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of 2 September 2024

setting out guidelines for the interpretation of Article 26 of Directive (EU) 2023/1791 of the European Parliament and of the Council as regards the heating and cooling supply

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 292 thereof,

Whereas:

(1) Directive 2012/27/EU of the European Parliament and of the Council ([1]) introduced a requirement to achieve the headline target of at least 32,5 % energy savings at Union level by 2030.

(2) In its Staff Working Document SWD(2013)0449 of 6 November 2013 ([2]), the Commission provided guidance to the Member States for transposing and implementing Article 14 of Directive 2012/27/EU on promotion of efficiency in heating and cooling. The Commission clarified the provisions on comprehensive assessment of the potential for the application of high efficiency cogeneration and efficient district heating and cooling, the installation-level cost-benefit analysis and authorisation and equivalent permit procedures for installations subject to cost-benefit analyses. Annex VIII to Directive 2012/27/EU on assessing the potential for efficiency in heating and cooling was replaced by Commission Delegated Regulation (EU) 2019/826 ([3]). The new requirements were further explained in Commission Recommendation (EU) 2019/1659 ([4]).

(3) Directive (EU) 2023/1791 of the European Parliament and of the Council ([5]) was adopted on 13 September 2023. It recasts Directive 2012/27/EU, keeping some of its provisions unchanged while, at the same time, introducing some new requirements. In particular, it significantly raised the level of ambition for 2030 in terms of energy efficiency, including on the energy efficiency in heating and cooling supply.

(4) High-efficiency cogeneration and efficient district heating and cooling can provide significant primary energy savings in the Union and benefits for the climate. Therefore, Directive (EU) 2023/1791 increased the requirements for the high-efficiency cogeneration and efficient district heating and cooling. Through additional planning requirements, operators of the district heating and cooling systems having a total output exceeding 5 MW are required to have a plan to convert their systems into efficient district heating and cooling systems.

(5) Wider energy system integration is another extensively untapped source of energy savings. The cost-benefit analysis of heat and cold supply originating from waste heat or cold released by large fuel and electricity users helps to identify new solutions to cover heat or cold demand locally or in district heating or cooling networks. Wider use of the waste heat in district heating and cooling networks helps to meet the requirements of Directive (EU) 2023/1791 regarding district heating systems.

([1]) Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (OJ L 315, 14.11.2012, p. 1, ELI: http://data.europa.eu/eli/dir/2012/27/oj).

([2]) Commission Staff Working Document SWD(2013) 0449 final, 6.11.2013, 'Guidance note on Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EC, and repealing Directives 2004/8/EC and 2006/32/EC Article 14: Promotion of efficiency in heating and cooling'; https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013SC0449.

([3]) 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 (OJ L 137, 23.5.2019, p. 3, ELI: http://data.europa.eu/eli/reg_del/2019/826/oj).

([4]) Commission Recommendation (EU) 2019/1659 of 25 September 2019 on the content of the comprehensive assessment of the potential for efficient heating and cooling under Article 14 of Directive 2012/27/EU (OJ L 275, 28.10.2019, p. 94, ELI: http://data.europa.eu/eli/reco/2019/1659/oj).

([5]) Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (OJ L 231, 20.9.2023, p. 1, ELI: http://data.europa.eu/eli/dir/2023/1791/oj).

(6) Several provisions of Directive (EU) 2023/1791 on heating and cooling supply are of a technical nature, in particular the meaning of technical parameters. Their content deserves additional clarification about their interpretation. In order to ensure a more harmonised approach in the Member States, the technical aspects of implementing Article 26 should be pointed out together with possible solutions.

(7) In its Decision 2008/952/EC ([6]), the Commission established detailed guidelines for the implementation and application of Annex II to Directive 2004/8/EC of the European Parliament and of the Council ([7]), including an explanation of a calculation of the electricity from cogeneration. Since Directive 2004/8/EC is no longer in force, its Annex II has become Annex II to Directive (EU) 2023/1791, however the guidance document pursuant to Decision 2008/952/EC is still valid.

(8) Member States are to bring into force the laws, regulations and administrative provisions transposing Article 26 of Directive (EU) 2023/1791 by 11 October 2025, except its paragraph 3 which has an earlier transposition deadline.

(9) Member States can choose at their discretion the way of transposing and implementing the requirements regarding the efficiency in heating and cooling supply, that is best suited to their national circumstances. In this context, it would be recommended to interpret the relevant provisions of Directive (EU) 2023/1791 in a consistent way which would contribute to a coherent understanding of Directive (EU) 2023/1791 across Member States as they prepare their transposition measures.

(10) Moreover, this Recommendation should provide guidance on the interpretation of those provisions of Directive (EU) 2023/1791 that have been amended in comparison with Directive 2012/27/EU. It should therefore be read alongside the detailed guidelines established by Decision 2008/952/EC, Staff Working Document SWD(2013)0449 and complement them,

HAS ADOPTED THIS RECOMMENDATION:

Member States should follow the interpretative guidelines in the Annex to this Recommendation when transposing Article 26 of Directive (EU) 2023/1791 in their national law.

Done at Brussels, 2 September 2024.

For the Commission
Kadri SIMSON
Member of the Commission

([6]) Commission Decision 2008/952/EC of 19 November 2008 establishing detailed guidelines for the implementation and application of Annex II to Directive 2004/8/EC of the European Parliament and of the Council (OJ L 338, 17.12.2008, p. 55, ELI: http://data.europa.eu/eli/dec/2008/952/oj).

([7]) Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC (OJ L 52, 21.2.2004, p. 50, ELI: http://data.europa.eu/eli/dir/2004/8/oj).

ANNEX

1. **INTRODUCTION**

These guidelines provide guidance to Member States on how to interpret Article 26 of Directive (EU) 2023/1791 when transposing it into their national legislation. They are intended purely for the purposes of transposing and implementing of Directive (EU) 2023/1791, and do not provide interpretation in the context of other legal acts. Article 26 of Directive (EU) 2023/1791 replaces Article 14 of Directive 2012/27/EU. Article 26 of Directive (EU) 2023/1791 addresses heating and cooling ('H&C') supply and the efficiency of district heating and cooling ('DHC').

Nonetheless, the binding interpretation of Union legislation is the exclusive competence of the Court of Justice of the European Union.

2. **LEGAL AND POLICY CONTEXT**

Article 26 of Directive (EU) 2023/1791 encourages the conversion towards a clean and carbon-neutral H&C supply. To reach the Union's energy and climate goals, the H&C sector must sharply reduce its energy consumption and its use of fossil fuels as in 2022, only 24,9 % of the energy used for H&C originated from renewable energy sources (RES) ([1]).

Article 26 of Directive (EU) 2023/1791 is closely linked to some of the requirements set out by the following legal acts of the Union:

— **Directive (EU) 2018/2001 of the European Parliament and of the Council** ([2]) ('Renewable Energy Directive' or 'RED') – with regard to DHC provisions, Articles 23 and 24 of the RED are relevant. In the RED, targets are set for the share of renewables and waste heat and cold. Member States are required to encourage DHC operators to connect third parties. Member States are also required to put in place a coordination framework to facilitate the use of waste heat and cold. The review of the definition of efficient DHC under Directive 2012/27/EU is an important complement to the review of the DHC provisions in the RED. The RED specifies conditions for exemptions on disconnection, network access and the indicative annual average renewable energy's share increase requirement at Member State level, while Directive (EU) 2023/1791 focuses on the share of renewable energy sources only at a single DHC system level;

— **Directive (EU) 2019/944 of the European Parliament and of the Council** ([3]) – Article 8 of that Directive is relevant for the authorisation procedure referred to in Article 26(9) of Directive (EU) 2023/1791;

— **Directive (EU) 2024/1275 of the European Parliament and of the Council** ([4]) ('Energy Performance of Buildings Directive' or 'EPBD') – for the DHC, EPBD provisions on integration of solar energy in buildings (Article 10) and requirements for zero-emission buildings (Article 11) are the most relevant. Heating or cooling supply from efficient DHC can cover total annual primary energy use of a new or renovated zero-emission building;

— **Commission Delegated Regulation (EU) 2015/2402** ([5]) – Provides reference values to calculate primary energy savings from high-efficiency cogeneration, as referred to in Article 26(13) of Directive (EU) 2023/1791.

([1]) Eurostat, 2024: https://doi.org/10.2908/NRG_IND_REN.

([2]) 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, ELI: http://data.europa.eu/eli/dir/2018/2001/oj).

([3]) Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (OJ L 158, 14.6.2019, p. 125, ELI: http://data.europa.eu/eli/dir/2019/944/oj).

([4]) Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast) (OJ L, 2024/1275, 8.5.2024, ELI: http://data.europa.eu/eli/dir/2024/1275/oj).

([5]) Commission Delegated Regulation (EU) 2015/2402 of 12 October 2015 reviewing harmonised efficiency reference values for separate production of electricity and heat in application of Directive 2012/27/EU of the European Parliament and of the Council and repealing Commission Implementing Decision 2011/877/EU (OJ L 333, 19.12.2015, p. 54, ELI: http://data.europa.eu/eli/reg_del/2015/2402/2024-01-01).

Furthermore, the Article 26 of Directive (EU) 2023/1791, and specifically the way in which efficient DHC and high-efficiency cogeneration are regulated, impacts other legal acts and guidelines on the Union level. These legal acts and guidelines are related to the eligibility of projects and installations for public funding, as those installations not complying with Article 26 of Directive (EU) 2023/1791 may be excluded on certain conditions. This concerns acts such as Guidelines on State aid for climate, environmental protection and energy ([6]), Regulation (EU) 2023/1315 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty ([7]) ('General Block Exemption Regulation' or 'GBER'), Council Directive 2003/96/EC ([8]) and legislation governing the use of cohesion funds and the Recovery and Resilience Facility.

With regards to the Recovery and Resilience Facility, the Commission published the 'Guiding template: District heating/cooling generation and distribution infrastructure' ([9]). It specifies that state aid 'shall only be granted for investments in the construction, extension or upgrade of district heating and/or cooling systems that are or are to become energy efficient' (paragraph 54) as regulated in Directive (EU) 2023/1791.

Heating or cooling supply from efficient DHC is also supported from cohesion funds. Regulation (EU) 2021/1060 of the European Parliament and of the Council ([10]) ('Common Provisions Regulation') foresees in its Annex I specific codes for the types of intervention for the European Regional Development Fund, European Social Fund Plus, Cohesion Fund and Just Transition Fund. In the Common Provisions Regulation, two intervention codes are applicable for district heating projects: code '054' for district heating and cooling, and code '055' for efficient DHC with low lifecycle emissions. The second one is linked to a higher coefficient for the calculation of support to climate change objectives, and thus contributes more to the Member States obligations in terms of climate concentration laid down in the Common Provisions Regulation. However, in the limited scope of cohesion policy as expressed in the Common Provisions Regulation, the definition of intervention code '055', which is applicable to obtain a higher climate coefficient, still refers to the definition of efficient DHC contained in Article 2(41) of Directive 2012/27/EU.

In addition, Article 26 is interlinked with other provisions of Directive (EU) 2023/1791, namely:

— Article 2: see the definitions discussed in Chapter 3 of this Annex.

— Article 11: Member States have the option of requiring in the energy audits an assessment of the technical and economic feasibility of connection to an existing or planned district heating or cooling network;

— Article 25: an obligation of Member States to notify a comprehensive heating and cooling assessment as a part of its integrated National Energy and Climate Plan and its updates;

— Article 30: an obligation of Member States to promote the establishment of financial support schemes to increase the uptake of energy efficiency improvement measures for the substantial refurbishment of district heating and cooling systems.

Article 26 of Directive (EU) 2023/1791 is composed of the following **main provisions**:

— an update of **the criteria to be met by efficient DHC ('Efficient District Heating and Cooling' or EDHC)**, which establishes a clear step-by-step approach to increase energy efficiency and the decarbonisation of heat and cold supply (Article 26(1));

([6]) Communication from the Commission – Guidelines on State aid for climate, environmental protection and energy 2022 (OJ C 80, 18.2.2022, p. 1, https://eur-lex.europa.eu/legal-content/EN/TXT/?toc=OJ:C:2022:080:TOC&uri=uriserv:OJ.C_.2022.080.01.0001.01.ENG).

([7]) Commission Regulation (EU) 2023/1315 of 23 June 2023 amending Regulation (EU) No 651/2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty (OJ L 167, 30.6.2023, p. 1–90, ELI: http://data.europa.eu/eli/reg/2023/1315/oj).

