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ANNEXES 1 to 7

ANNEXES

to the

COMMISSION RECOMMENDATION

on the content of the comprehensive assessment of the potential for efficient heating and cooling under Article 14 of Directive 2012/27/EU

Contents

ANNEX I

Contents of comprehensive assessments of the potential for efficient heating and cooling

1. GENERAL RECOMMENDATIONS TO ANNEX VIII EED

Article 14(1) and (3) of Directive 2012/27/EU (Energy Efficiency Directive – EED) requires each Member State to carry out and submit to the Commission a comprehensive assessment of the potential for energy efficiency in heating and cooling. The assessment must include all the elements referred to in Annex VIII EED.

The Member States had to submit a first assessment by 31 December 2015. That assessment is to be updated every five years following a request from the Commission. The preparation of the analysis must be closely linked to the planning and reporting arrangements in Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action[1] (Governance Regulation) and build on previous assessments where possible. Member States may use a reporting template provided by the Commission.

In order to simplify the assessments, the Commission used the possibilities in Articles 22 and 23 EED to propose a Delegated Regulation (EU) 2019/826[2] amending Annex VIII and Part 1 of Annex IX EED.

The aim of this document is to explain the new requirements and to facilitate the effective and coherent application of the provisions of Annex VIII EED on the information to be notified to the Commission in the comprehensive assessments. This document replaces the existing guidance on promotion of efficiency in heating and cooling published by the Commission[3].

To generate a national overview of heating and cooling, the steps leading to a complete comprehensive assessment must include:

- an assessment of the amount of useful energy (UE)[4] and quantification of final energy consumption (FEC)[5] by sector (GWh per year);
- the estimated and identified current heating and cooling supplied to sectors of final consumption (GWh per year), with breakdowns by technologies and as to whether the energy was derived from fossil and renewable sources;
- the identification of potential supply from installations that generate waste heat or cold (GWh per year);

[1] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council (OJ L 328, 21.12.2018, p. 1).

[2] Commission Delegated Regulation (EU) 2019/826 of 4 March 2019 amending Annexes VIII and IX to Directive 2012/27/EU of the European Parliament and of the Council on the contents of comprehensive assessments of the potential for efficient heating and cooling.

[3] Guidance note on Directive 2012/27/EU; https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013SC0449

[4] 'Useful energy' means all the energy required by the end-users in the form of heat and cold after all the steps of energy transformation have taken place in the heating and cooling equipment.

[5] All energy supplied to industry, transport, households, services and agriculture. FEC excludes deliveries to the energy transformation sector and the energy industries themselves. Any differences from statistics and balances available through Eurostat must be explained.

- reported shares of energy from renewable sources and from waste heat or cold in district heating and cooling FEC over the past 5 years;
- forecast trends in demand for heating and cooling for the next 30 years (GWh); and
- a map of the national territory showing energy-dense areas, heat and cold supply points identified under point 2(b) and district heating transmission installations, both existing and planned.

To give a general overview of policy on heating and cooling, the assessment must include:

- a description of the role of efficient heating and cooling in long-term greenhouse gas (GHG) emission reductions; and
- a general overview of existing policies and measures on heating and cooling, as reported in accordance with the Governance Regulation.

In order to analyse the economic potential for efficiency in heating and cooling, the steps leading to a complete assessment must include:

- the identification of suitable technologies for supplying low-carbon and energy-efficient heat and cold on the national territory using a cost-benefit analysis (CBA);
- a baseline and alternative scenarios for a well-defined geographical area;
- financial and economic analyses (the latter taking into account external costs);
- a sensitivity analysis; and
- a presentation of the method used and assumptions made.

Finally, proposals for additional and future policy measures in heating and cooling must be presented to complete the comprehensive assessment.

2. SPECIFIC RECOMMENDATIONS

2. OVERVIEW OF HEATING AND COOLING

2.1. Assessing annual heating and cooling demand in terms of useful energy and quantified final energy consumption by sector

Under point 1 in Annex VIII EED, Member States must report the most recent quantified FEC data for heating and cooling in residential, service and industry sectors, and any other sector that individually accounts for more than 5% of total national useful heating and cooling demand. In parallel, Member States must also assess and report UE required for heating and cooling in these sectors. The FEC and UE for each sector must be expressed in GWh.

Final heating and cooling energy consumption should be based on real, measured and verified information, and sectoral breakdowns as provided as default in European energy statistics and national energy balances[6].

To comply with point 3 in Annex VIII EED, it is useful to present a geographical breakdown of supply and consumption data, in order to relate future energy demand to sources of supply. This requires knowledge of the location of the main heating and cooling users. Together with

[6] *Guidance note on Directive 2012/27/EU*; https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013SC0449

the information on potential suppliers for point 2 of Annex VIII to the EED, this allows creating a map of locations for point 3 thereof and improve understanding of the varying conditions within a country. One approach for the geographical breakdown could be to use a well-established system of territorial division, such as postcode areas, local administrative units (LAUs), municipalities, industrial parks and their surroundings, etc.

A sectoral breakdown of heating and cooling demand into relevant sub-elements may be produced where possible and useful, e.g. to determine the amount or temperature grade of energy that would typically be needed[7] (e.g. into high grade heat, medium grade heat, medium/low grade heat, low grade heat, cooling and refrigeration). This would make the analysis more accurate and useful, e.g. in establishing technical and economic viability as part of the CBA of specific heating & cooling supply solutions to meet the specific needs in different sub-sectors.

A proper breakdown of demand requires a robust data gathering and processing. It will often involve combining different data sets, processing data top-down and bottom-up, and using hypotheses and assumptions. If no direct data on energy consumption is available, indirectly derived data should be used. Possible elements could include the population in a territorial unit, energy consumption *per capita* and heated area of buildings *per capita*. Different sub-sectors will probably require different approaches.

The residential sector and most of the service sector consist of a large number of small and medium-sized consumers, dispersed over the territory of a municipality or other territorial unit. Their energy demand is primarily for space heating/cooling and thus determined by the building area that requires heating and/or cooling. It might be useful to apply criteria that explain demand in geographical terms[8], e.g. to group such consumers into high and low heat demand density groups. Where building segments are differentiated, e.g. to meet 'nearly zero-energy building' standards, the same segmentation may also be used.

The industrial sector usually consists of a small number of large heat consumers, whose demand is governed by industrial processes. In this case, the consumers could be grouped using energy demand (MWh/a) and temperature thresholds.

2.2. Identifying/estimating current heating and cooling supply by technology

The purpose of this step is to identify the technological solutions used to supply heating and cooling (point 1 in Annex VIII EED). The analysis and reported values should follow the same structure as the description of heating and cooling demand. Under point 2(a) in Annex VIII EED, the most recent data available must be reported, in GWh per year. Distinctions should be made between on-site and off-site sources and between renewable and fossil energy sources.

Point 2(a) lists the technologies for which supply data must be provided:

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7 For more information on a typical heat and cold breakdown based on their application, see Annex IV.

