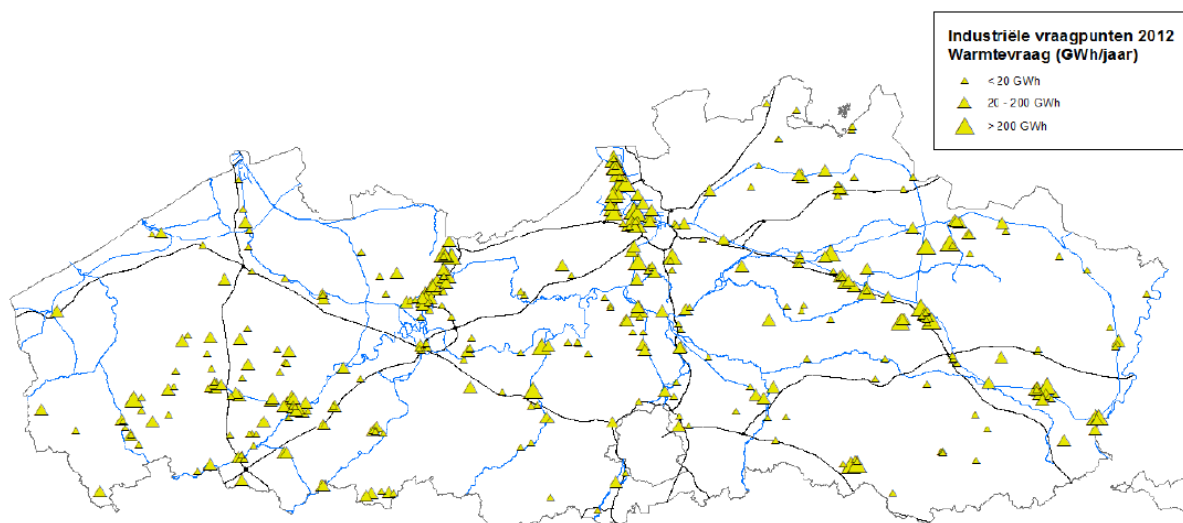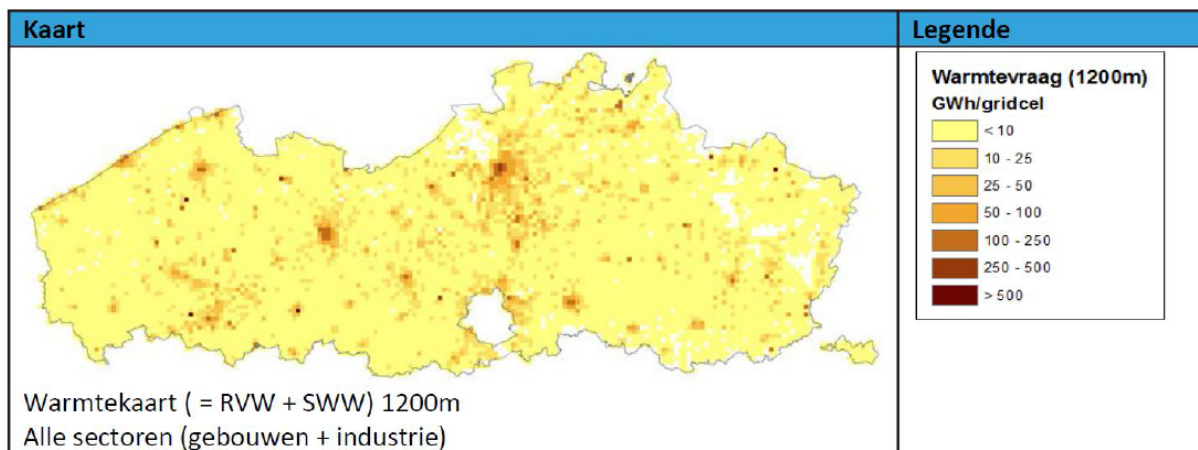
Key to graphic
Kaart = Map
Warmtekaart (= RVW + SWW) 1200m = Heat map (= Space heating + Hot water for sanitary facilities) 1 200 m
Alle Sectoren (gebouwen + industrie) = All sectors (buildings + industry)