([8]) Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity (OJ L 283, 31.10.2003, p. 51, ELI: http://data.europa.eu/eli/dir/2003/96/oj).

([9]) Recovery and Resilience Facility – State Aid (https://competition-policy.ec.europa.eu/system/files/2023-04/template_RRF_district_heating_and_cooling_04042023.pdf).

([10]) Regulation (EU) 2021/1060 of the European Parliament and of the Council of 24 June 2021 laying down common provisions on the European Regional Development Fund, the European Social Fund Plus, the Cohesion Fund, the Just Transition Fund and the European Maritime, Fisheries and Aquaculture Fund and financial rules for those and for the Asylum, Migration and Integration Fund, the Internal Security Fund and the Instrument for Financial Support for Border Management and Visa Policy (OJ L 231, 30.6.2021, p. 159–706, ELI: http://data.europa.eu/eli/reg/2021/1060/oj).

— an **alternative approach to meeting the EDHC criteria** set by Article 26(1), which Member States might opt for, which uses sustainability performance criteria based on the amount of GHG emissions from the DHC per unit of heat or cold delivered to customers (Article 26(2) and (3)) ([11]);

— additional conditions for a situation in which an EDHC is built or an existing DHC is converted into EDHC (Article 26(4));

— **mandatory transformation plans as from 1 January 2025 for existing DHC not complying with the requirements of EDHC**, to ensure more efficient consumption of primary energy, reduce distribution losses and increase the share of renewable energy in H&C supply (Article 26(5));

— an obligation for Member States to ensure that **data centres** with a total rated energy input exceeding 1 MW utilise the waste heat or other waste heat recovery applications unless it is not technically or economically feasible (Article 26(6));

— requirements for an installation-level **cost-benefit analysis** (CBA) to be carried out where new installations or substantial refurbishments are planned in order to assess the economic feasibility of increasing energy efficiency of H&C supply (Article 26(7));

— a possibility for Member States to also **exempt specific installations** from mandatory CBA (Article 26(8)).

The provisions in Article 26(9) to (14) of Directive (EU) 2023/1791 did not change when compared to Article 14 of Directive 2012/27/EU, except Article 26(12) on collecting the information on the performed CBAs.

In terms of chronological order, the requirements set out in Article 26 of Directive (EU) 2023/1791 are to be applied or completed as follows:

Table 1

Deadlines of transposing requirements of Directive (EU) 2023/1791

Paragraph	Requirement	Deadline
Article 26(1)	EDHC shall use at least 50 % renewable energy, 50 % waste heat, 75 % cogenerated heat or 50 % of a combination of such energy and heat	Until 31 December 2027
	EDHC shall use at least 50 % renewable energy, 50 % waste heat, 50 % renewable energy and waste heat, 80 % of high-efficiency cogenerated heat or at least a combination of such thermal energy going into the network where the share of renewable energy is at least 5 % and the total share of renewable energy, waste heat or high-efficiency cogenerated heat is at least 50 %	From 1 January 2028
	EDHC shall use at least 50 % renewable energy, 50 % waste heat, or 50 % renewable energy and waste heat, or a system, where the total share of renewable energy, waste heat or high-efficiency cogenerated heat is at least 80 % and in addition the total share of renewable energy or waste heat is at least 35 %	From 1 January 2035

([11]) Regarding the promotion of energy efficiency, the alternative criteria (Article 26(2) and (3)) directly promote energy efficiency thanks to the fact that they consider the delivery to customers (and therefore integrate network losses). However, it should be noted that also the default criteria of EDHC (Article 26(1), indirectly lead to higher energy efficiency through the higher share of renewable or other potential low temperature heat sources (which are driving higher performance) as they concern the H&C injected into the network.

Paragraph	Requirement	Deadline
	EDHC shall use at least 75 % renewable energy, 75 % waste heat or 75 % renewable energy and waste heat, or a system using at least 95 % renewable energy, waste heat and high-efficiency cogenerated heat and in addition the total share of renewable energy or waste heat is at least 35 %	From 1 January 2040
	EDHC shall use at least 75 % renewable energy, 75 % waste heat or 75 % renewable energy and waste heat	From 1 January 2045
	System using only renewable energy, only waste heat, or only a combination of renewable energy and waste heat	From 1 January 2050
Article 26(2)	A notification to the Commission to use sustainability performance criteria to define EDHC	11 January 2024
	Max amount of GHG/unit: 200 grams/kWh	Until 31 December 2025
	A notification to the Commission to use sustainability performance criteria to define EDHC	30 June 2025
	Max amount of GHG/unit: 150 grams/kWh	From 1 January 2026
	A notification to the Commission to use sustainability performance criteria to define EDHC	30 June 2034
	Max amount of GHG/unit: 100 grams/kWh	From 1 January 2035
	A notification to the Commission to use sustainability performance criteria to define EDHC	30 June 2044
	Max amount of GHG/unit: 50 grams/kWh	From 1 January 2045
	A notification to the Commission to use sustainability performance criteria to define EDHC	30 June 2049
	Max amount of GHG/unit: 0 grams/kWh	From 1 January 2050
Article 26(5)	Planning to become EDHC	From 1 January 2025
Article 26(8)	Notification of the exemptions adopted under paragraph 8	When exemptions are adopted
Article 26(10)	Notification of the exemptions granted to individual installation declining to implement measures with a positive cost-benefit outcome identified in the cost-benefit analysis	Three months after the exemptions are granted
Annex III	New and substantially refurbished high-efficiency cogeneration (HECHP) units must meet the GHG emission threshold of less than 270 gCO_2/kWh	12 October 2025
	All HECHP units must meet the GHG emission threshold of less than 270 gCO_2/kWh	From 1 January 2034

3. OBLIGATIONS RELATED TO ENERGY EFFICIENCY IN HEATING AND COOLING IN ARTICLE 26 OF DIRECTIVE (EU) 2023/1791

3.1. Criteria of EDHC (default and alternative approach): Article 26(1) and (2) of Directive (EU) 2023/1791

3.1.1. *Scope of the requirements, relevant definitions and terms*

The obligations arising from Article 26(1), (2) and (3) of Directive (EU) 2023/1791 apply to DHC systems and to their operators. Some of the terms used in Article 26 are clearly defined in Article 2 of Directive (EU) 2023/1791, but some of the definitions such as DHC require additional clarification, as follows:

Cogeneration

'Cogeneration' (cogeneration of heat and power, CHP), as defined in Article 2, point (36), of Directive (EU) 2023/1791, takes place in units which are, in accordance with Article 2, point (43), installations able to operate in cogeneration mode. That implies, in the Commission's view, that in installations where steam is used in parallel for multiple processes including CHP, only process involving simultaneous generation of thermal energy and electrical or mechanical energy can be considered as CHP.

High-efficiency cogeneration

Article 2, point (40), of Directive (EU) 2023/1791 and Annex III thereto set out the definition of 'high-efficiency cogeneration' (HECHP). For CHP to qualify as an HECHP plant, it needs to save 10 % ([12]) primary energy compared to separate heat and electricity production and meet the specific emissions and fuel use criteria of Annex III.

District heating and cooling

'District heating and cooling' (DHC) is defined by the Renewable Energy Directive ([13]) and the Energy Performance of Buildings Directive ([14]). However, it is recommended to use the same principles for the definition of DHC as set out in earlier guidelines for the implementation of Directive 2012/27/EU. In accordance with the reporting instructions for completing the DHC template pursuant to Article 24(6) of Directive 2012/27/EU provided by Eurostat ([15]), the thermal energy that is to be counted as heat or cold from a DHC network must be:

— produced in a site other than the one where it is consumed;

— sold (as reported in the Annual Electricity and Heat Questionnaire) to either of the following:

  — multiple buildings owned or occupied by at least two different customers;

  — multiple sites owned by at least two different customers.

DHC operator

In the Commission's view, a 'DHC operator' should be understood as a private or public company that owns and operates a DHC network and distribution system which delivers heat or cold to end users.

Building

The Commission considers that a 'building' should be defined in the same way as in Article 2(1) in the EPBD, namely 'a roofed construction having walls, for which energy is used to condition the indoor environment'.

([12]) For small-scale and micro-cogeneration units having capacity equal to or less than 1 MW_{el}, any primary energy savings are acceptable.

([13]) Article 2, point (19), of the RED defines DHC as the 'distribution of thermal energy in the form of steam, hot water or chilled liquids, from a central or decentralised source of production through a network to multiple buildings or sites, for the use of space or process heating or cooling'.

([14]) Article 2, point (50), of the EPBD defines: 'district heating' or 'district cooling' means the distribution of thermal energy in the form of steam, hot water or chilled liquids, from a central or decentralised source of production through a network to multiple buildings or sites, for the use of space or process heating or cooling.

([15]) Reporting instructions for completing the district heating and district cooling template for data reporting under Article 24(6) of Directive 2012/27/EU (https://ec.europa.eu/eurostat/documents/38154/42195/Reporting-instructions-DH-DC.pdf/0e62bb06-2a29-478f-87bd-b4625d2d8f40); Article 24(6) in Directive 2012/27/EU corresponds to Article 35(3) of Directive (EU) 2023/1791.

Site

'Site' is not defined in Union legislation but should be understood as a defined space that includes buildings or any other facility involving an economic activity such as industrial processes or services.

3.1.2. *Default approach to the criteria of EDHC*

To deliver on the objectives of ensuring more efficient consumption of primary energy and increasing the share of renewable energy in heating and cooling supply going into the DHC network, Article 26(1) of Directive (EU) 2023/1791 lays down a common methodology for assessing whether a DHC system is 'efficient', based on the share of renewable energy, waste heat and (high-efficiency) cogeneration ((HE)CHP). The criteria are based on thermal energy going into the network and therefore concern thermal energy on the supply side at the point of injection (after conversion by the heat/cold generation unit).

The purpose of criteria for EDHC is to ensure that DHC systems contribute to the long-term climate policy goals and energy efficiency targets. To achieve this, EDHC systems need to increase the efficiency of primary energy consumption by using efficient energy generation technologies or integrating waste heat. Also, the share of renewable energy should be gradually increased in EDHC systems to reduce greenhouse gas emissions.

The shares of renewable energy, waste heat and heat from the (HE)CHP plant going into the network determine whether a DHC system is 'efficient'. In the default approach, requirements for the EDHC are tightened in five consecutive steps: in 2028, in 2035, in 2040, in 2045 and in 2050. Key effects of this schedule are:

— until 2035, the EDHC status can be met through HECHP only, or a combination of a 5 % share of RES and 45 % of HECHP, renewable energy and/or waste heat;

— from 1 January 2035 onwards, systems using only fossil fuels cannot be qualified as EDHC;

— from 2035 to 2045, 35 % of the heat supplied in EDHC should originate from RES and waste heat. HECHP can still contribute up to 45 % until 2040 and 60 % until 2045, while the share of CHP not meeting the criteria for HECHP is reduced;

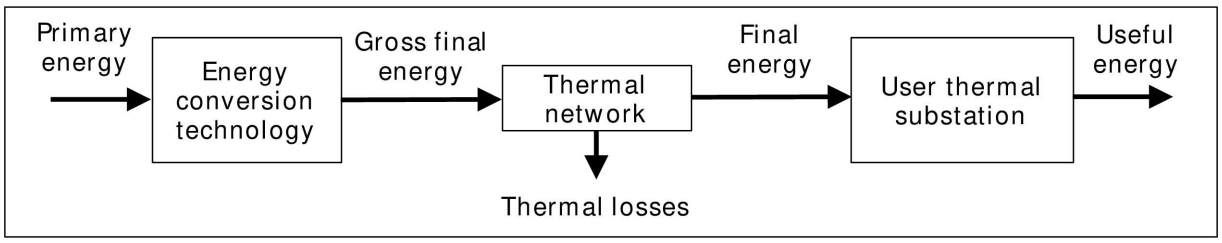
— from 2045 onwards EDHC systems must include at least 75 % renewable energy and waste heat and HECHP stops counting towards meeting the criteria;

— from 2050 all the input to EDHC must be from renewable energy or waste heat.

The share of renewable energy, waste heat and heat from the (HE)CHP plant going into the network are measured at the handover point between the energy conversion technology and the network. In Figure 1, the energy going into the network is called 'gross final energy'.

Figure 1

Nomenclature of energy flows in DHC networks.