8 Examples of such criteria are:

- heat demand density (MWh/km²) – the annual consumption of heating and cooling by buildings located in a given territorial unit, e.g. according to the STRATEGO project report (https://heatroadmap.eu/wp-content/uploads/2018/09/STRATEGO-WP2-Background-Report-6-Mapping-Potenital-for-DHC.pdf), high-demand areas are those consuming over 85 GWh/km² of heating per year; and
- plot ratio (m²/m²) – the heated or cooled floor area of buildings in a given territorial unit divided by the area of that unit. For more details, see *Background report providing guidance on tools and methods for the preparation of public heat maps*, point 2.1.1; http://publications.jrc.ec.europa.eu/repository/handle/JRC98823

- ‘in the case of supply provided on-site:
  - *heat-only boilers;*
  - *high-efficiency heat and power generation;*
  - *heat pumps;*
  - *other on-site technologies and sources; and*
- in the case of off-site supply:
  - *high-efficiency heat and power generation;*
  - *waste heat;*
  - *other off-site technologies and sources;’*

For each technology, a distinction must be made between renewable and fossil energy sources. Data that cannot be gathered directly should be derived indirectly. The above list is not exhaustive and represents the minimum to be included. Additional energy sources should be added if necessary to ensure completeness and accuracy.

The level of detail of data on heating and cooling supply sources should reflect the requirements of the method chosen for the comprehensive assessment. This could include location data, technology, fuel used, the quantity and quality[9] of energy supplied (MWh/a), the availability of heat (daily or yearly), the age and expected lifetime of the installation, etc.

2.3. Identifying installations that generate waste heat or cold and their potential heating or cooling supply

The purpose of this step is to identify, describe and quantify sources of waste heat or cold that are not yet used to their full technical potential. This could serve as an indicator to cover existing or future heating and cooling demand. Point 2(b) in Annex VIII EED lists the heat generation installations to be analysed:

- *‘thermal power generation installations that can supply or can be retrofitted to supply waste heat with a total thermal input exceeding 50 MW;*
- *heat and power cogeneration installations using technologies referred to in Part II of Annex I with a total thermal input exceeding 20 MW;*
- *waste incineration plants;*
- *renewable energy installations with a total thermal input exceeding 20 MW other than the installations specified under point 2(b)(i) and (ii) generating heating or cooling using the energy from renewable sources;*
- *industrial installations with a total thermal input exceeding 20 MW which can provide waste heat.’*

Member States may go beyond the listed waste heat and cold sources, in particular from the tertiary sector and report them separately. For the purposes of authorisation and permitting records of Article 14(7) EED, Member States can assess the waste heat generation potential of thermal power generation installations with a total thermal input between 20 and 50 MW.

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[9] For more information on a typical heat and cold breakdown based on their application, see Annex IV.

It might also be useful to describe the quality of energy produced, e.g. temperature (steam or hot water) available per application for which it could typically be used[10]. If the quantity or quality of the waste heat or cold are not known, they can be estimated using proper methodology based on well-documented assumptions. For example, waste heat from electricity generation installations can be recovered using various methods and technologies[11].

Member States must show on a map the location of the potential sources of waste heat and cold that could satisfy demand in the future.

2.4. Maps on the supply and demand of heat and cold

Annex VIII EED requires that the comprehensive assessment of national potential for efficient heating and cooling include a map of the entire national territory that shows the sources and infrastructure of heating and cooling demand, including (point 3 in Annex VIII):

- *'heating and cooling demand areas following from the analysis of point 1, while using consistent criteria for focusing on energy dense areas in municipalities and conurbations;*
- *existing heating and cooling supply points identified under point 2(b) and district heating transmission installations;*
- *planned heating and cooling supply points of the type described under point 2(b) and district heating transmission installations'*

This list contains only the items that must be included on the map. Other items may be included, e.g. distribution of renewable energy resources.

Producing the heat and cold map should not be seen as a separate task, but rather as an integral part of the process of assessing potential heating and cooling efficiency improvements and synergies between consumers and their potential suppliers. In the light of the requirement to produce the map, all data collected on heating and cooling supply and demand should have a spatial dimension, so that opportunities for synergies can be identified.

The resolution of the map elements required under point 3(a) in Annex VIII EED must be sufficient to identify particular heating and cooling demand areas. For the elements under point 3(b) and (c), the virtual representation may be more general (subject to the chosen method of analysis and information available), but it must make it possible to determine the location of a particular element with sufficient accuracy for the purpose of the CBA.

Where plans for future supply points and installations have been notified to the national administration or referred to in national policy documents, that may mean that they are sufficiently mature to be included in this category. This will not prejudge future planning or investment decisions and will not be binding on any party.

Various methods can be used to compose map layers[12]. Some provide more detail and may require larger sets of detailed information (e.g. isopleth-based maps). Others may require less effort, but are less useful for identifying synergies between consumers and suppliers of heat

[10] For more information on a typical heat and cold breakdown based on their application, see Annex V.

[11] *Guidelines on best practices and informal guidance on how to implement the comprehensive assessment at Member State level*; http://publications.jrc.ec.europa.eu/repository/handle/JRC98819

[12] For more details on methods for estimating waste heat, see *Background report providing guidance on tools and methods for the preparation of public heat maps*, points 3 and 4; http://publications.jrc.ec.europa.eu/repository/handle/JRC98823

and cold (e.g. choropleth maps). Member States are encouraged to construct maps using the most detailed information available, while protecting commercially sensitive information.

It is advisable to make the heat map publicly available on the internet. This is already the practice in some Member States and the map can be a useful tool for potential investors and the public.

2.5. Forecast of heating and cooling demand

Point 4 in Annex VIII EED requires a forecast of demand for heating and cooling for the next 30 years, with more precise information for the next 10 years. The forecast must take into account the impact of policies and strategies relating to energy efficiency and heating and cooling demand (e.g. long-term building renovation strategies under the Energy Performance of Buildings Directive[13], integrated energy and climate plans under the Governance Regulation) and should reflect the needs of the various sectors of industry.

When preparing forecasts, Member States should use the segmentation established pursuant to points 1 and 2 in Annex VIII EED to determine current supply and demand (i.e. residential, service, industrial and other, and their possible sub-segments).

Relevant international, national and scientific reports can be used, as long as they are based on a well-documented methodology and provide sufficiently detailed information. Alternatively, forecasting can be based on energy-demand modelling. The methods and assumptions must be described and explained.

2.6. Share of energy from renewable sources and from waste heat or cold in the final energy consumption of the district heating and cooling sector

Member States must report the share of energy from renewable sources and from waste heat and cold in accordance with Article 15(7) of the Renewable Energy Directive (RED)[14]. The data may be reported for every type of renewable non-fossil source referred to in Article 2(1) RED, and also for waste heat.

Until the methodology for accounting renewable cooling is established in accordance with Article 35 RED, Member States must use an appropriate national methodology.

3. OBJECTIVES, STRATEGIES AND POLICY MEASURES

3.1. Role of efficient heating and cooling in long-term GHG emission reduction and overview of existing policies

An overview of existing policies relevant for efficient heating and cooling should be presented briefly, focussing on any changes compared to those reported under the Governance Regulation and avoiding any duplication.

Specific policies for heating and cooling must be consistent with policies contributing to the five energy union dimensions, in particular energy efficiency (Article 4, point b(1) to (4) and Article 15(4)(b) of the Governance Regulation); these dimensions are:

[13] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (OJ L 153, 18.6.2010, p. 13).

[14] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (OJ L 328, 21.12.2018, p. 82).

