H2020 Work Programme

D6.2 - SO WHAT LESSONS LEARNT: REGULATORY ISSUES

Lead Contractor: **RINA-C**

Date: November 30th, 2022

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847097. The content of this publication is the sole responsibility of the author(s). The European Commission or its services cannot be held responsible for any use that may be made of the information it contains.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847097.

Project title			
Project acronym	SO WHAT	**Start / Duration**	42 months
Coordinator	RINA-C		
Website	https://sowhatproject.eu/		

Deliverable details			
Number	D6.2		
Title	SO WHAT lessons learnt: regulatory issues		
Work Package	WP6 - SO WHAT impact analysis and maximisation of lessons learnt		
Dissemination level[1]	PU	**Nature**	Report
Due date (M)	M42	**Submission date (M)**	**M42**
Deliverable responsible	RINA-C		

[1] PU = Public
CO = Confidential, only for members of the consortium (including Commission Services)

	Beneficiary
Deliverable leader	RINA-C
Contributing Author(s)	Roberta Montesano (RINA-C), Giorgio Bonvicini (RINA – C), Arianna Amati (as representative of RINA-C project team), UOB, CAR, 2GOOUT, KELVIN, MEDGREEN, LIPOR, ELEU
Reviewer(s)	IESRD
	SIE
Final review and quality approval	Arianna Amati (RINA-C) (30/11/2022)

Document History			
Date	**Version**	**Name**	**Changes**
28/04/2022	0.1	Giorgio Bonvicini	ToC
26/10/2022	0.2	Roberta Montesano, Giorgio Bonvicini	First complete draft for review
28/11/2022	0.3	Roberta Montesano	Final draft for review
30/11/2022	0.4	Mariana Fernández Carla Sebastiani	Peer review

Executive Summary

The present report, SO WHAT D6.2, entitled "Lessons learnt from SO WHAT – regulatory issues" aims to provide a study of the main regulatory issues in the different EU countries, which could represent a barrier to the deployment of certain solutions proposed by the SO WHAT tool. The study has been carried out considering not only the technical and financial framework but also the regulatory one. With regards to waste H/C exploitation within and outside the industrial premises, towards commercial and/or residential end-users, the regulatory framework has been analysed and suitable countermeasures have been proposed.

Also, in parallel, a certification/standardisation procedure has been developed in order to support the implementation of the proposed solutions and encourage replication activities in all EU countries.

The Deliverable is articulated into the following sections:

- Chapter 1 gives an introduction to the report;
- Chapter 2 provides a review of applicable regulations at EU level and for each Demo site country;
- Chapter 3 focuses on the barrier analysis and provides some recommendations to overcome them;
- Chapter 4 proposes a Standardisation/Certification procedure for WH/C recovery;
- Chapter 5 presents the conclusions of the study.

Abbreviations

CHP: Combined Heat and Power

DHC: District Heating and Cooling

DHN: District Heating Network

EED: Energy Efficiency Directive

EPC: Energy Performance Contract

EPBD: Energy Performance of Buildings Directive

ERSE: Entidade Reguladora dos Serviços Energéticos

ESCO: Energy Service Company

IDEA: Instituto para la diversificación y el ahorro de la energía

IRR: Internal Rate of Return

NECP: National Energy and Climate Plan

NPV: Net Present Value

PEF: Primary Energy Factor

REC: Renewable Electricity Certificates

RED: Renewable Energy Directive

RES: Renewable Energy Sources

SQESE: Qualification System for Energy Service Companies

TOE: Ton of oil equivalent

TUEL: Consolidated text of laws on local government

WC: Waste Cold

WH: Waste Heat

WHR: Waste Heat Recovery

TABLE OF CONTENTS

1 Introduction

This report summarises the regulatory issues in the different EU countries of SO WHAT's demosites, which could represent a barrier to the deployment of certain solutions proposed by the SO WHAT tool, to consider not only the technical and financial framework but also the regulatory one.

The main European Directives, such as **Energy Efficiency Directive (EED) 2012/27/EU** and **Renewable Energy Directive (EU) 2018/2001**, have been analysed and commented on. Also, the local transpositions have been reported for the following countries: Belgium, Italy, Portugal, Romania, Spain, Sweden and the United Kingdom.

In addition, to identify the main barriers and related recommendations to overcome them, the following issues, which influence the development of some of the solutions proposed by the SO WHAT tool, have been studied from a regulatory point of view:

- District heating/cooling network regulation and terms of sale of waste heat/cold recovered to other users or the network;
- Combined Heat and Power plants regulation and the definition of high efficiency operating;
- Solutions for energy efficiency in the industry;
- Renovation of buildings and the potential connection to the district heating/cooling network;
- Electricity self-production plants from renewable sources and their potential connection to the grid.

For each of the previous topics, a matrix has been drawn up that summarises the current state, for each country, of some aspects fundamental for the development of some opportunities.

Lastly, in parallel, a certification/standardisation procedure has been developed in order to maximise the impact of the proposed solutions and encourage replication activities in all EU countries. Specific attention has been given to the evaluation of a unique methodology to evaluate the waste H/C recovery and potential in the framework of energy efficiency measures to promote policies and regulatory frameworks preparation to foster WH/C recovery measures.

2 Review of Applicable Regulations

In this section, a review of the Applicable Regulations has been carried out considering the policies and the regulation related to EU Level and the following countries' contexts: Belgium, Italy, Portugal, Romania, Spain, Sweden, and United Kingdom.