Legende = Legend
Warmtevraag (1200m) GWh/gridcel = Heat demand (1 200 m) GWh/grid cell

Industriële vraagpunten 2012 = Industrial demand points, 2012
Warmtevraag (GWh/jaar) = Heat demand (GWh/year)

Figure 2. Heat demand [GWh/year] in 2012 for industrial demand points in Flanders

(ii) existing and planned district heating and cooling infrastructure;

//

The existing and planned district heating and cooling infrastructure is mapped in Chapter 3 of Annex 1.

Gloss for graphic:

Heat networks in Flanders

Ghent, IVAGO	Harelbeke, phase 2, Infrax	Roeselare, Mirom
Torhout, Karel de goedelaan, Infrax	Harelbeke, phase 1, Infrax	Ghent, EDF, luminus1
Middelkerke, Sluisvaartstraat, Infrax	Antwerp, New-South	Ghent, EDF, luminus2
Gistel, Ellestraat, Infrax	Antwerp, Indaver steam piping	Bruges, IVBO
Diksmuide, Hof ter bloemmolens, Infrax	Knokke-Heist, HVVI, Dalkia	Mol, VITO
Harelbeke, Goudwinde, Infrax		
Houthalen, Biogema		
Geel, VITO – IRMM		

Warmtenetten Vlaanderen

- Gent, IVAGO
- Torhout, Karel de goedelaan, Infrax
- Middelkerke, Sluisvaartstraat, Infrax
- Gistel, Ellestraat, Infrax
- Diksmuide, Hof ter bloemmolens, Infrax
- Harelbeke, Goudwinde, Infrax
- Houthalen, Biogerna
- Geel, VITO - IRMM

- Harelbeke, fase2, Infrax
- Harelbeke, fase1, Infrax
- Antwerpen, Nieuw-Zuid
- Antwerpen, stoomleiding Indaver
- Knokke-Heist, HVVI, Dalkia

- Roeselare, Mirom
- Gent, EDF luminus1
- Gent, EDF luminus2
- Brugge, IVBO
- Mol, VITO

Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, Mapmyindia, © OpenStreetMap contributors, and the GIS User Community

(iii) potential heating and cooling supply points, including:
— electricity generation installations with a total annual electricity production of more than 20 GWh, and
— waste incineration plants,
— existing and planned cogeneration installations using technologies referred to in Part II of Annex I, and district heating installations.

The potential supply points are mapped in Chapter 4 of Annex 1.

Figure 5: Estimated residual heat potential for plants with electricity generation > 20 GWh in Flanders, 2012

Key to figure:
Potentieel restwarmte elektriciteitscentrales = Potential residual heat from electricity-generating plants
GWh/jaar = GWh/year

Figure 6. Estimated potential residual heat from waste incineration plants in Flanders, 2012

Key to figure:
Potentieel restwarmte afvalverbrandingsinstallaties = Potential residual heat from waste incineration plants
GWh/jaar = GWh/year

Figure 7: Overview of the location of CHP plants in Flanders by capacity class (excluding plants < 50 kW$_e$ – [MW$_e$])

Key to figure:
WKK (in MWe) = CHP (in MW$_e$)

(d) identification of the heating and cooling demand that could be satisfied by high-efficiency cogeneration, including residential micro-cogeneration, and by district heating and cooling;

(e) identification of the potential for additional high-efficiency cogeneration, including from the refurbishment of existing and the construction of new generation and industrial installations or other facilities generating waste heat;

Chapter 6 of Annex 1 describes the demand that could be satisfied by high-efficiency cogeneration and the potential for high-efficiency cogeneration. The economic feasibility was investigated in the cost-benefit analysis to be found in Chapter 7 of Annex 1.