- decarbonisation, including the reduction and removal of GHG emissions and contributing to the trajectories of the sectoral share of renewable energy in FEC;
- energy efficiency, including the contribution to achieving the EU's 2030 energy efficiency target and indicative milestones for 2030, 2040 and 2050;
- energy security, including diversification of supply, increasing the resilience and flexibility of the energy system and reducing import dependency;
- internal energy markets, including improving interconnectivity, transmission infrastructure, competitively priced and involvement-oriented consumer policy and alleviating energy poverty; and
- research, innovation and competitiveness, including the contribution to private research and innovation, and the deployment of clean technologies.

Member States must describe how energy efficiency and the reduction of GHG emissions in heating and cooling relate to these five dimensions and quantify this where justified and possible.

3.1.1. ***Example: Decarbonisation dimension***

For example, for the decarbonisation dimension, the impact of policies for energy efficiency in heating and cooling on the amount of GHG emitted and on land use must be quantified. The use of technologies in the future should be stated, indicating the uptake of renewable non-fossil sources, including renewable electricity applications for heat or cold (wind, solar PV) and the direct generation of heat from renewable energy carriers (solar thermal heating and cooling, biomass, biogas, hydrogen, synthetic gases), or other. The subsequent CBA (see section 4) would make it possible to identify new policies and measures (section 5) in order to achieve national energy efficiency and decarbonisation targets related to heating and cooling.

3.1.2. ***Example: Energy Efficiency dimension***

As regards general energy efficiency, Member States must express the amount that policy on energy efficiency in heating and cooling is expected to contribute to the 2030, 2040 and 2050 milestones. This must be quantified in terms of primary or final energy consumption, primary or final energy savings, or energy intensity, in line with the approach chosen in the context of the Governance Regulation.

Member States should also describe the relevant impact of their policies on energy security, research, innovation and competitiveness.

4. ANALYSING ECONOMIC POTENTIAL FOR EFFICIENCY IN HEATING AND COOLING

4.1. Analysis of economic potential

4.1.1. Outline

Member States have a range of options when it comes to analysing the economic potential of heating and cooling technologies, but the method must (points 7 and 8 in Annex VIII EED):

- cover the entire national territory – this does not exclude possible sub-analyses, e.g. using regional disaggregation;
- be based on a CBA (Article 14(3) EED) and use net present value (NPV) as the assessment criterion;

- identify alternative scenarios for more efficient and renewable heating and cooling technologies – this involves constructing baseline and alternative scenarios for national heating and cooling systems[15];
- consider a number of technologies – industrial waste heat and cold, waste incineration, high-efficiency cogeneration, other renewable energy sources, heat pumps and reducing heat losses in existing district networks; and
- take account of socio-economic and environmental factors[16].

The part of the CBA dedicated to the Article 15(7) RED assessment must include a spatial analysis of areas suitable for the 'low ecological risk' deployment of energy from renewable sources and of the use of waste heat and cold in the heating and cooling sector, and an assessment of the potential for small-scale household projects.

Depending on their availability and that of the requisite information, other advanced energy system modelling tools could be used to evaluate more complex relationships between heat demand and supply components of the national energy system, in particular the more dynamic aspects.

The assessment report must set out what assumptions have been made, in particular as regards the prices of major input and output factors and the discount rate.

4.1.2. Geographical and system boundaries

Establishing geographical and system boundaries for the comprehensive assessment is a critical step in the analysis. These determine the group of entities and the aspects of their interaction that the analysis will cover.

Point 8(d) in Annex VIII EED lays down two general requirements in this context:

- the geographical boundary must cover a suitable well-defined geographical area; and
- the CBA must take account of all relevant centralised or decentralised supply resources available within the system and geographical boundaries.

The area enclosed by the overall geographical boundary must be identical to the territory covered by the assessment, i.e. the administrative territory of the Member State in question. However, large Member States in particular are recommended to divide their territory further into regions (e.g. NUTS-1), in order to make energy mapping and planning exercise more manageable, and allowing to take account of different climatic zones. Member States should identify opportunities for synergies between heating and cooling demand and sources of waste and renewable heat and cold within the geographical boundary.

System boundaries, on the other hand, are a much more local concept. They must enclose a unit or a group of heating and cooling consumers and suppliers between which the exchange of energy is or might be significant. The resulting systems will be analysed within their boundaries (applying the CBA) in order to determine whether it is economically worthwhile to implement a particular heating and cooling supply option.

Examples of such systems could be[17]:

[15] Including assessment of the potential of energy from renewable sources and of the use of waste heat and cold in the heating and cooling sector, as referred to in Article 15(7) RED.
[16] For more explanations, see Annex V.
[17] This non-exhaustive list is presented here for illustration purposes only.

- a group of apartment buildings (heat consumers) and a planned district heating system (potential supplier of heating);
- a district of a city located near a suitable heat source;
- smaller heating and cooling installations such as shopping areas (heat and cold consumer) and heat pumps (possible technology to cover heat and cold demand); and
- an industrial plant that consumes heat and another plant that could supply waste heat.

4.1.3. Identifying suitable technical solutions

A wide range of high-efficiency heating and cooling solutions could satisfy the demand identified in the previous steps. The most cost-effective and beneficial heating or cooling solution can be defined as one or more of the following elements:

- a resource used as a source of energy, e.g. waste heat, biomass or electricity;
- a technology used to convert the energy carrier into a useful form of energy for consumers, e.g. heat recovery or heat pumps; and
- a distribution system that allows the provision of useful energy to consumers (centralised or decentralised).

Possible technical solutions should also be assessed on the basis of their applicability in:

- decentralised (or individual) systems, where several producers (or each consumer) produce their own heat or cold on-site; and
- centralised systems, which use district heating and cooling systems to distribute thermal energy to consumers from off-site heat sources – these can be used to supply heating and cooling to system boundaries that have been characterised as high demand density and to large-scale consumers, e.g. an industrial plant.

The choice of suitable solutions within the boundaries of a particular energy supply and demand system[18] will depend on many factors, including:

- the availability of the resource (e.g. the availability of biomass might determine the practicality of biomass boilers);
- properties of heat demand (e.g. district heating is particularly suitable for high heat demand density urban areas); and
- properties of possible heat supply (low-temperature waste heat might not be suitable for use in industrial processes, but it might be suitable as an input to a district heating system).

4.1.4. Baseline scenario

As outlined in point 8(a)(ii) in Annex VIII EED, the baseline scenario will serve as a reference point, by taking account of policies at the time of compiling the comprehensive assessment. The characteristics of the following national heating and cooling system elements should provide the point of departure:

- overview of heat consumers and their current energy consumption;
- current heat and cold supply sources; and

[18] This means an area within which supply and demand systems are interconnected and similar system characteristics apply.

- potential heat and cold supply sources (if such developments can be reasonably expected given current policies and measures under Part I of Annex VIII EED).

The baseline scenario shows the most likely development of energy demand, supply and transformation based on current knowledge, technological development and policy measures. It is therefore the 'business as usual' (BAU) or reference scenario. It must reflect existing policy measures under national and EU legislation and can be based on the energy efficiency and renewable energy 'with existing measures' (WEM) scenarios developed for the Governance Regulation.