Source: JRC ([16]).

'Renewable energy' is defined in Article 2, point (1), of the RED. It includes energy generated from wind, solar (thermal and solar photovoltaic) and geothermal energy, osmotic energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogas.

([16]) Efficient District Heating and Cooling, JRC 2021 (https://publications.jrc.ec.europa.eu/repository/handle/JRC126522).

However, given the need to ensure a level playing field in district heating systems for all renewable energy supply options, all the heat supply from heat pumps needs to be accounted when assessing the compliance with the EDHC criteria in the context of the relevant articles of Directive (EU) 2023/1791 ([17]). To this end, recital 107 of Directive (EU) 2023/1791 establishes that all the heat generated by a heat pump should be counted under Directive (EU) 2023/1791 as renewable energy provided that the heat pump meets the minimum efficiency criteria set out in Annex VII to RED at the time of its installation.

To ensure consistency regarding the requirements on the use of biomass and biofuels it is strongly advised to count towards the renewable energy threshold only biomass and biofuels that achieve the sustainability criteria of the RED. Otherwise, the proliferation of sustainable biomass and biofuels might be hindered through, for example, a lower rate of cost decreases.

Efficient DHC systems should increase efficiency of primary energy use and the progressive integration therein of renewable and waste heat and cold. 'Waste heat and cold' is defined in Article 2, point (9) of the RED as unavoidable heat or cold generated as by-product in industrial or power generation installations, or in the tertiary sector, which would be dissipated unused in air or water without access to a DHC system, where a cogeneration process has been used or will be used or where cogeneration is not feasible ([18]). This definition should be used for the provisions of Directive (EU) 2023/1791 related to efficient district heating and cooling ([19]), in view of the objective of Article 26 of Directive (EU) 2023/1791 to ensure more efficient consumption of primary energy and maximising the reuse and recovery of waste heat.

Heat from CHP (or HECHP) is counted towards the thresholds specified in the EDHC criteria when it originates from the installations compatible with the definitions of the CHP (or HECHP) provided in Article 26(1), points (a) to (d) of Directive (EU) 2023/1791.

The methodology to identify EDHC should follow a 3-step approach as presented with further details in Appendix A.

3.1.3. *Alternative approach to the definition of EDHC*

In addition to the criteria of EDHC based on the shares of energy supplies, Article 26(2) and (3) of Directive (EU) 2023/1791 set out an alternative approach based on GHG emissions per unit of heat or cold delivered to customers. To apply that alternative approach, GHG emissions and the amount of heat or cold delivered to customers should be known in order to calculate the emissions factors per unit of energy.

The emissions to be covered in checking the compliance with the criteria of EDHC are those which are directly related to the generation of heat and cold, for example, through the combustion of an energy carrier. In the Commission's view, emissions from indirect emission sources, such as those arising through the production or storage of the energy carrier, are excluded.

The amount of heat or cold delivered to customers includes each unit of heat or cold delivered to customers, typically measured through a metering system. For the purposes of Article 26(2) of Directive (EU) 2023/1791, energy amount delivered to customers are to be measured and reported in kWh. In Figure 1, such energy amount is referred to as 'final energy'. Final energy can significantly differ from gross final energy due to distribution losses, which may increase the emission intensity per delivered unit.

The methodology to identify EDHC should follow a 5-step approach as presented in Appendix B.

([17]) For the purpose of the targets specified in the RED, and according to its Article 7(3), third subparagraph, only ambient and geothermal energy used for heating and cooling by means of heat pumps and district cooling systems is to be taken into account for the targets specified in the RED.

([18]) See Recital 105 of Directive (EU) 2023/1791.

([19]) However, in relation to other provisions on waste heat in Article 26, namely in paragraphs 6 to 8 and 14, a wider set of energy flows needs to be considered as waste heat, and in particular the requirement that it can only be considered as waste heat if it is sent to a district heating or cooling system, should not be required. This acknowledges the broader purpose of waste heat recovery in the overall context of Directive (EU) 2023/1791, that is to avoid that heat streams are dissipated and ensure optimisation of the energy system. See Recital 105 of Directive (EU) 2023/1791.

3.1.4. *Different uses of the EDHC criteria and possible related policy options*

Article 26(1), (2) and (3) of Directive (EU) 2023/1791 do not set out the cases in which the criteria of EDHC are to be applied. Instead, the use of the criteria is set out in other provisions of Article 26 of Directive (EU) 2023/1791, particularly in paragraphs (4) and (5). Additional guidance for such cases is provided in Section 3 of this Annex.

In addition to the mandatory application of the criteria provided for in Article 26(1) and (2) of Directive (EU) 2023/1791, there are several opportunities to use the criteria of EDHC at Member States' level. They are not mandatory and depend on the specific implementation by each Member State.

Member States may support EDHC systems provided such support complies with State aid rules or General Block Exemption Regulation, and is also in line with the legislation governing and guidelines provided on the use of Cohesion Policy funds or Recovery and Resilience Facility. When providing support to EDHC systems, it is important to establish a mechanism to ensure ongoing compliance with the criteria, for example by conducting *ad hoc* controls or audits at the facilities of the DHC system in order to verify the energy mix the system is supplied with.

Member States may promote voluntary commitments to maintain the standard of EDHC by DHC operators. For that purpose, in the Commission's view, certificates or labels for EDHCs, requiring a complete monitoring, reporting and verification scheme, could be established. That would increase public exposure of efficient DHC systems, possibly leading to expanding market shares of such systems, and thereby contributing to meeting the headline targets for energy and emission savings.

3.2. **Applying the definition of EDHC to the newly built and refurbished DHC systems: Article 26(4) of Directive (EU) 2023/1791**

3.2.1. *Relevant definitions and terms*

Article 2, point (50), of Directive (EU) 2023/1791 defines **'substantial refurbishment'** as a refurbishment the cost of which exceeds 50 % of the investment cost for a new comparable unit. The definition of substantial refurbishment only addresses the cost of the refurbishment and does not address the types of works that can be considered as refurbishment. Typically, a DHC system refurbishment project includes two types of costs, as follows, which both should be taken into account in the assessment ([20]):

— costs related to technical aspects such as the integration of new technologies, the optimisation of existing technologies and the replacement of worn-out equipment and components;

— costs related to non-technical aspects, such as project management, stakeholders' consultations, financial viability analysis, permitting procedures, monitoring, compliance with national, regional and local regulations and policies.

The '**investment cost of a new comparable unit**' could be understood as the total investment cost of a completely new DHC system, including:

— the generation units, to comply with the EDHC criteria set out in Article 26(1) or (2) of Directive (EU) 2023/1791;

— the network, including storage and distribution infrastructure;

— the delivery at all similar points of consumption (including all heat exchangers if they must be replaced).

Given the broad range of refurbishment costs and given the fact that they are network-specific, Member States need to clearly establish who is responsible for estimating such costs and possibly how they have to be estimated. Appendix C sets out a list of suggested eligible costs and a methodology for quantifying them.

([20]) Upgrading the performance of district heating networks: A Handbook (https://www.upgrade-dh.eu/images/Publications%20and%20Reports/D2.5_2019-07-02_Upgrade-DH_Handbook_EN.pdf).

3.2.2. *Qualification of a DHC system as an EDHC system*

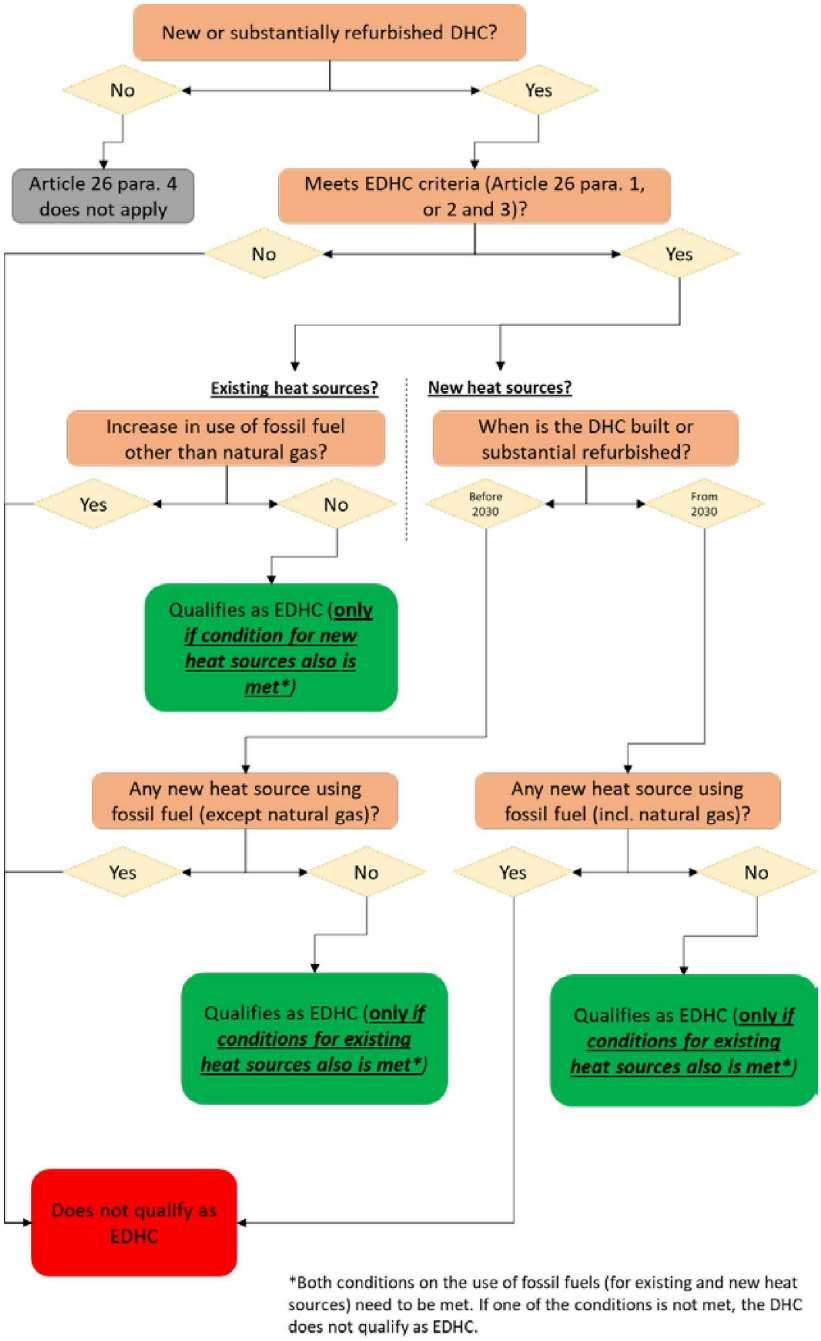
Article 26(4) of Directive (EU) 2023/1791 steers investments made by Member States towards the construction of new or a substantial refurbishment of a DHC system and/or their supply units. Where the conditions set out by Article 26(4) of Directive (EU) 2023/1791 are met, the results of the investments should qualify as EDHC.

To ensure implementation of Article 26(1) and (2) in refurbished DHC systems, Member States should assess whether the refurbishment is substantial or not. In the Commission's view, this can be done also by DHC operators.

Figure 2 illustrates the workflow to assess whether an installation qualifies as EDHC after the refurbishment and the links between the provisions of Article 26(1), (2) or (3) of Directive (EU) 2023/1791 and the conditions set out in Article 26(4) of that Directive.

Figure 2

Flowchart of the procedure to categorise district heating or cooling system



In order to qualify as EDHC (for example to be eligible for public support), Member States are to ensure that where a DHC system is built or its supply units are substantially refurbished, they meet both the following conditions:

Condition 1: the DHC system meets the criteria set out in Article 26(1) or (2) of Directive (EU) 2023/1791 applicable at the time when it starts or continues its operation after the refurbishment;

Condition 2: there is no increase in the use of fossil fuels other than natural gas in existing heat sources, and any new sources in that system do not use fossil fuels, except natural gas if the DHC is built or substantially refurbished until 2030.

Those two conditions must be met by all DHC systems aiming to qualify as an EDHC, regardless of their size. Member States may require that DHC operators are responsible for ensuring that the two conditions are met, which will also require the support from heat producers (operators of the generation units) and end users to collect the necessary data.

To ensure both conditions are met, Member States should include them as eligibility criteria for public funding and/or support. The eligibility should be verified via a compliance assessment, which consists of at least the following one or two steps depending on whether the system is new or substantially refurbished:

Step 1 (for refurbished systems only): assess whether the refurbishment is substantial.