2.1 EU Level

Most of the topics covered by the SO WHAT tool are included in different European Directives, and then transposed locally by individual countries.

Energy Efficiency Directive (EED) 2012/27/EU of the 25th October 2012 required Member States to carry out an assessment of the potential for efficient heating and cooling (Article 14) and to provide a vision of the policy instruments that can be used to facilitate this. In addition, **Renewable Energy Directive (EU) 2018/2001** requires Member States to assess the potential of energy from renewable sources and of the use of waste heat/cold in the heating and cooling sector.

The following points are focused on the main regulatory provisions that could represent limitations or barriers to the deployment of certain solutions proposed by the SO WHAT tool.

- **Overview of the regulatory framework for heating or cooling networks and combined heat and power (CHP)**

Article 14 of the EED 2012/27/EU promotes the **efficiency of heating and cooling systems.** Its primary goal is to encourage the Member States to identify the potential for the application of **high-efficiency cogeneration (CHP)** and/or **efficient District Heating/Cooling (DHC)** whose benefits exceed the costs. In particular, the Directive encourages the Member States to take adequate measures to implement efficient district heating and cooling infrastructure and/or to support the development of high-efficiency cogeneration and the heat and cooling recovery from waste heat and renewable sources.

As described in paragraph 5 of Article 14, the Member States shall ensure that **cost-benefit analyses** will be carried out, especially for the letter (c): an industrial installation with a total **thermal input exceeding 20 MW** generating waste heat at a useful temperature level is planned or substantially refurbished, in order to assess the cost and benefits of utilising the waste heat to satisfy economically justified demand, including through **cogeneration**, and of the connection of that installation to a **district heating and cooling network**. Through the waste heat recovery for electricity generation, the factories could "evolve" themselves from an existing thermal plant to a CHP system where the produced electricity could be self-consumed or sold to the grid.

In addition, as mentioned in paragraph 11 of Article 14, the Member States shall ensure that any available support for cogeneration is subject to the **electricity produced originating from high-efficiency cogeneration** and the waste heat being effectively used to achieve primary energy savings. Public support to cogeneration and district heating generation and networks shall be subject to State aid rules, where applicable.

It is important to highlight that District Heating Networks could be the best candidates to receive the recovered waste heat. In Annex VIII of the EED, in order to improve the efficiency of the district heating and cooling infrastructure, is proposed to accommodate the development of renewable energy sources by setting rules, minimum efficiency requirements or minimum share of renewable origin energy. Also, with the aim of maximizing the potential for efficiency in WH/C

recovery, the Member States shall provide a forecast of how the heating and cooling demand will change in the next 10 years, considering the evolution of demand in buildings (based on the type and use of them) and the different sectors of industry. This study will allow to define the heat loads, existing and future, and to identify opportunities to develop WH/C recovery and/or CHP solutions through new or existing district heating networks.

- **Energy efficiency and building renovations**

The **EU Heating and Cooling Strategy (2016)** emphasises the significance of heating and cooling planning and aims to address the major issues related to achieving long-term decarbonization goals, energy security, the risk of a heating crisis caused by a disruption in natural gas supply, and the increasing of EU industry competitiveness. The Strategy focuses on stopping the energy leakage from buildings, maximising the efficiency and sustainability of heating and cooling systems, promoting efficiency in industry, district heating, renewable sources use and reaping the benefits of integrating heating and cooling into the electricity system. [2]

The Strategy highlights, for example, that many industries generate **heat as a by-product**. Much more of this could be reused within plants or sold to heat buildings nearby. In addition, **waste cold** is generated in sites such as liquified gas terminals. It is rarely reused, although the technology to do is already used on a commercial basis in some district cooling systems. Integrating the production, consumption and reuse of waste cold creates environmental and economic benefits and reduces the primary energy demand for cold.

In addition, the future **electricity grid will integrate more renewable energy**, especially wind and solar including decentralised supplies. So, supply and demand must become more flexible, through wider use of demand reduction, demand response mechanisms and energy storage. **Linking heating and cooling with electricity networks** will reduce the cost of the energy system – to the benefit of consumers. For example, off-peak electricity can be used to heat water in lagged tanks which can store energy for days and even weeks.

To achieve the decarbonisation objectives, the **building must be decarbonised**. This entails renovating the existing building stock, along with intensified efforts in energy efficiency and renewable energy. In fact, buildings are the first consumers of heating and cooling, moreover, buildings frequently lose heat or cold due to poor quality.

In order to support energy efficiency or renewable energy solutions, the Strategy report highlights that **Energy Performance Contracting (EPC),** and **Energy Services Companies (ESCOs)** can offer technical assistance, expertise and access to capital. An ESCO can implement a project and uses the cost savings/renewable energy sales to repay the costs.

Lastly, by putting a price on CO_2 emissions, the **EU Emissions Trading Scheme** has provided an incentive to use low-carbon fuels and to invest in energy efficiency. The industry can take economic advantages through the adoption of energy efficiency measures and new technical solutions to use more renewable energy.

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=157555175456 8&uri=CELEX:52016DC0051

2.2 Belgium

Belgium is a federal state, composed of communities and regions with a three-level structure. At the top level, there are Federal State, the Communities and the Regions (Flanders, Walloon and Brussels). They are on an equal footing but have powers and responsibilities for different fields. The next level down is occupied by the provinces and at the bottom level, there are the communes, which is the level of administration that is closest to the people.

- **Overview of the regulatory framework for heating or cooling networks**

The Decree basis of the Flemish energy policy can be found in the **Energy Decree of 8th May 2009** containing general provisions regarding energy policy. The implementation of the provisions is reported in the **Decree of the Flemish Government of 19th November 2010**.