It should include information on how demand is met at present and assumptions as to how it will be met in the future. The future technologies do not have to be confined to options used currently. They might include, for instance, high-efficiency cogeneration or efficient district heating and cooling (DHC), if such developments can reasonably be expected.

4.1.4.1. Current mix of heating and cooling supply technologies

The baseline scenario must include a description of the current mix of heating and cooling supply technologies for each segment of heat demand and within each energy system boundary. Priority should be given to a bottom-up approach based on detailed information (e.g. data gathered close to source, results of inquiries, etc.).

In the absence of detailed information, this input could be derived by means of a top-down approach based on:

- information on the current mix of fuel consumption; and
- assumptions about the main technological solutions applied in the national context.

Since the heat supply technology mix is related to the heat demand source, information on the latter can be used to calibrate estimates for the former. For example, data on the number of houses or flats within an energy system boundary could be used to estimate the total number and size of individual heating units installed (assuming one installation per house). Likewise, data on the number and size of industrial installations could be used to approximate the number of heat generation units (and their sizes) in the industrial sector.

4.1.4.2. Future mix of heating and cooling supply technologies and their replacement rate

The future mix of heating and cooling supply technologies could be estimated by taking the fuel mix in the final year and then determining the technology mix for that year and all years in between, assuming different evolution trajectories depending on how the technologies involved. By combining this information with the heating and cooling demand forecasts, it is possible to produce technology mix forecasts for the whole period.

Assumptions as to the future mix of heating and cooling supply technologies can also be formulated on the basis of the technology replacement rate. Assuming that current heat generation equipment will have to be replaced at the end of its economical lifetime, assumptions may be made as to:

- the use of some technologies throughout the timeframe of the analysis; and
- the replacement of others.

In these cases, the replacement rate would represent the limit for the penetration of new technologies for existing demand. The replacement rates for specific sectors could be:

- determined by market studies or other relevant sources, also taking into account the potential influence of policy measures; or
- estimated on the basis of the average lifetime of the technology – assuming a lifetime of 20 years and market saturation, 1/20 of the stock of this technology is replaced each year.

4.1.5. Construction of alternative scenarios

Under point 8(c) in Annex VIII EED, all scenarios that may affect the baseline must be considered, including the role of efficient individual heating and cooling. Consequently, within each analysed energy system, the number of alternative scenarios should correspond to the number of technically viable solutions, presented in accordance with point 7.

Scenarios that are not feasible (for technical or financial reasons or due to national regulation) may be excluded at an early stage of the CBA, but well-documented justifications must be given for such exclusion.

The procedures for producing alternative scenarios mostly resemble those used for the baseline scenario. The shares of different technologies can be determined for each year and the size and number of installations has to be calculated. Alternative scenarios must take into account of the energy efficiency and renewable energy objectives for the European Union in the Governance Regulation and should explore ways to deliver a more ambitious national contribution, assuming that the evolution of energy demand is the same as in the baseline.

The level of detail in the alternative scenarios will differ, as follows:

- for on-site solutions, the share of technology within a ‘segment’ of demand[19] should be determined; while
- for off-site solutions, the decision to implement the solution will affect all segments as a block; therefore, the required capacity should be assessed on the basis of total demand and seasonal load patterns, without distinguishing between demand segments (e.g. if a DHC network supplies heating to households and the service sector, it is necessary to estimate only the combined capacity of both segments).

Each alternative scenario must quantify the following (as compared with the baseline scenario):

- the economic potential of technologies examined, using NPV as the criterion;
- GHG emission reductions;
- primary energy savings (GWh per year); and
- impact on the share of renewables in the national energy mix.

4.2. Cost-benefit analysis

A CBA must be carried out to assess the welfare change attributable to an investment decision relating to efficient heating and cooling technology. Under point 8(a)(i) in Annex VIII EED, NPV must be used as the evaluation criterion.

[19] i.e. a specific end-use (space heating, cooling, hot water or steam) or (sub-)sector (e.g. residential sector or one of its sub-sectors).

The social discount rate (SDR) needs to be determined. This is a parameter that reflects society's view as to how future benefits and costs should be valued against present ones[20]. By giving future costs and benefits a present value, it is possible to compare them over time.

The CBA must include an economic analysis and a financial analysis from an investor's perspective, including applying a financial discount rate. This makes it possible to identify potential areas for policy influence based on the difference between the financial and the economic costs of a technical solution.

In order to assess the impact and possible benefits of heating and cooling to the energy system, Member States should assess what types of technical solutions could be best suited to meeting the needs. The benefits could include:

- a flattening of the energy demand curve;
- offsetting demand in cases of grid congestion or peak energy price periods;
- improving system resilience and security of supply; and
- offering load at times of high supply or offering inertia in the energy system – the CBA should take account of the value of this flexibility.

4.3. Sensitivity analysis

The CBA must include a sensitivity analysis to assess the impact of changes in key factors. This involves assessing the effect of changes and uncertainties on the NPV (in absolute terms) and makes it possible to identify parameters with a higher associated risk. Typical parameters to explore would be:

- changes in investment and operating costs;
- fuel and electricity prices;
- CO_2 quotas; and
- effects on the environment.

5. POTENTIAL NEW STRATEGIES AND POLICY MEASURES

5.1. Presenting future legislative and non-legislative policy measures

Member States should provide an overview of policy measures that are additional to the existing ones described under point 6 in Annex VIII EED. There should be a logical link between:

- the data on heating and cooling gathered for points 1 and 2;
- the future policy measures; and
- their assessed impact.

Under point 9, the following elements must be quantified for each policy measure:

- '*greenhouse gas emission reductions;*

[20] The SDR recommended by the Commission (*Guide to cost-benefit analysis of investment projects*) is 5% in cohesion countries and 3% for other Member States. Member States may establish a different benchmark, provided that:
  – they justify it on the basis of an economic growth forecast and other parameters; and
  – they apply it consistently across similar projects in the same country, region or sector.

- *primary energy savings in GWh per year;*
- *impact on the share of high-efficiency cogeneration;*
- *impact on the share of renewables in the national energy mix and in the heating and cooling sector;*
- *links to national financial programming and cost savings for the public budget and market participants;*
- *estimated public support measures, if any, with their annual budget and identification of the potential aid element.'*

Planned policy measures to realise energy efficiency potential in heating and cooling should be included in the integrated national energy and climate plan pursuant to Article 21 of the Governance Regulation. Member States can include new elements and establish a link to the comprehensive assessment when updating the plans by 30 June 2024.

ANNEX II

ADDITIONAL SOURCES OF LITERATURE

1. General literature

- Best practices and informal guidance on how to implement the Comprehensive Assessment at Member State level. Joint Research Centre, European Commission, 2016. ISBN 979-92-79-54016-5.

  http://publications.jrc.ec.europa.eu/repository/handle/JRC98819

2. Literature on the estimation of waste heat and cold

- Waste heat from industry for district heating. Commission of European Communities, Directorate-General Energy, 1982.

  https://publications.europa.eu/en/publication-detail/-/publication/2fcd5481-ac79-4e8f-9aaa-ed88a38444db

3. Literature on the preparation of maps on the supply and demand of heat and cold

- Background report providing guidance on tools and methods for the preparation of public heat maps. Joint Research Centre, European Commission, 2016. ISBN 978-92-79-54014-1.

  http://publications.jrc.ec.europa.eu/repository/handle/JRC98823

4. Literature on the execution of cost-benefit analysis incl. external costs

- Handbook on the external costs of transport. A report by CE Delft for European Commission, Directorate-General for Mobility and Transport, 2019.

  https://ec.europa.eu/transport/sites/transport/files/studies/internalisation-handbook-isbn-978-92-79-96917-1.pdf

- Methodologies for the Assessment of Project GHG Emissions and Emission Variations. European Investment Bank, 2018.

  https://www.eib.org/attachments/strategies/eib_project_carbon_footprint_methodologies_en.pdf

- The Economic Appraisal of Investment Projects at the EIB. European Investment Bank, 2013.