Step 2 (for all systems applying for public support): verify compliance with the two conditions set out by Article 26(4) of Directive (EU) 2023/1791.

In **Step 1**, the assessment should consist in estimating and comparing the following two cases:

Case 1: *Ex ante* (before the refurbishment works have started) estimation of the total refurbishment costs of the DHC system or heat supply unit.

Case 2: Estimation of the investment costs of a new comparable DHC system or heat supply unit.

The refurbishment level of the system or the heat supply unit is substantial when the refurbishment costs of DHC heat supply unit or DHC system exceed 50 % investment costs of new comparable DHC heat supply unit or DHC system. If the refurbishment level is considered as 'substantial', DHC operators applying for public support should ensure compliance with efficient DHC criteria and continue with Step 2.

In **Step 2**, compliance with criteria on the use of fossil fuels is assessed. The verification of compliance with EDHC criteria could be made in accordance with the methodology set out in section 3.1.2 or 3.1.3 of this Annex.

The methodology to assess the compliance with criteria on the use of fossil fuels is different for new and existing heat sources. For existing heat sources, Member States should ensure that there is no increase in the use of fossil fuels other than natural gas compared to the annual consumption averaged over the previous three calendar years of full operation before refurbishment. For new heat sources, Member States should ensure that they do not use fossil fuels, except natural gas, until 2030.

Where public support is provided to DHC through an open call, the methodology for conducting a compliance assessment with the EDHC criteria should be transparent and clearly described in the public support application procedure.

3.3. Mandatory planning to increase efficient use of primary energy and renewable energy use: Article 26(5) of Directive (EU) 2023/1791

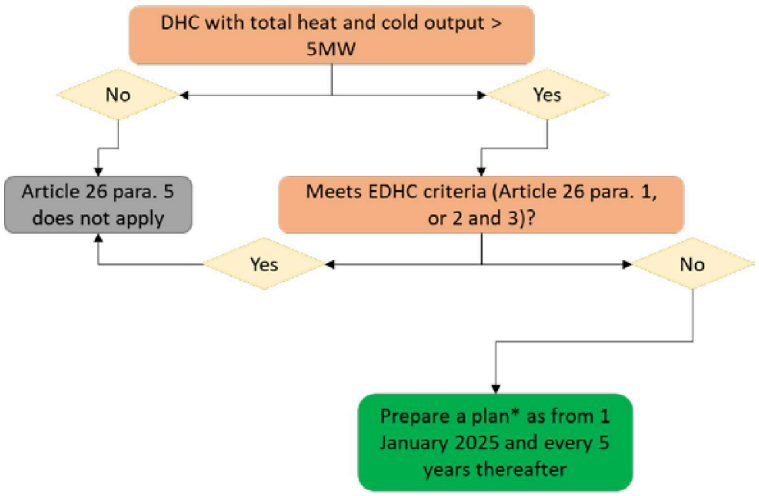
3.3.1. *Scope of the requirements, relevant definitions and terms*

Article 26(5) of Directive (EU) 2023/1791 requires Member States to ensure that a DHC system above a specific threshold, that is to say heat and cold output exceeding 5 MW, is to either meet the criteria of EDHC set out in Article 26(1) of Directive (EU) 2023/1791, or prepare a plan to ensure more efficient consumption of primary energy, to reduce distribution losses and increase the share of and renewable energy or waste heat and cold in H&C supply. The purpose of the plan is to provide measures to meet the criteria set out in Article 26(1), points (b) to (e).

Parties concerned by Article 26(5) are DHC operators with support from the main heat and/or cold suppliers. Figure 3 illustrates the necessary steps and identification of parties subject to planning obligation.

Figure 3

Flowchart of the procedure to identify a need to prepare a plan to convert the system into efficient district heating and cooling system



The term '**total heat and cold output**' should be interpreted as a capacity rather than an energy volume, as it should be compared to a 5 MW threshold which refers to a heat/cold capacity. That threshold of total heat and cold output exceeding 5 MW does not specify which capacity should be considered, as it does not specify the measurement point. To operationalise that indicator, it is recommended to use the installed capacity of all heat generation units injecting into the DHC system. Importantly, heat generation capacity only used at times of peak demand, that is to say less than a few hours per year, yet permanently connected to the DHC system, should be excluded from the calculation.

To ensure the correct application of the term '**total heat and cold output**' in practice, multiple options are available to the Member States. For example, the measurement and calculation could be carried out by independent experts and results could be verified through random and unannounced checks by the competent authority. Furthermore, the verification process can be sped up by a regular monitoring of the energy mix a DHC system is supplied with, for example, through digital metering.

3.3.2. *Establishing which operators are concerned by Article 26(5) of Directive (EU) 2023/1791*

To ensure a common approach to the identification of DHC system operators, two aspects require clarification; the threshold itself and whether the DHC system complies with the criteria set out in Article 26(1), points (b) to (e), of Directive (EU) 2023/1791.

For all DHC systems with a total capacity above 5 MW it should then be verified whether they comply with the criteria set out in Article 26(1), points (b) to (e), of Directive (EU) 2023/1791 or, alternatively, the criteria set out in Article 26(2), points (b) to (e), of that Directive. The verification should follow the methodology presented in section 3.1.2 or 3.1.3 of this Annex. Where the DHC system complies with the EDHC criteria, then no further action is required. Where the DHC does not comply with the EDHC criteria, its operator should prepare a plan to increase efficient use of primary energy and renewable energy use.

3.3.3. *Plan to ensure more efficient consumption of primary energy and renewable energy use*

Pursuant to Article 26(5) of Directive (EU) 2023/1791 the 5-years plans have the objective of increasing efficient use of primary energy and the share of renewable energy, reducing distribution losses and setting out measures to bring the DHC system into compliance with Article 26(1), points (b) to (e), of Directive (EU) 2023/1791.

The plan should provide a long-term perspective for the development of the DHC system to ensure that upgrading operations reinforce each other. For that purpose, it would be desirable the plan would already anticipate the following 5 years.

DHC operators should be recommended to consult relevant stakeholders when drafting the plan, such as the operators of main heat and/or cold generation units, local authorities, technicians and managers employed by the DHC operator, external experts and individuals affected by the upgrading works, customers as well as other local citizens and communities.

It is recommended for the plan to contain at least the following sections:

(a) a description of the current state of the DHC system, regarding supply, network efficiency and demand, including operating temperature;

(b) the future demand and expansion of the network;

(c) the potential of covering current and future demand by renewable energy sources and waste heat;

(d) a specify target state/system (demand and supply), for example which potentials will be exploited and when;

(e) energy efficiency of the entire system: losses, options to decrease the temperature level (depending on the current practice) at demand and network sides;

(f) the establishment of a strategy and individual measures, with timing.

Within each of the sections set out in points (a) and (b), the operators should provide specific and detailed information. The section on policy measures in Appendix D contains further advice on what could be included in the plan to ensure more efficient consumption of primary energy and renewable energy use.

A plan fulfils the requirements of Article 26(5) of Directive (EU) 2023/1791 if the results set out in Appendix E either lead to full compliance with Article 26(1) or, at least, represent significant steps towards such compliance.

Appendix E contains a more detailed description of the contents of a plan.

3.3.4. *Approval of the plans by the competent authority*

The Member States should designate a competent authority for approving the plans of DHC operators. Directive (EU) 2023/1791 does not describe the procedures for such approval and competent authorities should follow the procedures applied in similar administrative tasks on a national or a regional level.

3.4. **Ensuring efficient use of waste heat from data centres: Article 26(6) Directive (EU) 2023/1791**

Article 26(6) of Directive (EU) 2023/1791 requires Member States to ensure utilisation of waste heat or other waste heat recovery applications in data centres with a total rated energy input exceeding 1 MW unless they can show that it is not technically or economically feasible in accordance with the assessment referred to in paragraph 7. In the Commission's view, this obligation applies to all operating data centres above 1 MW threshold where waste heat or other waste heat recovery applications are not currently used. In data centres, where waste heat is not used or there is no other waste heat recovery application, an assessment of potential use of waste heat needs to be done in accordance with the procedure referred to in paragraph Article 26(7) of Directive (EU) 2023/1791.

3.5. Installation level cost-benefit analysis for new or substantially refurbished facilities: Article 26(7) and (8) of Directive (EU) 2023/1791

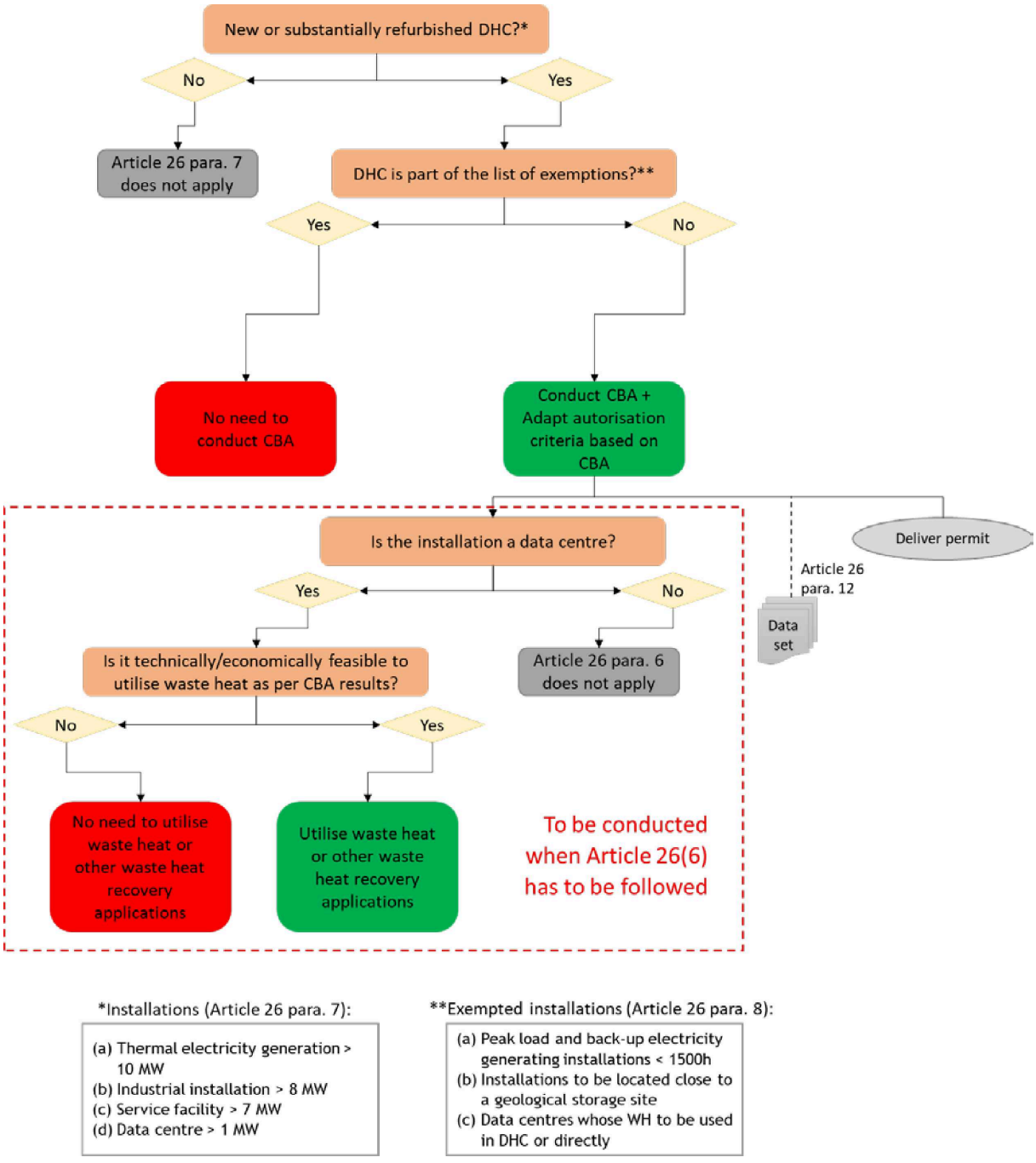
3.5.1. *Scope of the requirements*

Article 26(7) of Directive (EU) 2023/1791 requires Member States to ensure that operators of thermal electricity generation installations, industrial installations, service facilities (such as large commercial buildings, wastewater treatment facilities, electrical substations and LNG facilities) and data centres (as listed in Article 26(7), points (a) to (d), of Directive (EU) 2023/1791) carry out a Cost-Benefit Analysis (CBA). Such analysis are to be carried out when they plan to build new or to substantially refurbish energy production capacities or a facility above a certain energy input threshold (varying per type of installation), to assess the economic feasibility of increasing energy efficiency of H&C supply.