The definition of "**heating and cooling networks**" according to the Energy Decree is important because it determines which systems must comply with legal obligations. The regulatory framework applies to all systems that fall under the definition of a heating or cooling network in the Energy Decree, art. 1.1.3.,133. It can be noticed that networks, where the heat distribution takes place entirely within the same industrial site, are excluded by this definition. And the distribution of heat from a production installation to several customers within one building is not regarded as a heat network. While collective boiler rooms that serve several buildings, whether or not within their own (non-industrial) site (e.g., heat networks on campus sites, sites with buildings for social housing), do fall under the definition.

In Belgium, both the regions and the federal government are responsible for the energy market. The **local transposition of the EED 2012/27/EU** has been carried out from the three Regions in 2015 and updated in 2020. Updated information about the local situation is reported in dedicated EU studies about heating and cooling. [3]

From 17th November 2020, **cost allocation for a central source for heating, cooling or hot tap water** has been defined. These rules apply in:

- apartment buildings or multifunctional buildings with a common source that serves different users within that building;
- buildings with several users that are connected to a heating or cooling network or to a central source that serves different buildings.

The **connection to heat or cold network** can be of two types:

- the heat/cold supplier has a contract directly with the individual end user. In that case, the supplier invoices based on the metered consumption and the agreed prices and the rules for cost allocation do not have to be followed;
- the heat/cold supplier has a contract with the association of co-owners (VME) and the VME divides the common costs among the individual units. In that case, the cost allocation rules apply.

The Royal Decree of 5th May 2022 setting **social maximum prices for the supply of heat** to protected residential customers was published in the Belgian Official Gazette (pp. 44720- 44721) on 24th May 2022. This royal decree states that heat companies supplying heat to residential protected customers must do so at the maximum prices set in accordance with this decree. The

[3] https://energy.ec.europa.eu/topics/energy-efficiency/heating-and-cooling_en

introduction of a social tariff for heat, analogous to a social tariff for natural gas and electricity, is important to protect vulnerable people from very high energy prices. Moreover, this legislation will also help make heat networks more attractive e.g., social housing companies.

For what concerns the application of the SO WHAT tool, it can be noted that there are ongoing discussions about the maximal cost of district heating for non-protected customers that can influence the business cases of district heating networks. In certain projects, the cost of the heat is not coupled to natural gas prices, but in most other projects the heat tariffs are based on the 'not-more-than-other principle' (Niet meer den anders - NMDA). This protects users from higher prices than natural gas-based heating. The maximum price paid by heat customers is on average no higher than the price paid when heating with a modern, natural gas-fired central heating system.

- **Building and renovation**

Since 2014, all buildings in Flanders for which an urban planning permit is requested or notification is made must meet certain energy performance standards. These standards are called the EPB requirements. EPB stands for '**Energy Performance and Indoor Climate**'. The size of the minimum share and the quality requirements that apply depends on the date of the building permit application, the nature of the works (new construction or major energy renovation) and the destination (residential building or non-residential building). Decree of the Flemish Government of 19 November 2010; Residential: art.9.1.12/2; Non-residential: art.9.1.12/3.
In addition to the mandatory share of renewable energy, there is also a 'mandatory renewable energy feasibility study' for large buildings. For new buildings with a usable floor area greater than 1,000 m², the feasibility of renewable energy technologies must be investigated. The scope explains which techniques to investigate, depending on the function and size of the building. Decree of the Flemish Government of 19 November 2010; art 9.1.13 and 9.1.14.

With the aim of promoting the SO WHAT tool application and replication it is important to highlight the following aspects of the regulatory framework that influence waste heat recovery and the use of renewable energy sources in this context:

- waste heat is considered when EPB is calculated, but there is a correction factor that makes connecting to a district heating network less attractive for owners of the building;
- the waste heat use is not defined as a renewable energy source in EPB, the renewable energy share of waste is 0%. As an exception, the renewable share of waste incineration plants, which falls under 6.1.10 of the Energy Decree, is equal to the amount of electricity production from the organic-biological part of residual waste, namely 47.78%.

These aspects make joining a district heating network less attractive than, for example, installing an individual heat pump powered by renewable energy.

- **Energy efficiency in the industry**

As the most important policy instrument to improve energy efficiency of the energy-intensive industry in Flanders without undermining its growth opportunities, the Flemish Government on 19 November 2002 signed the benchmarking covenant as an energy policy agreement in accordance with art. 7.7.1. of the Energy Decree.

The target group of the **benchmarking covenant** is the large energy-intensive establishments (annual primary energy consumption of at least 0.5 PJ) and the establishments that fall under the European directive on tradable emission allowances. By entering into the benchmarking covenant, the companies have entered into an obligation to bring and/or maintain the energy efficiency of their process installations at the world's top level by 2012.
By analogy with the benchmarking covenant for large energy-intensive sites, the audit covenant has been elaborated as an **energy policy agreement for medium-sized energy-intensive sites**. On 10 June 2005, the Flemish Government gave its final approval to the audit covenant. The aim is to strive for a win-win situation for companies and the government. Companies that join the audit covenant voluntarily have an audit carried out to map out their energy-saving potential. In addition, they undertake to effectively implement all economically justifiable energy-saving measures, as included in the energy policy agreement.
Additionality compared to the current regulations (Articles 6.5.1-6.5.8 of the Energy Decree, the former Energy Planning Decree) is expressed in the **IRR limits for profitable and potentially profitable investments**. In the new energy policy agreements, the limits for profitable investments are lower than in the Energy Planning Decree. An IRR limit of 14% is used for VER companies, the IRR limit is 12.5% for non-VER companies. The limit for a potentially profitable investment is set at an IRR of 10%.