In the Flemish Region, 19.9 % of gross domestic electricity consumption was already drawn from combined heat and power in 2014.

//

(f) identification of energy efficiency potentials of district heating and cooling infrastructure;

This potential is identified in the cost-benefit analysis to be found in Chapter 7 of Annex 1.

(g) strategies, policies and measures that may be adopted up to 2020 and up to 2030 to realise the potential in point (e) in order to meet the demand in point (d), including, where appropriate, proposals to:
(i) increase the share of cogeneration in heating and cooling production and in electricity production;
(ii) develop efficient district heating and cooling infrastructure to accommodate the development of high-efficiency cogeneration and the use of heating and cooling from waste heat and renewable energy sources;
(iii) encourage new thermal electricity generation installations and industrial plants producing waste heat to be located in sites where a maximum amount of the available waste heat will be recovered to meet existing or forecasted heat and cooling demand;
(iv) encourage new residential zones or new industrial plants which consume heat in their production processes to be located where available waste heat, as identified in the comprehensive assessment, can contribute to meeting their heat and cooling demands. This could include proposals that support the clustering of a number of individual installations in the same location with a view to ensuring an optimal match between demand and supply for heat and cooling;
(v) encourage thermal electricity generating installations, industrial plants producing waste heat, waste incineration plants and other waste-to-energy plants to be connected to the local district heating or cooling network.
(vi) encourage residential zones and industrial plants which consume heat in their production processes to be connected to the local district heating or cooling network;

The following **Flemish policy measures** apply in the Flemish Region that could ensure, by 2020 and 2030, greater realisation of the potential for cogeneration, for residual heat recovery and the development of heat networks.

CHP certificates:

Each year, electricity suppliers are required to submit an increasing number of CHP certificates. CHP certificates are allocated in relation to the number of MWh in primary energy savings via CHP. In 2014 5 569 387 CHP certificates were issued, which, at an average market value of EUR 22.07, together represent support totalling EUR 123 million.

In December 2015 the Flemish Parliament approved a levy that will be used, inter alia, to buy up a significant number of CHP certificates (to the value of EUR 112 million a year), thus further raising the targets in respect of CHP certificates.

Support programme for residual heat recovery and heat production from renewable sources of energy

Since 2013, the Flemish Government has offered investment support for projects that recover residual heat or produce green heat from biomass or geothermal energy. Two calls for applications are launched each year. For the call in late 2015 (by way of exception, there was only one call in 2015), a budget of EUR 10.2 million was provided for.

Individual cost-benefit analyses pursuant to Article 14(5) and (7) of the Energy Efficiency Directive

///

The obligation to carry out an individual cost-benefit analysis in respect of the implementation of CHP and/or heat recovery has been included in environmental regulations in Flanders. Installations falling within the scope of Article 14(5) must carry out an individual cost-benefit analysis in connection with their application for an environmental permit, and take the energy efficiency path where the benefits outweigh the costs.

<div align="center">Energy policy agreements with industry for 2015-2020</div>

The energy policy agreements are aimed at both companies that fall within the scope of application of emissions allowances trading and those that do not. Under the energy policy agreements, the companies involved must carry out a feasibility study into the implementation of CHP and heat and cooling networks by 30 June 2015. Those projects that are viable must be implemented. The companies in the scheme must carry out an energy audit every four years and implement any viable measures from their energy plan.
The results of the feasibility studies were incorporated into Chapter 6 of Annex 1, *Heat in Flanders*.

(h) the share of high-efficiency cogeneration and the potential established and progress achieved under Directive 2004/8/EC;
(i) an estimate of the primary energy to be saved;

In this regard, please see the extensive CHP inventory for the Flemish Region (Annex 2), which tracks the evolution of CHP and primary energy savings via CHP from 1990 to 2014.

Grid map of combined heat and power in Flanders – 2014
The table below gives an overview of the key figures in relation to combined heat and power plants in Flanders in 2014.