Figure 4 illustrates the necessary steps and identification of parties required to carry out a CBA, including for the data centres according to Article 26(6).

Figure 4

Flowchart to identify the need of a Cost-Benefit Analysis and its procedure



Directive (EU) 2023/1791 does not specify who should be responsible for overseeing and for conducting the CBA. It indicates that Member States are to require the CBA to be carried out in cooperation with the companies responsible for the operation of the facility. A common-sense solution would be to assign the task of carrying out the **analysis to the operators of new or substantially refurbished installations**, while Member States would designate competent authorities responsible for providing the common methodology, assumptions and timeframes for at least the economic analysis and would also ensure that the assessments are well-founded, through a third-party validation, for example.

It is suggested to Member States to choose to be more involved, for example by helping to coordinate with interested parties, such as consumers and H&C producers, or data gathering (as suggested in Annex XI to Directive (EU) 2023/1791). That involvement would have the benefit of creating possibilities of synergies between the comprehensive assessment set out in Annex X to Directive (EU) 2023/1791 and the CBA, set out in Annex XI to Directive (EU) 2023/1791.

Table 2 illustrates that the purpose of the CBA varies according to the type of installation. Whereas Directive 2012/27/EU required to conduct CBA for both heat sources (power plants and industrial installations) and heat sinks (DHC networks), Directive (EU) 2023/1791 only deals with heat sources that recover and transform energy and transfer it to alternative sinks.

Table 2

Applicable thresholds for facilities and installations

Reference in Directive (EU) 2023/1791	Plan for (new or refurbished)	Threshold	Objective of the CBA
Article 26(7), point (a)	Thermal electricity generation installation	Average annual total energy input exceeding **10 MW**	Assess costs and benefits of providing for the operation of the installation as a high-efficiency cogeneration installation.
Article 26(7), point (b)	Industrial installation	Average annual total energy input exceeding **8 MW**	Assess utilisation of waste heat on-site and off-site.
Article 26(7), point (c)	Service facility (e.g., wastewater treatment facilities and LNG facilities)	Average annual total energy input exceeding **7 MW**	Assess utilisation of waste heat on-site and off-site.
Article 26(7), point (d)	Data centre	Total rated energy input exceeding **1 MW**	Assess costs and benefits, including but not limited to technical feasibility, cost-efficiency and impact on energy efficiency and local heat demand (incl. seasonal variation), of utilising the waste heat (from the cooling system) to satisfy economically justified demand and of the connection of that installation to a district heating network or and efficient/renewable energy based district cooling system or other waste heat recovery applications. The CBA is to consider cooling system solutions that allow removing or capturing the waste heat at useful temperature level with minimal ancillary energy inputs.

In the Commission's view, the results of the CBA should also be used to comply with the requirements of Article 26(6) of Directive (EU) 2023/1791, which requires Member States to ensure that data centres with a total rated energy input exceeding 1 MW utilise waste heat or other waste heat recovery applications. If the CBA shows that it is not technically or economically feasible to do so, data centres do not have to utilise the waste heat or other waste heat recovery applications.

Technical feasibility should be understood as depending on the characteristics of the data centre and on the availability of technical or technological solutions to utilise waste heat or other waste heat recovery applications, without compromising the purpose and primary activities of the data centre.

Economic feasibility should be understood as the ability of a project of waste heat or waste heat recovery applications utilisation by a data centre to be economically viable or sustainable, that is to say to generate enough revenue or value to cover its costs and provide a reasonable remuneration of risk and return on investment. In the Commission's view, economic feasibility should take into account factors such as production costs, financing options, risks and the potential for profit or savings.

Table 3 sets out the suggested methodology to determine whether the total energy input of an installation is below or above the threshold set by Article 26(7) of Directive (EU) 2023/1791 that is to say 10 MW for thermal electricity generation installations, 8 MW for industrial installations, 7 MW for service facilities or 1 MW for data centres. Table 3 of this Annex provides a description of how the different production capacities should be calculated/determined. The 'total energy input' should be interpreted as a production capacity rather than an energy volume (measured in MWh), as it should be compared to a given threshold (expressed in MW) which refers to a heat/cold capacity. When addressing total energy input (or production capacity), Article 26(7) of Directive (EU) 2023/1791 should be understood as referring to the production capacity of the installation concerned.

Table 3

Suggested methods to identify input capacity of facilities and installations.

Reference in Directive (EU) 2023/1791	Plan for (new or refurbished)	Method to determine the input capacity
Article 26(7), point (a)	Thermal electricity generation installation	Average annual total energy input is considered. **Measurement options:** — Default option: divide total annual energy input (in MWh) by number of equivalent load hours over the year; — Divide daily production by the number of hours in a day; — Take peak production
Article 26(7), point (b)	Industrial installation	Average annual total energy input is considered. **Measurement options:** — Default option: divide total annual energy input (in MWh) by number of equivalent load hours over the year; — Divide daily production by the number of hours in a day; — Take peak production

Reference in Directive (EU) 2023/1791	Plan for (new or refurbished)	Method to determine the input capacity
Article 26(7), point (c)	Service facility (e.g., wastewater treatment facilities and LNG facilities)	Average annual total energy input is considered. **Measurement options:** — Default option: divide total annual energy input (in MWh) by number of equivalent load hours over the year; — Divide daily production by the number of hours in a day; — Take peak production
Article 26(7), point (d)	Data centre	Total rated energy input is considered ([21]). **Measurement point:** At the handover point(s) of electricity supply.

Pursuant to Article 26(7) of Directive (EU) 2023/1791 Member States are to also to aim at removing barriers for the utilisation of waste heat and provide support for the uptake of waste heat where the installations are newly planned or refurbished. For this purpose, Member States are to first identify these barriers (which are likely to differ between Member States based on regulatory, environmental and technical context). Depending on the barriers, different solutions to overcome them will apply. Examples of EU-funded projects on the utilisation of waste heat that can be useful in this context are listed in Appendix F of this Annex.

3.5.2. *Key principles of the installation-level CBA and guidance by the Member States*

Annex XI to Directive (EU) 2023/1791 sets out the principles for the installation-level CBA to provide information for the measures set out in Article 26(7) and (9) of Directive (EU) 2023/1791. Annex XI of Directive (EU) 2023/1791 sets out the scope of the assessment, which is limited to the planned installation (that is to say the heat source, including waste heat recovery) and any appropriate existing or potential heat or cooling demand points the installation could supply considering rational possibilities (for example, technical feasibility and distance). That is to be considered within a given geographical boundary, which in the Commission's view, may be decided by local administrative units according to the guiding principles established by the Member State.

Both 'existing and potential heat and cooling demand points that could be supplied' are to be considered in the CBA. Clearly, potential H&C load points may still not exist at the time the installation is commissioned. The CBA and authorisation may therefore need to be made on the assumption that the installation is equipped to operate as cogeneration/waste heat recovery (rather than actually operating as such at the time of commissioning) and capable of supplying the potential heat and cooling loads once they exist. That is the case when, based on the comprehensive H&C assessment pursuant to Article 25(1) of Directive (EU) 2023/1791, there are clear perspectives for a heat and cooling load, that is to say the adoption of measures, policies or strategies, for example the creation of the DHC network or the missing equipment and the connection with the heat consumer(s) as part of a project or groups of projects the benefits of which exceeded the costs under country-level CBA conducted in accordance with Part III of Annex X to Directive (EU) 2023/1791.

Annex XI to Directive (EU) 2023/1791 sets out that the CBA 'shall include an economic analysis covering a financial analysis reflecting actual cash flow transactions'. The financial analysis must reflect actual cash flows from investing in and operating individual installations. That is because the outcome of the financial analysis should be reflected in authorisation decisions impacting on the economic activity of the installations.

([21]) Total rated energy input describes the maximum energy which can flow through a particular installation. Therefore, it is not the energy that actually flows through the data centre but a theoretical maximum.

However, the installation-level analysis could be embedded in the context of a broader economic analysis performed by the operators of the installations. Annex XI requires Member States to set out guiding principles for the methodology, assumptions and time horizons for the economic analysis.

It is recommended that Member States adopt detailed guidance on the CBA to ensure consistent application of that requirement across sites. In addition to the criteria mentioned in Article 26(8) of Directive (EU) 2023/1791, it is recommended that the guidance establishes common assumptions on payback periods, required rates of return on investment, projected fuel and electricity prices, policy costs and support levels. Such assumptions should be used in the economic analysis unless the applicant can provide evidence to demonstrate that alternative assumptions are appropriate in the case of their installation. In accordance with the requirements of Annex XI to Directive (EU) 2023/1791, the assumptions should realistically reflect actual investment terms for projects.

3.5.3. *Methodology for the CBA*

To comply with the requirements of Article 26(7) of Directive (EU) 2023/1791, it is recommended that Member States follow a **five-step approach** on how an installation-level CBA could be conducted. The proposed approach is set out in Appendix G of this Annex and is to a large extent based on the approach presented in the 2015 JRC report ([22]) on best practices and informal guidance on installation level CBA. Member States are encouraged to reflect the recommendations set out in Appendix G of this Annex in their national transposition measures.

3.5.4. *Exemptions from the Cost-Benefit Analysis for installations and notification on the exemptions*

Article 26(8) of Directive (EU) 2023/1791 allows Member States to exempt certain installations from conducting a CBA under specific conditions. In addition, Member States can also define thresholds expressed in terms of the amount of available waste heat, the demand for heat or the distances between industrial installations and district heating networks which exempt individual installations from preparing a CBA. Where a Member State opts to exempt an installation from conducting a CBA, they must notify to the Commission the exemptions granted pursuant to Article 26(8) of Directive (EU) 2023/1791, unless they were already notified during the implementation of Directive 2012/27/EU and are published on the Commission's website ([23]).

3.5.5. *Authorisation and equivalent permit procedures for installations*

Article 26(9) of Directive (EU) 2023/1791 requires the results of the CBA to be taken into account in authorisation or permit criteria issued to the installations subject to the CBA.

Section E of the Guidance note on Directive 2012/27/EU dealt with authorisation and equivalent permit procedures for installations ([24]).

3.5.6. *Data collection on the Cost-Benefit Analyses*

Article 26(12) of Directive (EU) 2023/1791 requires Member States to collect information on cost-benefit analyses, including information on heat parameters. Given the potential use of the heat, temperature is the most characteristic parameter of heat available for the secondary use.

([22]) 'Background report on best practices and informal guidance on installation level CBA for installations falling under Article 14(5) of the Energy Efficiency Directive', https://op.europa.eu/s/zhWd.

([23]) Cogeneration of heat and power: Exemptions, https://energy.ec.europa.eu/topics/energy-efficiency/cogeneration-heat-and-power_en#exemptions/.

([24]) Commission Staff Working Document SWD(2013) 0449 final, 6.11.2013, 'Guidance note on Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EC, and repealing Directives 2004/8/EC and 2006/32/EC – Article 14: Promotion of efficiency in heating and cooling'; https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013SC0449.

4. **REPORTING REQUIREMENTS**

Reporting on Article 26 of Directive (EU) 2023/1791 is not done in the framework of the National Energy and Climate Plans and National Energy and Climate Progress Reports.

Article 26 of Directive (EU) 2023/1791 contains several conditional notification requirements as follows:

— paragraph 3 requires Member States to notify Commission when they plan to use alternative method to define efficient district heating and cooling. For the period until 31 December 2025, referred to in Article 26(2), point (a), of Directive (EU) 2023/1791, reporting deadline was 11 January 2024. For the periods starting from the dates referred to in Article 26(2) points (b) to (e), of Directive (EU) 2023/1791 notification should be made at least 6 months before the beginning of the given period;

— paragraph 8 requires Member States to notify exemptions to perform cost-benefit analyses required by Article 26(7) of Directive (EU) 2023/1791. There is no deadline for notification, but the Commission is in view that this should be made at the same time with communication of the transposition measures;

— paragraph 10 requires Member States to submit a reasoned decision to the Commission regarding and exemption or exemptions granted to installations subject to cost-benefit analyses pursuant to Article 26(7) of Directive (EU) 2023/1791, within 3 months after granting the exemption or exemptions when applying authorisation or equivalent permit criteria;

— paragraph 13 requires Member States to notify any refusal to recognise a guarantee of origin for electricity from high-efficiency cogeneration together with a due justification.