Consultations with the sectors of the energy-intensive industry have shown that these limits are considered ambitious but achievable. After all, feasibility is a second important pillar of a voluntary energy policy agreement (covenant). Due to the feasibility of the engagement for potential entrants to the energy policy agreements, it can be stated that the degree of accession to these new energy policy agreements will be high. In this way, these voluntary agreements ensure that the energy-intensive industry of Flanders will remain at the forefront of energy efficiency and that energy efficiency improvements in these industrial sites will be realized faster and more far-reaching than through current legislation (Energy Planning Decree), as a result, it is also not necessary to adjust the definition of profitable investment in the context of the Energy Planning Decree.

New provisions in the energy policy agreements concern the potential studies for qualitative cogeneration and cooling and heating networks, as well as the implementation of energy management measures, the so-called broadening themes. This type of study could support the kind of investments that are promoted in SO WHAT.

An additional driver towards increased energy efficiency could be private and public **Energy Services Companies (ESCOs).** The development of the Belgian national and regional ESCO and EPC market is driven by the European climate policy and objectives, the 20-20-20 targets. On a more detailed level, the National Energy Efficiency Action Plan (NEAAP) and Regional Energy Efficiency Action Plan (REEAP) in Brussels, Flanders and Wallonia create an implementing framework that allows for more growth in the national and regional ESCO and EPC market and removes barriers for its successful development. Whereas the ESD created a general framework supporting energy services and ESCO development, the EED has set new targets and created initiatives to stimulate accelerated growth driven by Europe, based on **evidence that EPC is a key tool to reach the European climate and energy transition objectives**.[4]

[4] https://www.belesco.be/about-belesco/mission

2.3 Italy

The Italian Republic is composed of five constituent elements: metropolitan cities, municipalities, provinces, regions, and the State. Each region is a territorial entity with its own statutes, powers, and functions according to the principles established by the Constitution, as established by art. Paragraph 114 of the text. The regions are not considered local authorities (municipalities, provinces, etc.) which are instead governed by Legislative Decree no. 267 of 18 August 2000 (TUEL).

According to the current version of Article 117 of the Constitution, except for the determination of the fundamental principles of State competence**, the Regions have legislative power in the field of production, transport, and national distribution of energy**.

- **Overview of the regulatory framework for heating or cooling networks and combined heat and power (CHP)**

About DC/H, **Legislative Decree 311/2006** stipulated that all newly built buildings located no more than 1 km from a district heating network must be set up to allow connection to that network. This rule has been reinforced by Article 22 of Legislative Decree 28/2011, according to which infrastructure intended for the installation of networks for distributing renewable energy for heating and cooling are categorised, for all intents and purposes, as primary urban works.

On 19th July 2014**, Legislative Decree 102/2014** entered into force, **as a local implementation of Directive 2012/27/EU**, and in compliance with Law 96/2013 defines a set of actions to improve energy efficiency, in all areas useful for achieving the national energy savings target.

Article 14 of the EED 2012/27/EU, transposed in **Article 10 "Promoting efficiency for heating and cooling"[5], ** focuses on the identification of measures to be taken to exploit the high-efficiency cogeneration potential as well as district heating and cooling. To support the **synergies between district heating/cooling and industry,** thresholds are also defined, expressed in terms of useful waste heat, heat demand or distances between industrial installations and district heating networks.

In addition, it is defined that the owners or managers of cogeneration plants, except in cases where it is not economically viable, equip the plants themselves with **useful heat measuring** equipment. The cogeneration units with a generation capacity of less than 50 kWe, are not included by the latter indication.

The electricity produced by CHP (>50 MWh) can obtain a certificate of origin useful to the supplier for the sale in the network. Article 10 makes **mandatory the cost-benefits analysis for projects** of new industrial installations or substantial modernisation of existing installations with a **total input thermal input of more than 20 MW** generating waste heat at a useful temperature level, in order to assess the potential use of waste heat to meet economically justifiable demand, including through cogeneration, and the connection of this plant to a district heating and cooling network. The operator is supported by the companies responsible for the operation of district heating and cooling networks, where they exist.

About the investment promoted by the SO WHAT tool, it is important to highlight that any form of public support for cogeneration is subject to the condition that the electricity produced comes from **high-efficiency cogeneration** and that waste heat is used to meet an economic justifiable

[5] https://www.gazzettaufficiale.it/eli/id/2014/07/18/14G00113/sg

application. The high-efficiency cogeneration criteria are defined by DM 5/9/2011 and reported in the "Guida alla Cogenerazione ad Alto Rendimento – CAR" issued by Gestore dei servizi energetici (GSE)[6]. The CAR criteria respect is fundamental to obtaining **economic support, through white certificate incentives.**

The high-efficiency cogeneration and DH/C are able to get **some tax benefits** concerning heat production. Fuel consumption by cogeneration units and integration boilers that are connected to the same district heating network benefits from the reduced rate of excise duty for industrial uses (and the relevant share of the reduced rate for electrical uses), provided that certain conditions are met (high-efficiency cogeneration and power-to heat ratio > 10%). If this requirement is not met, this consumption is subject to the rate of excise duty for civil uses.