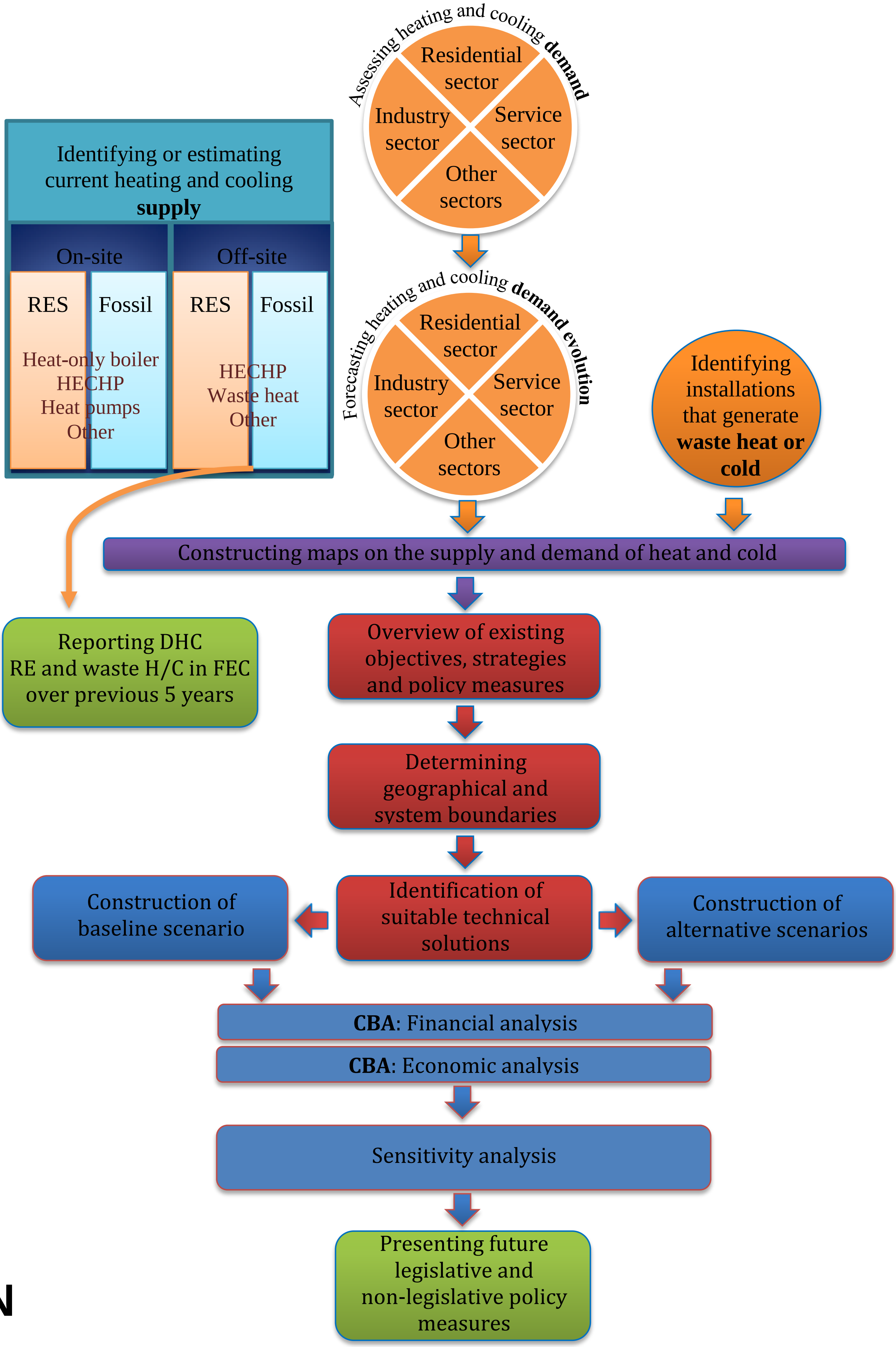
  https://www.eib.org/attachments/thematic/economic_appraisal_of_investment_projects_en.pdf

- Guide to Cost-Benefit Analysis of Investment Projects. Economic appraisal tool for Cohesion Policy 2014-2020. European Commission, Directorate-General for Regional and Urban policy, 2014. ISBN 978-92-79-34796-2.

  https://ec.europa.eu/inea/sites/inea/files/cba_guide_cohesion_policy.pdf

ANNEX III

PROCESS FOR COMPREHENSIVE ASSESSMENTS (ANNEX VIII EED)



ANNEX IV

WASTE HEAT ACCOUNTING

1. Outline

Waste heat is the excess thermal energy left after an industrial process and the extraction of heat. The scope for reporting waste heat for points 2(b) differs from that of point (c) in Annex VIII EED. Point 2(b) is concerned with potential waste heat supply in GWh (the technical potential) per year that can be supplied outside the listed installations. Point 2(c) on the other hand requires the reporting of the '*share of energy from renewable sources and from waste heat or cold in the final energy consumption of the district heating and cooling*[21] *sector over the past 5 years*'.

2. Accounting of waste heat and cold projects

Waste heat and cold from processes are difficult to account for, because from the moment the excess is used on-site, it is no longer 'waste' and feeds into the increased efficiency or reduced operational cost for the installation.

In principle, heat is considered as waste heat only when it is a by-product of another process that would be emitted into the environment, until supplied for off-site use. In other words, industrial waste heat is equivalent to <u>the energy load that is not extracted otherwise and requires external cooling</u>.

The following categories should not be considered as waste heat:

- ✗ heat that was generated with the main purpose of being directly used on- or off-site and is not a by-product of another process, irrespective of the energy input;
- ✗ cogenerated heat from combined heat and power (CHP) plants, because CHP is an energy-efficiency measure by design. It reduces waste heat, as it uses the energy of the input fuel in a more efficient way; and
- ✗ heat that is or could be recovered internally on the same site.

The following should be considered as examples of waste heat:

- ✓ data centres or shopping areas that need to be cooled down, where the heat resulting from the operations can be delivered off-site instead of being dissipated into the environment; and
- ✓ the direct use of condenser cooling stream from power plants (e.g. the heat can be supplied for warming greenhouses).

If heat generated from renewable fuels is a by-product of a main process, it can be considered waste heat (e.g. biodegradable waste incineration and biomass) for the purposes of reporting under point 2(b) and (c).

In order to show waste heat and cold projects on maps (point 3), Member States are recommended to collect the following information:

- name and location of plant;

[21] 'Renewable cooling' should be identified according to the common methodology for calculating the quantity of renewable energy used for cooling and district cooling (Article 35 RED), once it has been established. Until then, an appropriate national methodology should be used.