	Engines	Gas turbines	CCGTs	Steam turbines		TOTAL 2014	*Total 2013*
				Network-connected	Direct drive		
Electrical capacity [MW]	561	493	805	213	152	**2 223**	*2 193*
of which certifiable	557	368	751	147	54	***1 875***	*1 704*
Thermal capacity [MW]	694	735	583	850	937	**3 799**	*3 733*
Total production of electricity/power [PJ]	8.9	11.7	11.4	4.5	4.3	**40.7**	*44.2*
	2 469	3 239	3 170	1 239	1202	**11 318**	*12 288*
Total production of electricity/power [GWh]	2 467	3 223	3 170	1 239	0	***10 099***	*11 135*
of which electricity [GWh]							
Percentage of CHP electricity versus gross domestic electricity consumption (*)	5 %	6 %	6 %	2 %	0 %	**18.4 %**	*19.9 %*
Total production of heat [PJ]	12.1	20.6	9.9	16.5	25.3	**84.5**	*83.9*
Total production of heat [GWh]	3 374	5 720	2 752	4 595	7 033	***23 474***	*23 294*
Electrical efficiency [%]	40 %	31 %	41 %	16 %	12 %	**27 %**	*28 %*
Thermal efficiency [%]	54 %	54 %	36 %	61 %	71 %	**56 %**	*54 %*
Overall efficiency [%]	94 %	85 %	77 %	78 %	83 %	**83 %**	*82 %*
Average hours of full load [h/a]	4 410	6 574	3 938	5 829	7 894	**5 096**	*5 642*
Combined heat and power savings [PJ] (**)	11	8.3	5.9	5.6	8.8	**39.8**	*38.8*
Combined heat and power savings [GWh] (**)	3 097	2 309	1 651	1 569	2 439	**11 065**	*10 769*
Relative primary energy savings [%] (**)	34.1 %	18.0 %	20.9 %	19.2 %	19.9 %	**22.0 %**	*21.5 %*

(*) Calculated as: final consumption (excluding self-production) + gross self-production + self-consumption in the processing industry +

//

network losses.
(**) The combined heat and power savings are calculated on the basis of the European reference efficiencies based on the quantity of electricity from CHP pursuant to Annex II of the Energy Decree.

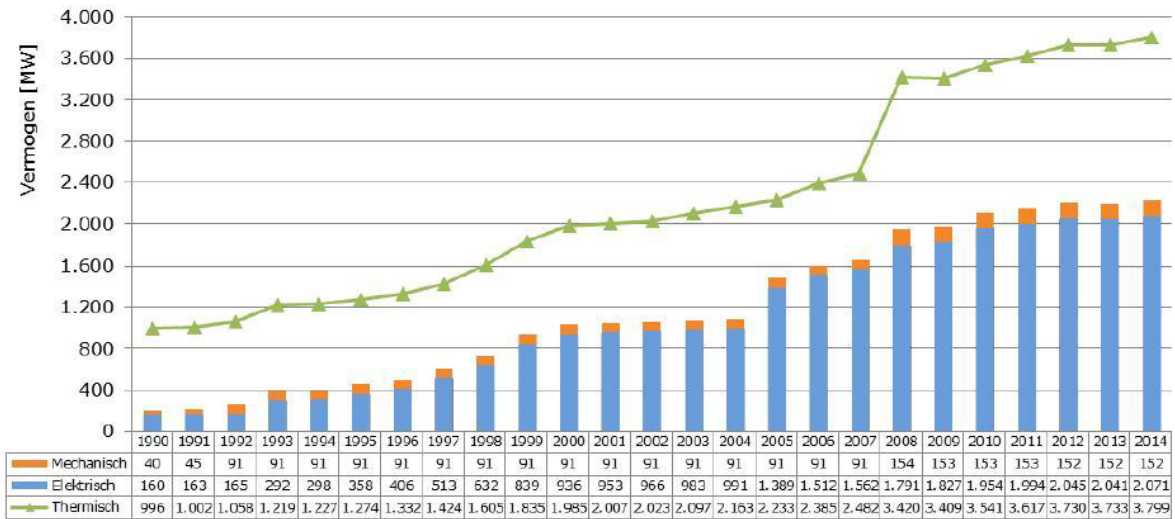|	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Mechanisch	40	45	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	154	153	153	153	152	152	152
Elektrisch	160	163	165	292	298	358	406	513	632	839	936	953	966	983	991	1.389	1.512	1.562	1.791	1.827	1.954	1.994	2.045	2.041	2.071
Thermisch	996	1.002	1.058	1.219	1.227	1.274	1.332	1.424	1.605	1.835	1.985	2.007	2.023	2.097	2.163	2.233	2.385	2.482	3.420	3.409	3.541	3.617	3.730	3.733	3.799