In Italy, as described in Art. 10 of Legislative Decree 102/2014, the National Authority (ARERA) **sets the tariffs for connection** to the district heating/cooling network while the supply cost can be variable according to the evolution of the market. In the case of heating/cooling recovery and exporting to DH/C networks from industrial plants, specific bilateral contracts have to be concluded between the DH/C network operator and the company that produces the waste heat/cold. Thus, the economic feasibility of selling waste heat/cold to the network depends on the sales price fixed with the network operator.

- **Energy efficiency and building renovations**

Article 11 of Legislative Decree 28/2011 lays down an **obligation to integrate renewables into heat and cold production in new and existing buildings** undergoing major renovation works, with the issuing of the building permit being made subject to compliance with that obligation. **This obligation does not apply** if the building is connected to a district heating network covering its entire primary energy demand for winter heating, space heating and domestic hot water supply.[7]

Sustainable building renovation plays a key role in the transition to clean energy systems and economies. Article 15 of Legislative Decree No 102/2014 established the Italian national energy efficiency fund (*il fondo nazionale per l'efficienza energetica)*, a revolving fund designed to support the financing of measures to help achieve national energy efficiency targets, by encouraging involvement from national and EU financial institutions and private investors on an appropriate risk sharing basis, for the following purposes:

- implementing measures to improve energy efficiency in buildings owned by the public administration;
- building district heating and district cooling networks;
- ensuring energy efficiency of public services and infrastructure, including public lighting;
- ensuring energy efficiency in entire buildings intended for residential use, including social housing;
- ensuring energy efficiency and reducing energy consumption in industry and the service sector.

[6] https://www.gse.it/documenti_site/Documenti%20GSE/Servizi%20per%20te/COGENERAZIONE%20AD%20ALTO%20RENDIMENTO/Guide/Aggiornamento%20Guida%20CAR%20-%20revisione%202019.pdf

[7] https://energy.ec.europa.eu/system/files/2021-10/it_ca_2020_it.pdf

As regards interest rate incentives, subsidised loans granted by the European Investment Bank play an important role in the development of the sector.[8]

Decree No 102/2014 promotes the introduction of the **energy management system, energy audits, collaboration with ESCOs and energy performance contracts**, to support building renovation and to improve energy efficiency in the industry.

In conclusion, there are different policies and measures have been implemented to promote energy efficiency in industry, and that could support the solutions promoted in the SO WHAT tool, for example:

- **Mandatory Energy Audit:** for large enterprises and those with high energy consumption, it introduces energy audits mandatory: they must be run by 5 December 2015 and then every four years;
- **White Certificates Scheme (WhC)**: this scheme was created in 2001 with the purpose of promoting energy efficiency, including the ESCOs and accounting for energy savings. Almost every project involving improved efficiency in the final consumption of energy is eligible under the scheme – from boilers to lighting systems, from solar thermal to cogeneration, from electric motors to industrial process projects – except for projects aimed at increasing efficiency in electricity generation. Each of the eligible projects is expected to issue white certificates for five years (eight years for building envelope-related projects and ten years for high-efficiency cogeneration). The Italian WHC scheme considers only additional savings (also referred to as "additionality"). It means that a market and regulatory baseline is defined for every technology. Savings are first evaluated as the difference between the ex-ante and ex-post situations and then reduced if the ex-ante level is below the baseline. Annually, once obtained the WHCs, these can be sold at a variable price on the market or at a fixed price, agreed with GSE at the start of the project.
- **Transition Plan 4.0:** it supports private investments for innovation and digitalisation of production processes, the ecological transition, the improvement of technical skills of employees and the development of new products and processes through the tax credit.

2.4 Portugal

The regulatory framework for energy in Portugal is divided into several distinct regulatory entities, each with a specific set of duties. The regulatory body for electricity, gas, and liquefied petroleum gas in Portugal is called ERSE. It is a public organisation with administrative and financial autonomy that is also in charge of arbitrating disputes and working to improve the sector's economic and environmental conditions over time. In addition to ERSE, the General Directorate for Energy and Geology (DGEG) is another state-run organisation whose goal is to support the planning, development, and implementation of the state's policies addressing the exploitation of natural resources and energy-related issues. In addition, the Portuguese Environment Agency (APA) is the country's regulating body for dam safety, waste management, and hydroelectric resources. It also has broad powers concerning other environmental matters, the most important being the responsibility for conducting environmental assessments for energy market-related projects.

[8] https://energy.ec.europa.eu/system/files/2022-05/IT%20CA%202020%20en.pdf

- **Overview of the regulatory framework for heating or cooling networks, electricity self-production and combined heat and power (CHP)**

The Portuguese regulatory framework concerning **waste heat and cooling recovery** is led by **Directive 2012/27/EU** of the European Parliament and the Council of 25 October 2012 on Energy Efficiency (the Energy Efficiency Directive).
That Directive was transposed into Portuguese legislation in 2015 through **Decree-Law 68-A/2015**, of 30th April, regulating energy efficiency and cogeneration, including regulations regarding energy audits, accreditation of service suppliers and energy auditors.

In accordance with the mentioned Directive, **Decree-Law 68-A/2015** establishes which installations must carry out a cost-benefit analysis in order to assess the potential of using high-efficiency cogeneration and/or the connection to a district heating and cooling system. The conditions to perform the **cost-benefit analysis** are defined in Annex IX of Decree Law 68-A/2015.

Among the installations that must carry out this analysis are **industrial installations and thermal energy production installations in a district heating and cooling network**, in both cases when total thermal input exceeds 20 MW. This requirement applies to both new installations and existing ones when a refurbishment is planned.