- quantity (GWh/a) and quality (usual temperature and medium) of current and potential waste heat and cold available; and
- availability of waste heat and cold (hours per year).

3. Accounting waste heat for cogeneration

The heat accounted for cogeneration must be deducted and cannot be counted towards waste heat for the purposes of presenting the results for analysis of potential heating and cooling supply (point 2(b) and (c)) and three kinds of energy need to be accounted separately:

- electrical energy;
- thermal energy from cogenerated heat; and
- waste heat that is not used and could be recovered from the condenser of a power plant or exhaust gases. Point 2(b) requires that all such heat be reported. For point 2(c), only the portion of such heat present in the final energy consumption of the district heating system can be reported.

4. Accounting waste heat and cold for point 2(b) Annex VIII EED

There is no limitation on waste heat and cold reporting related to a district system for point 2(b). Therefore, total current and potential waste heat and cold that can be used directly for another process (if the supplied temperature level allows) or be upgraded to a suitable level using heat pumps to be provided off-site must be reported.

Reporting of waste heat potential for the purposes of point 2(b) can also be based on a survey of industrial sites. The survey could ask respondents to quantify:

- total energy input;
- heat capacity;
- how much of the generated heat is already used; and
- how much of the heat is cooled down (or how much of the cold is warmed up) or emitted into the environment.

Another possibility of assessing potential waste heat and cold supply is to use indirect estimates based on an assumption of similar heat-temperature profiles among plants that:

- are in the same sector;
- are of a similar age;
- have the same degree of energy integration[22]; and
- are subject to similar measures to reduce energy losses.

Consequently, a similar amount of waste heat or cold could be estimated to be available per tonne of product produced or treated (e.g. all plants of a given age and technology could have similar waste heat profiles).

The estimated potential can be weighted by an availability factor that takes into account:

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[22] *Waste heat from industry for district heating* (Commission guidance) https://publications.europa.eu/en/publication-detail/-/publication/2fcd5481-ac79-4e8f-9aaa-ed88a38444db

- the technology used in recovery equipment;
- the age of the plant;
- the degree of energy integration; and
- recent levels of investment in recovery equipment.

It is strongly recommended that Member States report the temperature grade and the medium (liquid water, steam, molten salt or other) of waste heat and cold; these factors determine possible applications and transmission distances, thus influencing the analysis of the scenarios. The most common media used to recover waste heat include:

- combustion exhausts from glass-melting furnaces, cement kilns, fume incinerators, aluminium reverberatory furnaces and boilers;
- process off-gases from steel electric arc furnaces, aluminium reverberatory furnaces, and drying and baking ovens; and
- cooling water from furnaces, air compressors and internal combustion engines.

Steam rarely appears as waste heat, because it is usually generated on demand and exhausted or condensed during the process.

The table below gives an indicative categorisation of heat and cold based on temperature level and lists common applications of heat. This applies for both waste and useful heat, regardless of the fuel used to produce it.

Category	Medium	Temperature interval (°C)	Common applications
high-grade heat	direct heating via convection (flame-based), electric arc, oil-based, etc	>500	steel, cement, glass
medium-grade heat	high-pressure steam	150-500	steam processes in chemical industry
medium/low-grade heat	medium-pressure steam	100-149	steam processes in paper, food, chemical industry, etc.
low-grade heat	hot water	40-99	space heating, processes in food industry, etc.
cooling	water	0 — ambient	space cooling, processes in food industry, etc.
refrigeration	refrigerant	<0	refrigeration in food, chemical industry

5. Reporting waste heat for point 2(c) Annex VIII EED

The RED[23] makes a close link between efficiency and renewable energy, and considers that both can be counted towards the indicative target of annual increased share of renewable energy in the heating and cooling sector.

The RED[24] defines waste heat as '*unavoidable heat or cold generated as by-product in industrial or power generation installations, or in the tertiary sector, which would be*

[23] Article 23 RED (mainstreaming renewable energy in heating and cooling) sets indicative targets and governs the accounting of renewable energy and waste heat or cold.

dissipated unused in air or water without access to a district heating or cooling system, where a cogeneration process has been used or will be used or where cogeneration is not feasible'.

For the purposes of reporting the historical share of energy from waste heat or cold[25] over the past 5 years (point 2(c), only the waste heat or cold in the final energy consumption of district heating and cooling can be accounted for.

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[24] Article 2(9) RED.

[25] In this Annex, 'waste heat and cold' and 'excess heat and cold' are treated as synonyms. Waste heat is mostly the remaining heat from a thermodynamic cycle that would be emitted into the environment unless it is captured and supplied for off-site use. Part of it can be used off-site if an appropriate heat sink is found. It can be supplied to a heat network or another industrial site. The part of waste heat or cold that is distributed through a district system can be reported for the purposes point 2(c) in Annex VIII EED.

ANNEX V

FINANCIAL AND ECONOMIC COST-BENEFIT ANALYSIS

1. Outline

A CBA is an essential analytical approach to assess the welfare change attributable to an investment decision. It involves assessing changes in cost and benefits between baseline and alternative scenarios. The results must then be integrated into a common framework to compare them over time and come to conclusions about their profitability.

Under Annex VIII EED, the CBA must include:

- an economic analysis – this takes account of socio-economic and environmental factors and covers changes in the welfare of society as a whole (i.e. level of prosperity and standard of living), which can be linked to well-being. Economic analysis has generally been used to support policy-making; and
- a financial analysis – this takes a private investor's perspective, using the conventional discounted cash flow approach to assess net returns.

Conducting analysis from both perspectives makes it possible to identify areas in which policy can fill the gaps between society's need and the financial viability/suitability of an initiative. Policy-makers can then adopt measures to support or promote (e.g. by means of obligations, economic incentives, etc.) an initiative and abolish support mechanisms when evaluation shows that they are not justified in social terms.

The CBA is based on a discounted cash flow analysis, whereby the analyst:

- determines the baseline and alternative scenarios for each energy system boundary;
- quantifies and monetises their respective costs and benefits (considering also the distribution of costs and benefits along the timeframe of the analysis); and
- assesses the changes between the baseline and each alternative scenario.

Once information has been collected on total cost and total benefit, evaluation criteria (in this case, NPV) are used to assess the return on the various alternative scenarios.

2. Financial analysis

The financial analysis should take account of:

- inward and outward cash flows only; accounting items that do not correspond to actual flows (i.e. depreciation, reserves, etc.) are disregarded;
- constant (real) prices fixed at base-year or current (nominal) prices, in order to reduce uncertainty and complexity;
- a forecast consumer price index (CPI);
- VAT on costs and revenues (unless this is recoverable by the project promoter); and
- direct taxes on the prices of inputs (i.e. electricity, labour, etc.).

The benefits to be included are:

✓ revenues from selling energy;

- ✓ subsidies; and
- ✓ residual values.

The costs should include:

- × the capital costs of the heating and cooling technology;
- × its operation and maintenance costs; and
- × CO_2 costs.

A financial discount rate (FDR) is used to reflect the opportunity cost of capital, i.e. the potential return from investing the same capital in an alternative project. As an indicator of risk perception, this can vary depending on the decision-maker's perspective and between technologies (see section 4).