Figure 1: Evolution of operating CHP capacity in Flanders (1990-2014)

Key to figure
Vermogen [MW] = Capacity [MW]
Mechanisch = Mechanical
Elektrisch = Electrical
Thermisch = Thermal

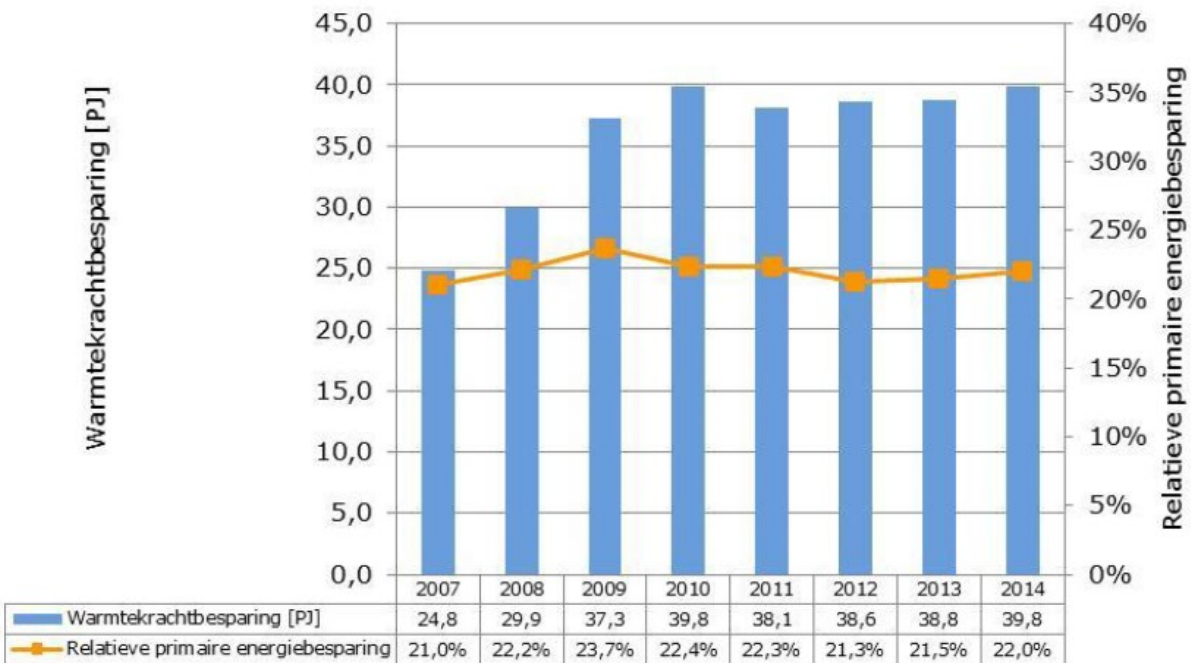|	2007	2008	2009	2010	2011	2012	2013	2014
Warmtekrachtbesparing [PJ]	24,8	29,9	37,3	39,8	38,1	38,6	38,8	39,8
Relatieve primaire energiebesparing	21,0%	22,2%	23,7%	22,4%	22,3%	21,3%	21,5%	22,0%

Figure 2: CHP savings by year in Flanders, based on European reference efficiencies (2007-2014)

Key to figure
Warmtekrachtbesparing [PJ] = CHP savings [PJ]
///

Relatieve primaire energiebesparing = Relative primary energy savings

(j) an estimate of public support measures for heating and cooling, if any, with the annual budget and identification of the potential aid element. This does not prejudge a separate notification of the public support schemes for a State aid assessment.