Regarding **industrial electricity self-consumption**, **Decree Law 15/2022** of 14 January, establishes the organization and functioning of the National Electric System and incorporates the regulations related to **renewable self-consumption**, regulating the administrative, technical, and economic conditions of the self-consumption of electric energy.

It establishes the conditions for the installation of a Production Unit for self-consumption (UPAC), defining two self-consumption categories:

- Individual Self-consumption. UPAC is associated with an installation of usage (IU);
- Collective Self-consumption. UPAC is associated with more than one installation of usage (IU). In this case, there are three options:
    - Collective self-consumption in an internal network;
    - Collective self-consumption using the electricity grid public service;
    - Collective self-consumption in internal network with storage.

This decree-law reduces the administrative burden for installations of self-consumption including the one associated with the creation of renewable energy communities (REC), regarding self-consumption collective systems. The different options for renewable self-consumption are summarized in the following table.

Regulatory aspects	Type of self-consumption			
	Self-consumption individual	**Collective self-consumption in an internal network**	**Collective self-consumption using the electricity grid public service**	**Collective self-consumption in internal network with storage**
What it means	Renewable production within a utilization facility (IU)	Renewable energy production for sharing between participants connected by a private grid	Renewable energy production for sharing between participants connected by the public grid	Renewable energy production, Including a storage system, for sharing between participants connected by a private network *

Who can access	- Domestic consumers, companies, utilities - On an individual basis	- Domestic consumers, companies, condominiums, public services - At least 2 participants	- Domestic consumers, companies, condominiums, public services - At least 2 participants	- Domestic consumers, companies, condominiums, public services - At least 2 participants
Where to place the production	- Residential, commercial, and industrial buildings - Inside consumption facilities	- Residential, commercial, and industrial buildings - Close to consumer facilities, connected to private networks	- Residential, commercial, and industrial buildings - Close to consumer facilities, connected to public networks	- Residential, commercial, and industrial buildings - Close to consumer facilities, connected to public networks
Obligations	- Licensing and ensuring installation by an accredited entity - Support charges with production meters - Pay the tariffs associated with the billed consumption of the network	- Define a participant or independent entity as responsible (EGAC) - Licensing and ensuring installation by an accredited entity - Support charges with production meters - Supply contract for UPAC [own consumption] - Pay associated fees to billed network consumption	- Define a participant or independent entity as responsible (EGAC) - Licensing and ensuring installation by an accredited entity - Support charges with production meters - Supply contract for UPAC [own consumption] - Pay tariffs associated with the billed consumption of the network and the energy produced and self-consumed [that circulates in the public network]	- Define a participant or independent entity as responsible (EGAC) - Licensing and ensuring installation by an accredited entity - Support charges with production and storage meters - Supply contract for UPAC and storage - Pay tariffs associated with the billed consumption of the network

* When connecting to the public network, the UPAC rules applied to "Collective self-consumption using the electricity grid public service".

There is no specific regulation governing the sale of thermal energy to third parties in Portuguese legislation. The only requirement is to become an **energy services provider**, which is any natural person or legal entity that provides energy services or applies measures to improve the energy efficiency of an end customer.

In Portugal, the figure of an energy services provider is regulated by **Order 6227/2022,** of 18 May 2022, which sets up that energy services providers, in the case of being a legal entity, will include, in its corporate purpose activities related to the provision of energy services or the application of measures, to improve the energy efficiency in installations.

In addition, it must prove an adequate technical qualification, according to the new Regulation of the Qualification System for Energy Service Companies (SQESE).

Regarding **industrial cogeneration (CHP),** the following national regulation must be considered: the **Decree Law 68-A/2015, of 30 April**, establishing regulations on energy efficiency and cogeneration production, transposing Directive no. 2012/27/EU, of the European Parliament and of the Council, of 25 October, on energy efficiency. This decree also establishes the discipline of the cogeneration activity.

Finally, regarding **district heating and cooling networks, there is no specific regulation** governing their implementation in Portuguese law.

2.5 Romania

The Regulatory framework for the integration of WH/C in District Heating Systems is following a harmonization with the European directives and initiatives and the regulatory framework in other EU Member States. Below, several aspects from the perspective of Romanian laws are presented.

- **Overview of the regulatory framework for heating or cooling networks**

Following the requirements of Article 14 of Directive 2012/27/EU, in July 2014, Romania implemented the cost-benefit analysis methodology by the following legal documents:

- **LAW no. 121 of July 18**, 2014, regarding energy efficiency, with subsequent amendments, Article 14, Appendix 7.
- **Government's emergency ordinance no. 130 of September 29, 2022,** for the amendment and completion of Law no. 121/2014 regarding energy efficiency.

The cost-benefit analyses must be carried-on to fulfilling the requirements mentioned in art. 14 para. (6) and (10) of the law. If an installation that produces only electricity or an installation without heat recovery is planned, **a comparison must be made between the planned installations or the planned rehabilitation and an equivalent installation that produces the same amount of electricity or process heat**, which recovers waste heat and/or provide heat through high-efficiency cogeneration towards district heating and cooling networks.
The cost-benefit analysis is based on a description of the planned facility and the reference facility, in terms of electrical and thermal capacity, as applicable, fuel type, planned use and number of planned annual operating hours, location and demand for electrical and thermal energy. Cost-benefit analyses will include an economic analysis, aimed at a **financial analysis**, which reflects the real transactions of financial flows from the investment in individual facilities and their operation.
Projects with positive results in terms of costs and benefits are those where the sum of the discounted benefits in the economic and financial analysis exceeds the sum of the discounted costs (cost-benefit gains).