Article 26 of Directive (EU) 2023/1791 is closely linked with the reporting requirements arising from that Directive, in particular from the following articles:

— Article 25(1) of Directive (EU) 2023/1791 requires Member States to notify a comprehensive heating and cooling assessment as a part of its integrated National Energy and Climate Plan and its updates. In preparing and reporting such assessments, Member States may follow Commission Recommendation (EU) 2019/1659 ([25]);

— Article 35(3) of Directive (EU) 2023/1791 requires Member States to submit to the Commission before 30 April each year statistics on national electricity and heat production from high-efficiency and other cogeneration. That data is to be reported directly to Eurostat through the EDAMIS system ([26]) and relevant instructions and reporting templates are issued by Eurostat ([27]).

([25]) Commission Recommendation (EU) 2019/1659 of 25 September 2019 on the content of the comprehensive assessment of the potential for efficient heating and cooling under Article 14 of Directive 2012/27/EU (OJ L 275, 28.10.2019, p. 94, ELI: http://data.europa.eu/eli/reco/2019/1659/oj).

([26]) EDAMIS Tool: https://cros-legacy.ec.europa.eu/content/edamis_en.

([27]) Methodological information: https://ec.europa.eu/eurostat/web/energy/methodology#Annual%20data.

APPENDIX A

METHODOLOGY TO DETERMINE THE SHARE OF RENEWABLE, WASTE HEAT AND (HIGH EFFICIENCY) CHP (DEFAULT APPROACH TO THE DEFINITION OF EDHC)

The methodology comprises three consecutive steps as follows:

Step 1 – Determining the technical details of the heat and cold generation units

For all heat generation units supplying the DHC system, data has to be collected on the amount of energy injected into the DHC, disaggregated into applied conversion technology and fuel. This should be measured at the handover point between the heat generation units to the DHC system. This is termed 'gross final energy'. Recommended template for the data collection is shown in Table A-1.

Table A-1

Recommended template for the data collection on energy use in district heating or cooling system

Energy source	Conversion technology	Amount of heat injected in DHC (in MWh, on yearly basis)
Renewable energy sources (RES) as defined in Article 2(1) RED		
Deep geothermal heat	Direct heat	X_1 MWh
Biomass (solid) (*)	Boiler	X_2 MWh
Biomass (solid) (*)	(HE)CHP	X_3 MWh
Renewable gas *e.g.*, landfill gas, biogas and biomethane (*)	Gas boiler	X_4 MWh
Renewable gas *e.g.*, landfill gas, biogas and biomethane (*)	(HE)CHP	X_5 MWh
Biofuels (liquids) (*)	Boiler	X_6 MWh
Biofuels (liquids) (*)	(HE)CHP	X_7 MWh
Electricity from renewable source	Electric boiler	X_8 MWh
Solar thermal heat	Direct heat	X_9 MWh
Ambient heat (*e.g.*, air, rivers, lakes, sea and sewage water)	Heat pump	X_{10} MWh
Shallow geothermal heat (*e.g.*, groundwater, ground)	Heat pump	X_{11} MWh
Waste Heat Recovery (WHR) (waste heat and cold are defined in Art 2(9) of RED)		
By-product of the industry, power generation, or tertiary sectors (*e.g.*, data centres and urban heat sources)	Direct heat	Y_1 MWh
By-product of the industry, power generation, or tertiary sector (*e.g.*, data centres and urban heat sources like hospitals, offices, shopping centres, metro, etc.)	Heat pump	Y_2 MWh

Energy source	Conversion technology	Amount of heat injected in DHC (in MWh, on yearly basis)
HECHP (defined by Article 2(36), (40) and Annex III of Directive (EU) 2023/1791)		
High-efficiency CHP using only fossil-based fuels	HECHP	Z_1 MWh (thermal)
High-efficiency CHP using fossil-based fuels and renewable fuels (co-firing unit) (*)	HECHP	Z_2 MWh (thermal)
Non renewable energy sources		
Fossil fuels not counted in HECHP	All technologies (incl. other CHP than HECHP)	W MWh
Total energy injected		
Total	All technologies	$\mathbf{T = \Sigma X_i + \Sigma Y_i + \Sigma Z_i + W}$
Notes: The heat as a by-product of a power generation unit is considered to be heat produced by a CHP, and therefore should comply with the definition of RES or HECHP to be counted. (*) Biomass and biofuels should be counted towards the share of renewable fuels, if they fulfil the sustainability criteria defined by the RED.		

Step 2 – Calculation of the shares of all energy supplies (% of total thermal energy injected)

To calculate the shares of all energy supplies, a template in Table A-2 may be used. The first and second columns of the Table describe different sources and technologies to provide heat. The third column indicates which share of the injected energy can be counted towards each threshold.

Table A-2

Template to calculate shares of energy supplies

Energy source	Conversion technology	Share of input counted towards the thresholds (in %)
RES (as defined in Article 2(1) RED)		
Deep geothermal heat	Direct heat	$RES_1 = X_1$ MWh / Total energy in MWh injected into the DHC system (T)
Biomass (solid)	Boiler	$RES_2 = X_2$ MWh / T
Biomass (solid)	(HE)CHP (*)	$RES_3 = X_3$ MWh / T
Renewable gas *e.g.*, landfill gas, biogas and biomethane	Gas boiler	$RES_4 = X_4$ MWh / T
Renewable gas *e.g.*, landfill gas, biogas and bio-methane	(HE)CHP (')	$RES_5 = X_5$ MWh / T
Biofuels (liquids)	Boiler	$RES_6 = X_6$ MWh / T
Biofuels (liquids)	(HE)CHP	$RES_7 = X_7$ MWh / T
Electricity from renewable source	Electric boiler	$RES_8 = X_8$ MWh / T

Energy source	Conversion technology	Share of input counted towards the thresholds (in %)
Solar thermal heat	Direct heat	$RES_9 = X_9$ MWh / T
Ambient heat (*e.g.*, air, rivers, lakes, sea and sewage water)	Heat pump	$RES_{10} = X_{10}$ MWh** / T
Shallow geothermal heat (*e.g.*, groundwater)	Heat pump	$RES_{11} = X_{11}$ MWh** / T
Total RES share		**$\%RES = \Sigma RES_i$**
WHR (Waste Heat Recovery, waste heat and cold are defined in Art 2(9) of RED)		
By-product of the industry, power generation, or tertiary sector (*e.g.*, data centres and urban heat sources)	Direct heat	$WHR_1 = Y_1$ MWh / T
By-product of the industry, power generation, or tertiary sector (*e.g.*, data centres and urban heat sources like hospitals, offices, shopping centres, metro, etc.)	Heat pump	$WHR_2 = Y_2$ MWh / T
Total WHR share		**$\%WHR = \Sigma WHR_i$**
HECHP (defined by Article 2(36), (40) and Annex III of Directive (EU) 2023/1791)		
HECHP using only fossil-based fuels	HECHP	$HECHP_1 = Z_1$ MWh / T
HECHP using fossil-based fuels and renewable fuels (bi-fuel systems)	HECHP	$HECHP_2 = Z_2$ MWh / T
Total HECHP share		**$\%HECHP = \Sigma HECHP_i$**

Notes:

(*) To avoid double counting, heat generated has to be counted as renewable for renewable energy sources (irrespective of whether it is a CHP or HECHP), and as CHP for fossil-based energy sources to be counted towards HECHP criteria.

(**) As suggested by recital 107 of Directive (EU) 2023/1791, it is recommended, for the purpose of calculating the share of renewable energy in a district heating system in the context of Article 26 of Directive (EU) 2023/1791, that all the heat originating from the heat pump and going into the network is accounted as renewable energy, provided that the heat pump meets the minimum efficiency criteria set out in Annex VII to Directive (EU) 2018/2001 at the time of its installation.

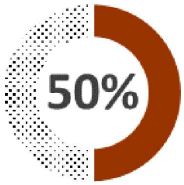
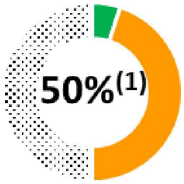
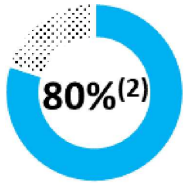
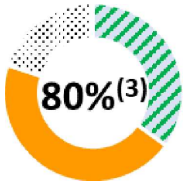
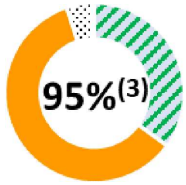
Step 3 – Comparing the resulting shares to the applicable thresholds

The last step of the process is to assess whether the shares calculated in step two comply with the definition in Article 26(1) of Directive (EU) 2023/1791.

A given DHC is defined as 'efficient' if it satisfies the criteria laid down in Article 26(1) of Directive (EU) 2023/1791, which are evolving over time in accordance with the following timeframes (see Table A-3):

Table A-3

Applicable minimum thresholds for efficient district heating and cooling system (default approach)

Energy sources to achieve EDHC criteria Periods	Renewable energy	Waste heat	Renewable energy and waste heat	Combined supply from renewables, waste heat and (high-efficiency) cogeneration	(High-efficiency) cogeneration
Until 31.12.2027					
1.1.2028 - 31.12.2034					
1.1.2035 - 31.12.2039					
1.1.2040 - 31.12.2044					
1.1.2045 - 31.12.2049					
After 1.1.2050					

Notes:

(1) Only high-efficiency cogeneration can be counted towards the threshold. At least 5 % of the heating and cooling supply going into the network should be from renewable energy.

(2) Only high-efficiency cogeneration can be counted towards the threshold.

(3) Only high-efficiency cogeneration can be counted towards the threshold. At least 35 % of the heating and cooling supply going into the network should be from renewable energy or waste heat.

APPENDIX B

METHODOLOGY TO DETERMINE THE AMOUNT OF GHG EMISSIONS FROM THE DHC PER UNIT OF HEAT OR COLD DELIVERED TO CUSTOMERS (ALTERNATIVE APPROACH TO THE DEFINITION OF EDHC)

The methodology consists of five consecutive steps as follows:

Step 1 – Determining the technical details of each generation unit

This step is largely equivalent to the first step under the default approach. For all heat and cold generation units the energy injected into the DHC system needs to be determined, disaggregated into applied conversion technology and fuel. The measurement should be conducted at the handover point between conversion technology and DHC system. Despite the emissions being considered as total and not being split into each generation unit, this is necessary, because only in that way can the overall amount of emissions produced through the generation processes be reliably determined which is required to calculate the emissions intensity of each unit of energy delivered to the customers.

Step 2 – Determining the emission factors

For each technology and fuel Member States shall set emission factors, which describe the emissions per unit of energy given in g/kWh. Recommended template to present the emission factors is shown in Table B-1. Guidance for the determination of the values is provided by the Emission Factor Database published by the European Environmental Agency. ([28]) Given the differences between Member States regarding factors influencing the emission factors, such as the exact characteristics of the employed fuels and technologies, different emission factors between Member States may arise. The emission factors for all RES defined in Article 2(1) RED and waste heat are 0.

Table B-1

Recommended template for the presentation of the emission factors

Energy source	Conversion technology	Emission Factor (in g/kWh)
RES (as defined in Article 2(1) RED)		
All sources	All technologies	0
WHR (Waste Heat Recovery, waste heat and cold are defined in Art 2(9) of RED)		
All by-products	Direct / heat pump	0 g/kWh
CHP (defined by Article 2(36), (40) and Annex III of Directive (EU) 2023/1791)		
High Efficiency CHP using only fossil-based fuels and/or non-RES-biomass	HECHP	F_{13} g/kWh
High Efficiency CHP using fossil-based fuels, non-RES-biomass and renewable fuels (bifuel systems)	HECHP	F_{14} g/kWh
CHP using only fossil-based fuels and/or non-RES-biomass	CHP	F_{15} g/kWh
CHP using fossil-based fuels, non-RES-biomass and renewable fuels (bifuel systems)	CHP	F_{16} g/kWh

([28]) European Environment Agency, 2020: Emission Factor Database.