3. Economic analysis

The economic analysis must include at least the costs and benefits of point 8(b) of Annex VIII EED, including

- ✓ the value of output to the consumer;
- ✓ capital costs of plants;
- ✓ equipment and the associated energy networks;
- ✓ variable and fixed operating costs; and
- ✓ energy costs.

Economic potential is a subset of technical potential that is economically cost-effective compared with conventional supply-side energy resources. The alternative scenarios are built to test the effects of realising the potential of various technical solutions to cover heat demand. Those parts of the potential that provide positive NPV compared with the baseline scenario indicate cost-effectiveness and therefore constitute the economic potential of that technology.

For alternative scenarios with similar results, the reduction of CO_2 emissions, primary energy savings or other key indicators could be used as additional criteria to support decision-making. Once the most cost-efficient solutions have been identified at system boundary level, they could be aggregated to determine the most cost-efficient potential at national level.

The social discount rate (SDR) used for the economic analysis reflects society's view as to how future benefits and costs should be valued against present ones (see section 4).

Although economic analysis follows the same route as financial analysis, there are a number of very important differences; in particular, in economic analysis:

- fiscal corrections have to be applied, as we are dealing mainly with transfers between agents within the economy that do not reflect real impacts on economic welfare;
- the prices of inputs (including labour) do not include direct taxes;

- subsidies are not included, because they are transfers between agents and do not affect the economic welfare of society as a whole;
- transfers of wealth from taxpayers to companies and the related societal and welfare impacts are a cost for society and should be accounted for; and
- externalities and impacts on society welfare should be estimated[26]; the main externalities to consider are:
    - the environmental and health impact of the combustion of fuels; and
    - the macro-economic impact of investment in the energy system.

4. Financial and social discount rates

Estimating NPV requires the use of a 'discount rate', a parameter that reflects the value for society of future cost and benefits, as compared with present ones. Discount rates are used to convert future costs and benefits into their present value, allowing comparison across time.

Two discount rates are used:

- a financial discount rate (FDR) – this is used in financial analysis to reflect the opportunity cost of capital, i.e. the potential return that could have been obtained by investing the same capital in an alternative project. It can vary depending on:
    - the perspective of the decision-maker – different stakeholders (e.g. industries, service enterprises and household owners) may have different expectations and opportunity costs on their available capital; and
    - the technology, because it is an indicator of risk perception; and
- a social discount rate (SDR) – this is used in economic analysis to reflect society's view as to how future benefits and costs should be valued against present ones.

  For the 2014-2020 programming period, the Commission[27] suggests using two benchmark SDRs: 5% for the cohesion countries and 3% for the others. It also encourages Member States to provide their own benchmarks for the SDR. Those Member States that have their own values can use them for the CBA; those that do not can use the reference values. Since these are provided for 2014-2020, the impact of a potential change in the SDR post-2020 could be analysed in the sensitivity analysis.

[26] Financial analysis does not take these into account, as they do not generate a real cash flow for investors.
[27] *Guide to cost-benefit analysis of investment projects*; https://ec.europa.eu/inea/sites/inea/files/cba_guide_cohesion_policy.pdf

ANNEX VI

EXTERNAL COSTS OF THE COST-BENEFIT ANALYSIS

1. Outline

Energy production has a range of environmental impacts relating to pollution, land use and the consumption of resources (e.g. fuel, water); these affect the welfare of society. There are various methods for estimating the monetary value of environmental impacts in order to account for them in the decision-making process[28] [29].

2. Assessing environmental value

Assessing environmental value is data- and resource-intensive. It can be facilitated by the use of databases providing 'environmental damage factors' that contain information on the environmental damage generated, for example, by each additional unit of energy produced using a certain technology.

These factors can be used to assess environmental and health impact in each scenario. Where they are expressed per additional unit of energy produced, the environmental damage of the scenario would be the result of multiplying the energy production from a given technology by the damage factor per unit of energy produced by that technology, as follows:

$$[ENV_{y,t}]_{Scen.} = [E_{y,t}]_{Scen.} \cdot DF_y$$

where:

$[ENV_{y,t}]_{Scen.}$ is the environmental damage associated with energy produced by technology *y*, in year *t*, in a specific scenario [EUR];

$[E_{y,t}]_{Scen.}$ is the energy produced by technology *y*, in the year *t*, in one scenario [MWh]; and

DF_y is the environmental damage per unit of energy produced by technology *y* [EUR/MWh].

The environmental damage under a scenario in any given year will be the sum of that generated by production from all the technologies used in that scenario that year:

$$[ENV_{Total,t}]_{Scen.} = \left[\sum_{y=1}^{n} ENV_{y,t}\right]_{Scen.}$$

Further information can be found in reports that provide environmental damage factors for the following environmental impact categories: climate change, ozone depletion, terrestrial acidification, freshwater eutrophication, human toxicity, particulate matter formation, agricultural land occupation, urban land occupation, depletion of energy resources, etc.

These values can vary over time due to changes in different parameters (e.g. population density, overall pollution load of the atmosphere). The impact of such changes could therefore be assessed as part of the sensitivity analysis.

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[28] *Guide to cost-benefit analysis of investment projects*; https://ec.europa.eu/inea/sites/inea/files/cba_guide_cohesion_policy.pdf

[29] Zvingilaite, E., *Health externalities and heat savings in energy system modelling* (Kgs. Lyngby, DTU, 2013).

Modifications in technology design and country-specific factors such as the energy mix will also have an impact on the external environmental costs[30] [31].

The financial analysis takes account of the costs of CO_2 emissions from installations covered by the EU emissions trading system (ETS), as they have been internalised in the market prices for CO_2. The valuation of climate change impact can be based on a damage-cost approach that provides higher values per tonne of emissions.

Regardless of the approach used, when going from the financial to the economic analysis, the costs of CO_2 emissions have to be removed to avoid double counting.

2.1 Examples

When the environmental impact of additional CHP capacity in the alternative scenario is assessed, account should be taken of the environmental effect of changes in electricity production:

- construction of new CHP plants – the impact of both energy products obtained as an output (heat and electricity) has to be accounted for (using the damage factors). In addition, the avoided environmental damage costs of producing the same amount of electricity and heat using another technology should be taken into account;
- conversion of existing power plants into CHP – it can be assumed that the fuel consumption of the plants and their environmental impact with respect to the baseline scenario will remain constant, so it is not necessary to account for it. Only the environmental impact of the additional electricity to be supplied using other technology has to be assessed.

3. Externalities on society welfare

It is required to estimate the positive and negative externalities and impacts on society welfare. These are not taken into account in the financial analysis as they do not generate a real cash flow for investors. The main externalities in terms of both costs and benefits, include:

- air quality and health impacts;
- security of energy supply to consumers, if not internalised via market mechanisms (e.g. value of flexibility, grid tariffs);
- investments and/or savings in energy infrastructure;
- circular economy and resource efficiency;
- broader environmental impacts;
- industrial competitiveness through increased energy efficiency in heating and cooling; and
- growth and jobs.

[30] European Commission ExternE-Pol project

[31] *Subsidies and costs of EU energy – final report* (Ecofys, 2014).