About the **thermal energy sale regulation**, in the Romanian regulatory **framework, there is a specific regulation** for companies that wish to sell thermal energy: **Law no. 325/2006 of the public thermal energy supply service**, which states:

- "(3) For the activity of thermal energy production in thermal power plants, intended for DH, and the transport, distribution and supply services of thermal energy through DH, **the prices and tariffs are established, adjusted or modified by the administrative-territorial authorities**, at the request of the operators, with the approval of the competent regulatory authority, based on the methodologies developed by the competent regulatory authority;
- (4) The local price, consisting of the production price of thermal energy and the tariffs for transport, distribution and supply services are established, adjusted or modified at the request of the operators of the public thermal energy supply service, with the approval of the competent regulatory authority, through decisions of the administrative-territorial authorities, based on the methodology developed by the competent regulatory authority.

- **Industrial electricity self-consumption from Renewable Energy Sources - RES**

The regulatory framework for the development of equipment and installations to produce industrial power for self-consumption from Renewable Energy Sources is including the following legal documents:

  - LAW no. 123 of July 10, 2012, electricity and natural gas, with subsequent amendments, ISSUER Romanian Parliament. Published in the Official Monitor no. 485 of July 16, 2012.
  - ORDER no. 19 of March 2, 2022, for the approval of the Procedure regarding the connection to the electricity networks of public interest of the places of consumption and production belonging to the prosumers Issuer National Energy Regulatory Authority Published in the Official Monitor no. 222 of March 7, 2022.
  - Order no. 15 of February 23, 2022, for the approval of the Methodology for establishing the rules for the sale of electricity produced in power plants from renewable sources with an installed power of no more than 400 kW per place of consumption belonging to prosumers Issuer National Energy Regulatory Authority published in the Official Monitor no. 215 of March 4, 2022.

The methodology **supports end-users who have the quality of prosumers**, in the sense that they have ensured the electricity produced for their consumption, but also the sale of exceeding electricity produced from renewable sources by supply to the local grid. The main changes brought by the new Methodology refer to the followings:

  - Prosumers who own electricity production units from renewable sources with an installed **power of no more than 400 kW** per point of consumption can sell the electricity produced and supplied through the grid to electricity users with whom they have signed electricity supply contracts, according to ANRE regulations;
  - At the request of prosumers who produce electricity in electricity production units with an installed **power of up to 200 kW** per point of consumption, the grid operators with whom they have concluded contracts for the supply of electricity are obliged to proceed iwith the invoice of prosumers with a quantitative compensation between the electricity produced and delivered to the network and that consumed. In the situation where the amount of energy produced and delivered to the network is greater than the amount of electricity consumed, prosumers are able to use the amount of electricity carried forward for a maximum period of 24 months from the date of invoice;
  - At the request of prosumers who produce electricity in energy production units with an installed power between **200 kW and 400 kW** per place of consumption and with whom they have concluded electricity supply contracts, electricity suppliers are obliged to purchase electricity produced and delivered at a price equal to the weighted average price recorded in the market for the next day in the month in which the respective energy was produced and to realize in the prosumers' invoice the financial regularization between the electricity delivered and the electricity consumed from the network.

- **Combined Heat and Power (CHP) in industry**

In Romania, there are support schemes that are applied to promote the production of electricity from renewable sources and based on high-efficiency cogeneration plants. For this purpose, for the transposition of Directive 2004/8/EC of the European Parliament and of the Council of February 11, 2004, on the promotion of cogeneration based on the demand for useful thermal energy on the internal energy market and amending **Directive 92/42/EEC, a government decision** was issued with no. 219 of February 28, 2007, regarding the promotion of cogeneration based on the demand for useful thermal energy (updated on October 19, 2015).

The decision establishes the **legal framework necessary** for the promotion and development of **high-efficiency cogeneration of thermal energy and electricity**, based on the demand for useful thermal energy and the saving of primary energy on the energy market, in order to increase energy efficiency. A **bonus-based support scheme is applied** - the support scheme in which the producer of electricity and thermal energy in cogeneration receives for each unit of electricity produced under high-efficiency conditions and which is intended for internal consumption a fixed amount of money (lei/ kWh), called a bonus.

- **Building renovations**

The requirements set out in **Directive 2018/844/EU** of the European Parliament and of the European Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency, the member states must comply with the guidelines established in the annex to Recommendation (EU) 2019/786 of the European Commission of May 8, 2019, regarding the renovation of buildings.

These requirements have been transposed in the Romanian regulation framework by the **Government Decision no. 1,034 of November 27, 2020,** for the approval of the National Long-Term Renovation Strategy to support the renovation of the national inventory of residential and non-residential buildings, both public and private, and its gradual transformation into a real estate inventory with a high level of energy efficiency and decarbonization until 2050, issued by the Government of Romania, published in the Official Monitor no. 1247 of December 17, 2020.

The main objectives of the National Long-Term Building Rehabilitation Strategy, related to decarbonization and the improvement of energy efficiency are the following:

- improving the energy performance of the existing building inventory by reducing energy consumption, and carbon emissions and expanding the use of renewable energy sources in buildings;
- streamlining the financing mechanisms regarding the renovation of the built inventory;
- developing professional skills regarding energy efficiency in buildings and supporting innovation;
- increasing the quality of the built inventory by improving the safety of buildings and ensuring the architectural quality and integration into the urban environment of the renovation interventions.