Support measure	Aid in millions of euros
Quota of CHP certificates for suppliers	123 (2014)
Purchasing of CHP certificates via levy	112 (from 2017)
Investment support for residual heat and green heat	10.2 (2015)

2. To the extent appropriate, the comprehensive assessment may be made up of an assembly of regional or local plans and strategies.

2   ANNEX IX, PART 1 COST-BENEFIT ANALYSIS

General principles of the cost-benefit analysis

The purpose of preparing cost-benefit analyses in relation to measures for promoting efficiency in heating and cooling as referred to in Article 14(3) is to provide a decision base for qualified prioritisation of limited resources at society level.

The cost-benefit analysis may cover a project assessment of an individual installation or a group of projects for a broader local, regional or national assessment in order to establish the most cost-effective and beneficial heating or cooling option for a given geographical area for the purpose of heat planning.

Cost-benefit analyses for the purposes of Article 14(3) shall include an economic analysis covering socio-economic and environmental factors.

The cost-benefit analyses shall include the following steps and considerations:

(a) Establishing a system boundary and geographical boundary

The scope of the cost-benefit analyses in question determines the relevant energy system. The geographical boundary shall cover a suitable well-defined geographical area, e.g. a given region or metropolitan area, to avoid selecting sub-optimised solutions on a project-by-project basis.

(b) Integrated approach to demand and supply options

The cost-benefit analysis shall take into account all relevant supply resources available within the system and geographical boundary, using the data available, including waste heat from electricity generation and industrial installations and renewable energy, and the characteristics of and trends in heat and cooling demand.

(c) Constructing a baseline

The purpose of the baseline is to serve as a reference point, to which the alternative scenarios are evaluated.

(d) Identifying alternative scenarios

All relevant alternatives to the baseline shall be considered. Scenarios that are not feasible due to technical reasons, financial reasons, national legislation or time constraints may be excluded at an early stage of the cost-benefit analysis if justified based on careful, explicit and well-documented considerations.

Only high-efficiency cogeneration, efficient district heating and cooling or efficient individual heating and cooling supply options should be taken into account in the cost-benefit analysis as alternative scenarios compared to the baseline.

(e) Method for the calculation of cost-benefit surplus
(i) The total long-term costs and benefits of heat or cooling supply options shall be assessed and compared.
(ii) The criterion for evaluation shall be the net present value (NPV)
criterion.
(iii) The time horizon shall be chosen such that all relevant costs and benefits of the scenarios are included. For example, for a gas-fired power plant an appropriate time horizon could be 25 years, for a district heating system, 30 years, and for heating equipment such as boilers 20 years.

(f) Calculation and forecast of prices and other assumptions for the economic analysis
(i) Member States shall provide assumptions, for the purpose of the cost-benefit analyses, on the prices of major input and output factors and the discount rate.
(ii) The discount rate used in the economic analysis for the calculation of net present value shall be chosen according to European or national guidelines.
(iii) Member States shall use national, European or international energy price development forecasts if appropriate in their national and/or regional/local context.
(iv) The prices used in the economic analysis shall reflect the true socio-economic costs and benefits and should include external costs, such as environmental and health effects, to the extent possible, i.e. when a market price exists or when it is already included in European or national legislation.