Energy source	Conversion technology	Emission Factor (in g/kWh)
Non renewable energy sources		
Natural Gas	All technologies (excl. CHP)	F_{17} g/kWh
Oil	All technologies (excl. CHP)	F_{18} g/kWh
Lignite	All technologies (excl. CHP)	F_{19} g/kWh
Coal	All technologies (excl. CHP)	F_{20} g/kWh
Non-RES-Biomass	All technologies (excl. CHP)	F_{21} g/kWh

Step 3 – Calculating the total emissions

For each generation installation the measured energy that is being injected into the DHC system, as measured in step 1, is multiplied with this factor. The sum of these products are the total emissions related to the generated energy injected into the DHC system. Calculation of total emissions can be reported as shown in Table B-2.

Table B-2

Calculation of total emissions

Energy source	Conversion technology	Emissions
RES (as defined in Article 2(1) RED)		
Total RES emissions		**EMRES = 0**
WHR (Waste Heat Recovery, waste heat and cold are defined in Art 2(9) of RED)		
Total WHR emissions		**EMWHR = 0**
CHP (defined by Article 2(36), (40) and Annex III of Directive (EU) 2023/1791)		
High Efficiency CHP using only fossil-based fuels and/or non-RES-biomass	HECHP	$CEM_{13} = X_{13}$ MWh * 1000 kWh/MWh * F_{13} g/kWh
High Efficiency CHP using fossil-based fuels, non-RES-biomass and renewable fuels (bifuel systems)	HECHP	$CEM_{14} = X_{14}$ MWh * 1000 kWh/MWh * F_{14} g/kWh
CHP using only fossil-based fuels and/or non-RES-biomass	CHP	$CEM_{15} = X_{15}$ MWh * 1000 kWh/MWh * F_{15} g/kWh
CHP using fossil-based fuels, non-RES-biomass and renewable fuels (bifuel systems)	CHP	$CEM_{16} = X_{16}$ MWh * 1000 kWh/MWh * F_{16} g/kWh
Total CHP emissions		**$EMCHP = \Sigma CEM_i$**

Energy source	Conversion technology	Emissions
Non renewable energy sources (NRES)		
Natural Gas	All technologies (excl. CHP)	$NEM_{17} = X_{17}$ MWh * 1000 kWh/MWh * F_{17} g/kWh
Oil	All technologies (excl. CHP)	$NEM_{18} = X_{18}$ MWh * 1000 kWh/MWh * F_{18} g/kWh
Lignite	All technologies (excl. CHP)	$NEM_{19} = X_{19}$ MWh * 1000 kWh/MWh * F_{19} g/kWh
Coal	All technologies (excl. CHP)	$NEM_{20} = X_{20}$ MWh * 1000 kWh/MWh * F_{20} g/kWh
Non-RES-biomass	All technologies (excl. CHP)	$NEM_{21} = X_{21}$ MWh * 1000 kWh/MWh * F_{21} g/kWh
Total NRES emissions		**EMNRES = Σ NEM_i**
Total emissions		**TOTEM = EMRES + EMWHR + EMCHP + EMNRES**

Step 4 – Calculating emissions per delivered unit of heat or cold

In this step, Member States have to assess how much heat and cold was delivered to customers. The point of measurement for this is the handover point between the DHC system and the customers. This step can be facilitated through data collection already in place, for example, through the operators of DHC systems or energy suppliers. This step gives the total energy delivered through the customers, which is not equivalent to the total energy injected, due to heat loss in the network. The emission intensity per delivered kWh heat or cold is calculated based on the following formula:

Emissions per unit of heat or cold delivered = Total emissions/Total energy delivered

The results of this calculation should be reported in grams of CO_2 equivalents (g) for the emissions and kWh for the energy.

Step 5 – Comparing the result to the applicable threshold

After the ratio of GHG to delivered energy has been established, Member States are to compare it to the applicable threshold shown in Table B-3 for the relevant period. If the emissions per unit of heat or cold delivered to the customers are equal or below the applicable threshold, the DHC system is efficient.

Table B-3

Applicable GHG emission's thresholds for efficient district heating and cooling

Period	Threshold for 'efficient district heating and cooling system'
Until 31 December 2025	200 grams/kWh
From 1 January 2026 until 31 December 2034	150 grams/kWh
From 1 January 2035 until 31 December 2044	100 grams/kWh
From 1 January 2045 until 31 December 2049	50 grams/kWh
From 1 January 2050	0 grams/kWh

APPENDIX C

QUANTIFICATION OF REFURBISHMENT COSTS

The scope of the costs that should be included in the assessment is summarised in Table C-1. This recommended list categorises costs based on the components of DHC networks from heat generation to consumption, including monitoring, control and digitalisation.

Table C-1

Refurbishment costs

Types of costs	Eligible costs
Technical costs	**Heat generation** Replacement and retrofit of generation units
	Heat distribution Replacement and retrofit of distribution technologies: — Primary grid (heat distribution pipelines) — Secondary grid (parallel return pipelines) Equipment (e.g., metering) & software for performance monitoring and data collection (including implementation of software tools, monitoring systems, surveillance systems and data collecting)
	Heat consumption Replacement and retrofit of substations Implementation of smart metering and remote control technologies
	Automation, monitoring, control and digitalisation Implementation and replacement of monitoring, control and digitalisation devices and technologies
Non-technical costs	Project management & planning Other costs like tendering procedures, information campaign for the public

Member States are advised to issue a methodology to guide DHC network operators in the estimation of the costs of a new comparable unit. Such methodology should consist of at least the following steps:

Step 1: Identify the main characteristics and components of the existing system, in terms of type of DHC installation, size, generation technology, and other technical issues related to heat generation, distribution and consumption. Specify the part of the system that will be subject to refurbishment.

Step 2: Define a comparable unit. A new unit would be considered 'comparable' if it has the same characteristics as the existing unit in terms of type of DHC installation, size, distribution or generation technology, and other technical issues related to heat generation, distribution and consumption.

Step 3: Collect data on the costs of each new component of a comparable unit on the market, including both equipment/material costs and installation costs. Data on costs can be collected directly from market actors (*i.e.* manufacturers, suppliers, installers and network operators). Data can also be collected in the literature. A list of potential studies and sources is provided in Table C-2.

Table C-2

Studies on building and refurbishment costs of district heating and cooling system elements

Author	Year of publication	Title	Link
ReUseHeat	2022	Handbook for increased recovery of urban excess heat	https://www.reuseheat.eu/wp-content/uploads/2022/09/ReUseHeat-Handbook-For-Increased-Recovery-of-Urban-Excess-Heat.pdf
ReUseHeat	2022	Calculation tool for levelised cost of heat (LCOH)	https://www.euroheat.org/resource/reuseheat-calculation-tool-for-levelised-cost-of-heat.html
Upgrade DH	2019	Upgrading the performance of district heating networks – Technical and non-technical approaches	https://www.upgrade-dh.eu/images/Publications%20and%20Reports/D2.5_2019-07-02_Upgrade-DH_Handbook_EN.pdf
Upgrade DH	2020	Summary on business models and initiating investments for upgrading district heating	https://www.upgrade-dh.eu/images/Publications%20and%20Reports/UpgradeDH%20D5.5.pdf

Step 4: Compare costs estimated for the refurbishment of the existing unit with the costs estimated for investing in a new comparable unit. When the estimated costs for the refurbishment are above 50 % of a new comparable unit, the refurbishment is substantial.

APPENDIX D

BEST PRACTICES FOR POLICY MEASURES AND THEIR IMPACT CALCULATIONS FOR MANDATORY REQUIREMENTS (INCLUDING MULTIPLE IMPACTS)

The Upgrade DH project provides examples of best practices of DHC having been refurbished to improve their energy performance and increase the share of renewables. It also provides guidance and recommendations illustrating the approach for decarbonisation plans of DH systems. The DH Upgrade project provides several best practices, such as the optimisation of pumping operations, the integration of tube collectors, of a biomass fired boiler, the full renovation, the replacement of fossil systems, the shift to low-temperature operation, or the interconnection of two separated networks.

Other practices are presented in the following papers:

— Galindo, M., Roger-Lacan, C., Gährs, U. and Aumaitre, V. (2016), 'Efficient district heating and cooling markets in the EU: Case studies analysis, replicable key success factors and potential policy implications', EUR 28418 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-79-65048-2 (online), 978-92-79-74179-1 (ePub), doi:10.2760/371045 (online),10.2760/649894 (ePub), JRC104437. Available online at: https://publications.jrc.ec.europa.eu/repository/handle/JRC104437.

— Galindo Fernandez, M., Bacquet, A., Bensadi, S., Morisot, P. and Oger, A. (2021), 'Integrating renewable and waste heat and cold sources into district heating and cooling systems', Publications Office of the European Union, Luxembourg, ISBN 978-92-76-29428-3, doi:10.2760/111509, JRC123771. Available online at: https://publications.jrc.ec.europa.eu/repository/handle/JRC123771.

— IEA (2022), 'Annex TS2: Implementation of Low Temperature District Heating Systems'. Available online at: https://www.iea-dhc.org/the-research/annexes/2017-2021-annex-ts2.

— European Commission, Directorate-General for Energy, Bacquet, A., Galindo Fernández, M., Oger, A., et al. (2022), 'District heating and cooling in the European Union: overview of markets and regulatory frameworks under the revised Renewable Energy Directive', Publications Office of the European Union. Available online at: https://op.europa.eu/en/publication-detail/-/publication/4e28b0c8-eac1-11ec-a534-01aa75ed71a1/language-en.

APPENDIX E

PROCESS TO DEVELOP A FIVE-YEAR PLAN

It is advised to carry out the development of the plan in two stages. First the high-level objectives are set out, defining how to comply with Article 26(1) of Directive (EU) 2023/1791, or alternatively, how to decarbonise the DHC system. In the second stage, concrete measures to reach the chosen objective are defined. That revolves around which heat generation units will be used, infrastructural upgrades for the DHC system and financing options. Regular updating of the plans and monitoring of the progress is beneficial and advisable.

Defining the specific measures is a multi-step procedure. This Appendix describes firstly how each step should be conducted and then suggests a list of the specific information to be collected or shown.

First step – Current state assessment

The first step is to assess the current state of the DHC system. To begin with, the geographical scope of the plan shall be determined. It consists of the currently existing network, connected customers and heat generation units. To that the future expansion of the network, potential customers and heat generation units should be added.

The template suggested in Table E-1 summarises the current state of the DHC system.

Table E-1

Template to describe current state of the district heating and cooling system

Indicator	Value
General indicators	
Levelised cost of heat/cold	Euro (€)
Complexity (heat generators, connection points, grid levels)	Number and description of each part
Maps with all heat generation facilities, network and pumping stations	Maps
Age of components	Number of years
Readiness for decentralised heat input (required for certain types of renewable energy)	Technical assessment
Pipes	
Length of the network and spatial coverage	km
Piping technology	Name of used technology
Technical details of the pipes (e.g., diameter, material, etc.)	Depending on indicator
Insulation	Name of used technology
Hydraulic parameters	bar and m^3/h
Temperature development (delivery and return)	°C
Number, capacity and technology of heat storages	Number, MW and name of used technology
Technical details of the pipes (e.g., diameter, material, etc.)	Depending on indicator

Indicator	Value
Customers	
Number of customers	Number (split into whole buildings and individual residential units)
Type of customer	Corporate, public or private (split into individual units or entire building)
Type of buildings	Residential or non-residential
Heat demand of each customer	kWh
Temperature level at the customers	°C
Temperature development (delivery and return)	°C
Heat generation	
Installed generation capacity	MW
Number of heat generation units	Number
Technology of each heat generation unit	Name of conversion technology (e.g., CHP, boiler or direct heat)
Energy source of each heat generation unit (particularly for heat pumps)	Name of source (e.g., air, ground, water, metro tunnels and data centres)
Power injected by each heat generation unit	MWh
Temporal availability of each heat generation unit	% of year in which the unit injects heat into the DHC
Temperature level at the customers	°C
Temperature development (delivery and return)	°C
Quality of the DHC	
Number of refills per year	Number of occasions on which the entire volume of the liquid has been exchanged
Corrosion in- and outside the pipes	Number of places in which corrosion occurred; description of strength of corrosion
Heat loss	MW
Water temperature	°C
Number of shutdowns per year	Number
Water quality	Recognised water quality standard, e.g., AGFW FW 510 (2018)

Second step – Potential for renewable energy, waste heat and high-efficiency cogeneration

Secondly, the potential for the increase of renewable energy (RE), waste heat (WH) and high-efficiency cogeneration (HECHP) shall be assessed. This can be split into a rough analysis of all potential heat sources followed by an in-depth assessment of the most promising ones. If the next detailed analysis shows that the potential of some heat sources is lower than anticipated, a reiteration is recommended by conducting the in-depth analysis for previously excluded heat sources. Recommended templates to analyse technical and economic potential for RE, WH and HECHP are shown in Table E-2 and Table E-3.