ANNEX VII

VOLUNTARY REPORTING TEMPLATE FOR COMPREHENSIVE ASSESSMENTS OF EFFICIENCY POTENTIAL FOR HEATING AND COOLING

The following forms are available on DG ENER's Europa website (https://ec.europa.eu/energy/en/topics/energy-efficiency/heating-and-cooling) and on request to ENER-EED-REPORTING@ec.europa.eu.

Voluntary reporting template for reporting of inputs and outputs of Comprehensive Assessment under Article 14 and Annex VIII of the Directive 2018/2002/EU
The following forms are available on DG ENER's Europa website (https://ec.europa.eu/energy/en/topics/energy-efficiency/heating-and-cooling) and on request to ENER EED REPORTING@ec.europa.eu.
The aim of this template is to facilitate reporting of the quantitative parameters and variables used in and resulting from the comprehensive assessment of the potential for efficient heating and cooling.
This template is based on Article 14 of and Annex VIII to Directive 2012/27/EU, as amended by Delegated Regulation (EU) 2019/826, and the Commission Recommendation C(2019) 6625 on the contents of comprehensive assessments of the potential for efficient heating and cooling.
The use of this reporting template is highly recommended, but voluntary. If the template is used, it must be annexed to the main report on the comprehensive assessment. It is not intended as a substitute for that report.
Member States are free to include additional inormation on this template.
Year X is the first year of the period covered by the comprehensive assessment.
This document states the views of the Commission services, does not alter the legal effects of the Directive and is without prejudice to the binding interpretation of the revised EED, as provided by the Court of Justice.

Part I: Overview of heating and cooling
1. Reporting current heating and cooling demand; 4. Reporting forecasted heating and cooling demand

			Year						
		Unit	X	X+5	X+10	X+15	X+20	X+25	X+30
Heating demand, **final** energy	Residential sector	GWh/a							
	Service sector	GWh/a							
	Industrial sector	GWh/a							
	Other sectors	GWh/a							
Cooling demand, **final** energy	Residential sector	GWh/a							
	Service sector	GWh/a							
	Industrial sector	GWh/a							
	Other sectors	GWh/a							
Heating demand, **useful** energy	Residential sector	GWh/a							
	Service sector	GWh/a							
	Industrial sector	GWh/a							
	Other sectors	GWh/a							
Cooling demand, **useful** energy	Residential sector	GWh/a							
	Service sector	GWh/a							
	Industrial sector	GWh/a							
	Other sectors	GWh/a							

Notes: X represents the starting year of the analysis;
The column for year X should cntain actual numbers of current heating and cooling demand;

Part I: Overview of heating and cooling
2.(a) Reporting current heating and cooling supply

YEAR X

Energy provided on-site			Unit	Value
Residential sector	Fossil fuel sources	Heat only boilers	GWh/a	
		Other technologies	GWh/a	
		HECHP	GWh/a	
	Renewable energy sources	Heat only boilers	GWh/a	
		HECHP	GWh/a	
		Heat pumps	GWh/a	
		Other technologies	GWh/a	
Service sector	Fossil fuel sources	Heat only boilers	GWh/a	
		Other technologies	GWh/a	
		HECHP	GWh/a	
	Renewable energy sources	Heat only boilers	GWh/a	
		HECHP	GWh/a	
		Heat pumps	GWh/a	
		Other technologies	GWh/a	
Industrial sector	Fossil fuel sources	Heat only boilers	GWh/a	
		Other technologies	GWh/a	
		HECHP	GWh/a	
	Renewable energy sources	Heat only boilers	GWh/a	
		HECHP	GWh/a	
		Heat pumps	GWh/a	
		Other technologies	GWh/a	
Other sectors	Fossil fuel sources	Heat only boilers	GWh/a	
		Other technologies	GWh/a	
		HECHP	GWh/a	
	Renewable energy sources	Heat only boilers	GWh/a	
		HECHP	GWh/a	
		Heat pumps	GWh/a	
		Other technologies	GWh/a	

Energy provided off-site				
Residential sector	Fossil fuel sources	Waste heat	GWh/a	
		HECHP	GWh/a	
		Other technologies	GWh/a	
	Renewable energy sources	Waste heat	GWh/a	
		HECHP	GWh/a	
		Other technologies	GWh/a	
Service sector	Fossil fuel sources	Waste heat	GWh/a	
		HECHP	GWh/a	
		Other technologies	GWh/a	
	Renewable energy sources	Waste heat	GWh/a	
		HECHP	GWh/a	
		Other technologies	GWh/a	
Industrial sector	Fossil fuel sources	Waste heat	GWh/a	
		HECHP	GWh/a	
		Other technologies	GWh/a	
	Renewable energy sources	Waste heat	GWh/a	
		HECHP	GWh/a	
		Other technologies	GWh/a	
Other sectors	Fossil fuel sources	Waste heat	GWh/a	
		HECHP	GWh/a	
		Other technologies	GWh/a	
	Renewable energy sources	Waste heat	GWh/a	
		HECHP	GWh/a	
		Other technologies	GWh/a	

Part I: Overview of heating and cooling
2.(b) Reporting identified available waste heat

YEAR X

	Threshold	Unit	Value
Thermal power generation installations	50 MW	GWh/a	
CHP	20 MW	GWh/a	
Waste incineration plants	-	GWh/a	
Renewable energy installations	20 MW	GWh/a	
Industrial installations	20 MW	GWh/a	

Part II: Objectives, strategies and policy measures

Name of policy, strategy or objective	Main objective of policy or strategy	Indicative national energy efficiency contribution, based on primary or final energy consumption, primary or final energy savings, or energy intensity*	Short description (precise scope and operational arrangements)	Relevant energy union dimension (see below) and intended impact, if applicable	Implementation period	Status of implementation

Decarbonisation, including the reduction and removal of GHG emissions and the contribution to the trajectories of the sectoral share of renewable energy in final energy consumption

General energy efficiency, including the contribution to achieving the EU's 2030 energy efficiency target and indicative milestones for 2030, 2040 and 2050

Energy security, including diversification of supply, increasing resilience and flexibility of the energy system and reducing import dependency

Internal energy markets, including improving interconnectivity, transmission infrastructure, competitively priced and involvement-oriented consumer policy and alleviating energy poverty

Research, innovation and competitiveness, including the contribution to private research and innovation, and the deployment of low-carbon technologies

** In line with the approach chosen in the framework of the Governance Regulation.*

Part III: Reporting economic potential of efficient and renewable heating and cooling technologies identified during the CBA

YEAR X+30

	TOTAL	Residential*	Services*	Industry*	Other*
	GWh/a	GWh/a	GWh/a	GWh/a	GWh/a
Industrial waste heat					
Industrial waste cold					
Waste incineration					
High efficiency CHP					
Renewable energy sources					
Geothermal					
Biomass					
Solar thermal					
Other RES					
Heat pumps					
Heat loss reduction in existing DHC networks					

* To be reported only if sectoral data is available.

Part IV: Overview of potential new strategies and policy measures

Short description of potential new strategy or policy measure	Main objective of new strategy or policy measure	Foreseen greenhouse gas emission reductions	Primary energy savings, GWh/a	Impact on the share of high-efficiency cogeneration	Impact on the share of renewables in the national energy mix and in the heating and cooling sector	Links to national financial programming and cost savings for the public budget and market participants	Estimated public support measures, if any, with their annual budget and identification of the potential aid element