(g) Economic analysis: Inventory of effects
The economic analyses shall take into account all relevant economic effects. Member States may assess and take into account in decision-making costs and energy savings from the increased flexibility in energy supply and from a more optimal operation of the electricity networks, including avoided costs and savings from reduced infrastructure investment, in the analysed scenarios. The costs and benefits taken into account shall include at least the following:
(i) Benefits
— Value of output to the consumer (heat and electricity)
— External benefits such as environmental and health benefits, to the extent possible
(ii) Costs
— Capital costs of plants and equipment
— Capital costs of the associated energy networks
— Variable and fixed operating costs
— Energy costs
— Environmental and health costs, to the extent possible

Chapter 7 of Annex 1 describes the cost-benefit analysis in accordance with the above guidelines (a) to (g), as well as the results thereof.

The results in the baseline scenario are shown on the maps below in terms of the cost-benefit analyses for heat recovery via heat networks, and in terms of energy production via CHP for heat networks.

///

Page 10 of 12   Article 14 Energy Efficiency Report for the Flemish Region   18.12.2015

Figure 18: The benefits of a heat network (including investment support) where the residual heat is not taken directly from the source but via an adjacent cell. The existing heat networks in Flanders from Figure 3 are shown in black.

Figure 19: The benefits of a local heat network with CHP (with CHP certification).

(h) Sensitivity analysis

A sensitivity analysis shall be included to assess the costs and benefits of a project or group of projects based on different energy prices, discount rates and other variable factors having a significant impact on the outcome of the calculations.

Chapter 7 of Annex 1 includes a sensitivity analysis for the cost-benefit analysis, carried out for the following parameters:
  - The discount rate;
  - The price for residual heat;
  - Natural gas prices;
  - Electricity prices.

Table 16. Financial parameters for scenario exercise: standard – lower limit – upper limit

//

Parameter	Standard	Lower limit	Upper limit
Discount rate	1.34 % Source: European reference rate of return for State aid, indicative of market interest rates, http://ec.europa.eu/competition/state_aid/legislation/reference_rates.html	/	14 % Source: Investment in an energy policy agreement is deemed 'viable' from 14 % (ETS)
Price of residual heat	0 Reason: avoidance of underestimation of potential + case-specific nature	/	EUR 25/MWh$_{th}$ Source: Expert judgement at Eandis
Price of natural gas	EUR/MWh$_{th}$		
Gas turbine 20-50 MW$_e$	30.3	19.11	34.62
	Source: Inevitable front-end loss, VEA, including CO_2 cost	Source: ENDEX TTF – minimum 2012-2015 – Belgian Commission for Electricity and Gas Regulation (CREG) Scoreboard, incl. transmission, taxes, CO_2 levy	Source: ENDEX TTF – maximum 2012-2015 – Belgian Commission for Electricity and Gas Regulation (CREG) Scoreboard, incl. transmission, taxes, CO_2 levy
Small-scale industry	44.00	31.34	/ (= standard)
	Source: Eurostat 13 – Gas price for industrial consumers	Source: Eurostat 13 – Gas price for industrial consumers – minimum 2010-2014	
Buildings	60 Source: Flemish Electricity and Gas Market Regulator (VREG) Market Monitor 2014 – average consumption D3 – 2014	/ (= standard)	69.65 Source: Flemish Electricity and Gas Market Regulator (VREG) Market Monitor 2014 – average consumption D3 – Minimum 2011-2014
Electricity price	EUR/MWh$_{ele}$		
Gas turbine 20-50 MW$_e$	52.80 Source: Inevitable front-end loss, VEA, costs avoided by own off-take	47.50 ENDEX – minimum 2011-2015 – Belgian Commission for Electricity and Gas Regulation (CREG) Scoreboard, incl. transmission, taxes	71.50 ENDEX – maximum 2011-2015 – Belgian Commission for Electricity and Gas Regulation (CREG) Scoreboard, incl. transmission, taxes

//

Page 12 of 12   Article 14 Energy Efficiency Report for the Flemish Region   18.12.2015