Table E-2

Simplified assessment of the technical and economic potential for RE, WH and HECHP

Simplified assessment				
Energy source	**Potential**	**Temperature**	**Temporal availability**	**Comments**
Ambient air	Everywhere available	Low; higher in summer than in winter	Entire year	
Solar thermal	Space is limited; availability fluctuates	Medium; depends on intensity	Fluctuates	
Waste heat (from data centre)	Constantly available	Medium; constant	Entire year	
Biomass burnt in HECHP	Fuel source has limited availability	High; constant	Entire year	

Table E-3

Detailed assessment of the technical and economic potential for RE, WH and HECHP

Detailed assessment (similar as above but quantified)					
Energy source	**Conversion technology**	**Temperature level**	**Theoretically available thermal energy**	**Heat generations plants**	**Potential locations for the plants**
Air	Heat pump	X °C, higher in summer than in winter	X GWh	2 plants with each X MW	Data centre 1
Biomass	HECHP	X °C, constant over the year	X GWh	5 plants with each X MW	Area 3, Area 5

Third step – Heat demand scenarios

As third step one or two scenarios for the development of heat demand shall be developed. These serve the purpose of determining what expansion of the DHC system is economically justified and how much of the identified potential for RE, WH and HECHP has to developed in which period of time. The scenarios should take into account factors such as:

— Demand changes through renovations;

— Significant construction projects and increasing density of the urban environment;

— The DHC system should connectable to new buildings and not hinder the realisation of such projects;

— Changes regarding the DHC system;

— Demand could increase by increasing the size of the network.

Following this scenario development, benchmarks are created how much heat or cold should be possibly supplied through the DHC system by which year.

Suggested template to report the main findings is shown in Table E-4.

Table E-4

Report of the main findings on the heat demand scenarios of the district heating and cooling system five-year plan

Indicator	Value
Number of potential customers	Number
Current type of heat supply for each potential customer	Name of technology
Energy required to supply all customers (including potential customers)	MWh

Fourth step – Technical concept for the future

During this stage, different options for fuelling the DHC system should be determined on the basis of the analysis of potential heat generation units and potential demand. It is important to define benchmarks to be achieved in certain years for each type of heat generation unit as well as the shares of RE, WH and HECHP. The minimum target of those benchmarks should be the thresholds set out in Article 26(1) of Directive (EU) 2023/1791. It is important in this step to factor in potential restrictions on certain energy sources, such as biomass. Beyond the heat generation units, this step also specifies infrastructural changes to the DHC system, such as constructing additional pipes or insulation improvements.

Each option should be accompanied by an assessment of feasibility, regarding heat generation, parameters of the DHC system and economic performance. It is also recommended to address how the DHC system could provide balancing and other system services in the electricity system. Such options in the DHC system facilitate combining intermittent renewable sources with permanently available ones to ensure a constant heat supply to final customers and consumers. This analysis contributes to implementation of the Article 24(8) of Renewable Energy Directive.

The outcome of this step is a preferred option for the future development of the DHC system. This decision could be based on an evaluation which of the different options has the best ratio of the time required to comply with Article 26(1) of Directive (EU) 2023/1791 and economic performance. Alternatively, it could be based on an evaluation which of the different options delivers the best ratio of economic performance and energy/emission savings.

Suggested template to report the main findings is shown in Table E-5.

Table E-5

Summary report on the technical concept of the district heating and cooling system five-year plan

Indicator	Value
General indicators	
Levelised cost of heat/cold	Euro (€)
Complexity (heat generators, connection points, grid levels)	Number and description of each part
Maps with all heat generation facilities, network and pumping stations	Maps
Readiness for decentralised heat input (required for certain types of renewable energy)	Technical assessment
Pipes	
Length of the network and spatial coverage	km
Piping technology	Name of used technology
Technical details of the pipes (*e.g.*, diameter, material, etc.)	Depending on indicator

Indicator	Value
Insulation	Name of used technology
Hydraulic parameters	bar and m^3/h
Temperature development (delivery and return)	°C
Number, capacity and technology of heat storages	Number, MW and name of used technology
Customers	
Number of customers	Number (split into whole buildings and individual residential units)
Type of customer	Corporate, public or private (split into individual units or entire building)
Type of buildings	Residential or non-residential
Heat demand of each customer	kWh
Temperature level at the customers	°C
Temperature development (delivery and return)	°C
Heat generation	
Increase in RE use	MW
Increase in WH use	MW
Increase in HECHP use	MW
Installed generation capacity (split into existing and planned)	MW
Number of heat generation units (split into existing and planned)	Number
Technology of each heat generation unit (split into existing and planned)	Name of conversion technology (e.g., CHP, boiler or direct heat)
Energy source of each heat generation unit (particularly for heat pumps)	Name of source (e.g., air, ground, water, metro tunnels and data centres)
Power injected by each heat generation unit	MW
Temporal availability of each heat generation unit	% of year in which the unit injects heat into the DHC
Temperature level at the customers	°C
Temperature development (delivery and return)	°C

Fifth step – Timeline, resources and strategy

As last step, specific measures, mapped onto a timeline, need to be developed which will lead up to the achievement of the preferred option defined in step four. Particularly those measures which will be taken in the first years after the plan was adopted shall be clearly specified. It is then necessary to determine the resources required to realise each measure and how they will be mobilised. That concerns particularly investment needs but could also include the required labour and permits. Furthermore, a communication and public acceptance strategy shall be devised to ensure that the measures to be undertaken will not be delayed through avoidable public resistance.

The results of the fifth step may be reported as shown in Table E-6.

Table E-6

Summary report on costs and financing of the district heating and cooling system five-year plan

Indicator	Value
Total required investment	€
Investment costs covered by public funding	€

APPENDIX F

EU-FUNDED PROJECTS ON THE UTILISATION OF WASTE HEAT

Examples of EU-funded projects on the utilisation of waste heat include:

— The ReUseHeat project looks into recovery and reuse of waste heat available at urban level, with the aim to increase energy efficiency of DHC systems, https://www.reuseheat.eu/.

— The HEATLEAP project looks into waste heat recovery systems such as large heat pumps in energy intensive industries, https://heatleap-project.eu/.

— The REFLOW project focuses on material flows, but also addresses excess heat in terms of wastewater heat, https://reflowproject.eu/ and https://reflowproject.eu/blog/matching-supply-and-demand-in-wastewater-heat/.

— The REWARDHeat project looks into low-temperature DHC networks, able to recover waste heat, https://www.rewardheat.eu/en/.

— The Celsius project looks a bit into excess heat for district heating, https://celsiuscity.eu/ and https://celsiuscity.eu/excess-heat-from-sewage-in-hamburg-and-singen-germany/.

— The SEEnergies focuses on energy efficiency, but also did some work on excess heat, in particular industrial excess heat potentials, https://www.seenergies.eu/about/ and https://s-eenergies-open-data-euf.hub.arcgis.com/search?categories=d5.1.

APPENDIX G

FIVE-STEP APPROACH TO CONDUCT AN INSTALLATION-LEVEL CBA

Step 1: identification of the scope

In Step 1, the scope of the CBA should be defined and identified. The purpose of the project should be identified and described. For a precise scope of the CBA, two main elements should be addressed:

— Establishing the heat link: in all cases for which a CBA is required and which are listed in Article 26(7), points (a) to (d), of Directive (EU) 2023/1791, there is a link between a source and a sink. The cost effectiveness of heat linking and consequently of the whole project will be dependent upon the quantity of heating/cooling demanded and the distance over which the heating/cooling will have to be supplied;

— Describe the system boundary: the analysis will include the main installation with its modifications and the heat link. The remote supplier/receiver of the energy product interacts with the system, but it is outside of the boundary and thus not necessarily to be analysed in the CBA.

Step 2: Available/potential waste heat

In Step 2, available/potential waste heat should be explored. Waste heat affects the CBA in two ways. First, waste heat that is recovered or transformed by the installation is the 'energy product' and will hence generate revenue flows. Second, waste heat will determine the design and size of the necessary heat recovery equipment and will thus have an influence on capital costs. Whether waste heat is consumed on-site or off-site will also have an impact on a project's benefits and costs. Whereas on-site recovery implies energy savings that can be translated into reduced operational costs for the installation, off-site recovery will generate additional revenues from selling an extra 'product' (*that is to say* waste heat) to the market. Waste heat potential varies among the type of installations and the methodologies to identify this waste heat will also differ.

Step 3: Collecting data for the CBA

Step 3 consists of collecting all data that is relevant for carrying out the CBA. Data collection can be facilitated by certain provisions of Directive (EU) 2023/1791, such as:

— Annex XI to Directive (EU) 2023/1791 indicates that Member States may require a series of stakeholders to contribute data for use in the CBA;

— Some data will already be collected for the comprehensive assessment that has to be conducted pursuant to Article 25 of Directive (EU) 2023/1791, such as H&C demand and supply forecasts and trends, existing and expected policies and measures that may affect the viability of the investment during its lifetime.

Some additional data might be required for specific equipment included in the CBA.

Step 4: Identification of the reference scenario and assumptions

In Step 4, reference scenario and assumptions are defined. The reference scenario refers to a scenario that will be compared to the planned new or refurbished installation. The reference scenario can be determined by calculating the price of heat for the potential beneficiaries of the waste heat that will be recovered through the planned installation. It estimates the economic savings (i.e. reduces the purchase of fuels for the same amount of heating/cooling) and carbon savings (i.e. decreases emissions, at a carbon price).

Step 5: Conducting CBA

In Step 5, the CBA is performed. The first task is to identify and define the parameters and assumptions that will influence the financial feasibility of the project and thus its implementation from the investor's perspective as well as external societal benefits that may result from the investment. There are three main categories of parameters to be considered in a financial analysis:

— costs of the project;

— benefits of the project;

— techno-economic parameters.

Costs of the project mainly include capital expenditures (CAPEX) and operational expenditures (OPEX). Capital expenditures are those costs that incurred when buying fixed assets or adding value to an existing asset. It may include for example, equipment, land costs, balance of plant, interconnection, development and financing costs, etc. Operational expenditures are day-to-day expenses such as operation and maintenance costs, insurance, project management, property taxes, emissions allowances, etc.

Benefits of the project mainly include:

— Financial benefits, referring to the positive cash flows resulting from the project activities (for example sales, energy savings, CO_2 savings, financial incentives such as subsidies, tax advantages). In the reference scenario benefits are based on achieved energy and carbon savings;

— Other external socioeconomic benefits that do not generate real cash flow but are important to society and should therefore be included in the analysis.

Techno-economic parameters mainly include parameters such as:

— Project lifetime, that is necessary to perform a discounted cash flow or Net Present Value (NPV) analysis of the project's costs and benefits;

— Construction period (lead time), referring to the time over which the project is constructed and hence does not always generate revenues;

— Operation time (capacity factor), which shows at what extent the initial capital will be utilised. It is common to use it as a factor representing the total energy produced/consumed in a year to the energy that could be produced/consumed throughout that year;

— Financial and economic discount rate (time value of money) that accommodates for the effects of inflation, cost of capital, opportunity costs taxation and other allowances;

— Energy price escalation that accounts for changes in fuel cost and heat tariffs.

The costs and benefits of the project are the categories of parameters used to perform the CBA and determine whether a project is economically justifiable by comparing the total benefits (which go beyond purely financial benefits and revenues to include wider environmental, social and economic benefits) against the total costs (which again go beyond the financial construction and operating costs to include social, environmental and wider economic costs). Different methodologies to conduct a CBA can be used, each of them considers a lower or higher range of parameters. Examples of CBA methodologies include:

— Financial analysis: these methods only consider the costs and benefits of the project for the project developer. It includes methodologies such as discounted cash flow or Net Present Value analysis;

— Economic analysis: a financial analysis can be converted into an economic analysis by considering the broader benefits and costs that a project brings/causes to society. Several adjustments can be made to ensure the conversion into an economic analysis (including fiscal corrections, conversion from market to shadow prices, evaluation of non-market and correction for externalities).