2.6 Spain

The Spanish regulatory context is divided into several levels. Moreover, under Spain's decentralised system of government, regional administrations have considerable authority over energy policy development and implementation. It's crucial making effective coordination between the centre and the regions to successfully enactment of energy strategies in Spain.

- **Overview of the regulatory framework for heating or cooling**

Article 14 of the previously mentioned Energy Efficiency Directive (EED) 2012/27/EU was transposed into Spanish legislation in 2016 through **Royal Decree 56/2016**, of 12 February, transposing Directive 2012/27/EU, on energy efficiency, as regards energy audits, accreditation of service suppliers and energy auditors, and the promotion of efficiency in the energy supply.
In accordance with the mentioned Directive, Royal Decree 56/2016 establishes which installations must carry out a cost-benefit analysis in order to assess the potential of using high-efficiency cogeneration and/or the connection to a district heating and cooling system. Among the installations that must carry out this analysis are **industrial installations and thermal energy production installations in a district heating and cooling network**, in both cases when total thermal input exceeds 20 MW. This requirement applies to both new installations and existing ones when a refurbishment is planned.

This Royal Decree established the Institute for the Diversification and Saving of Energy (IDAE) as the entity in charge of the publication of a **Methodological guide for the development of a cost-benefit analysis.** IDAE is the Spanish national entity for energy efficiency, and it published this guide in July 2019. In this sense, although Article 14(5) of the Energy Efficiency Directive was transposed in 2016, it did not come into force until July 2019 since installations did not have a guide to follow when carrying out the cost-benefit analysis.

Regarding the content of the **Methodological Guide published by Instituto para la diversificación y el ahorro de la energía (IDEA) in 2019,** it points out that the owner of the installation is usually the one in charge to carry out the cost-benefit analysis. This analysis will include a technical-economic analysis for each waste heat recovery alternative that is identified. In the case of industrial installations, the objective of the technical analysis is to identify available waste heat and to evaluate the costs and benefits of using it (including co-generation technologies if needed) or transferring it into a district heating and cooling network. The guide also proposes electricity generation (for self-consumption or export to the grid) and heat export to district heating and cooling networks as alternatives that can be considered when evaluating the use of waste heat.

For the economic analysis, the **net present value (NPV) will be calculated for each alternative** and compared with a baseline situation. This calculation will be based on the associated economic costs and revenues, as well as the initial investment, and these will be used to calculate the cash flow over the life cycle of the project. For industrial installations, the guide identifies that the operating costs that have to be considered are O&M, fuel purchase, thermal energy purchase, electrical energy purchase and emissions allowances (if fossil fuels are used). And for operating revenues, thermal energy sales and electricity energy sales (if a cogeneration plant is considered) will be considered. Once the cost-benefit analysis has been developed, the potential for waste heat recovery with high-efficiency cogeneration systems or district heating and cooling networks

will be studied. There will be economically feasible potential for an alternative if the NPV, compared with a baseline situation, is positive.

- **Electricity and District heating/cooling networks**

Regarding the industrial energy self-production and consumption, **Royal Decree 244/2010** of 5th April regulates the administrative, technical and economic conditions of the self-consumption of electricity and identifies two self-production categories:

- **Self-consumption without a surplus** includes a mechanism to prevent the injection of surplus energy into the transmission or distribution network that has to be installed;
- **Self-consumption with surplus**: where surplus energy will be injected into the transmission or distribution network. In this case, there are several options:
  - for those facilities with a capacity of **no more than 15kW**, the surplus energy will be compensated. That means that two-way meters will measure the amount of energy that is injected into the network, and at the end of the month, the energy that has been consumed will be compensated with the exported energy;
  - for those facilities **exceeding 100 kW**, the surplus energy will be directly sold to the electricity market, but not compensated;
  - for those facilities **exceeding 15 kW but with a capacity of no more than 100 kW**, the self-consumption model will depend on the energy demand pattern. For instance, a facility with a seasonal energy demand will sell its surplus energy to the electricity market since that surplus energy cannot be monthly compensated. However, a facility with surplus energy every month will compensate for that energy instead of selling it.

On the other hand, there is **no specific regulation governing the sale of thermal energy** to third parties in Spanish legislation. **Article 24 of 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, which assesses district heating and cooling networks, has not been transposed into the Spanish law yet. In Spain, the only requirement is to become an **energy services provider,** which is any natural person or legal entity that provides energy services or applies measures to improve the energy efficiency of an end customer. In Spain, the figure of an energy services provider is regulated by **Royal Decree 56/2016**, which sets up that energy services providers, in the case of being a legal entity, will include in their corporate purpose activities related to the provision of energy services or to the application of measures to improve the energy efficiency in installations. In addition, it must prove an adequate technical qualification.

- **Combined Heat and Power (CHP)**

Regarding industrial cogeneration (CHP), the production of electricity from renewable energy sources, cogeneration and waste is regulated bythe **Royal Decree 413/2014**, which establishes the "specific remuneration scheme" as an instrument for economic support. This Royal Decree classifies the facilities to which it applies into 20 different categories, divided into the following main groups:

a) Use cogeneration or other forms of electricity production from waste energies;
b) Use non-fossil renewable energies as primary energy;
c) Use waste for energy recovery not contemplated in (b), certain facilities using biomass as fuel when they do not comply with the consumption limits laid down, and facilities using black liquors.

The specific remuneration depends on the generation technology and therefore "hybrid" generation plants are not generally allowed. However, this Royal Decree establishes which **hybrid facilities are included in the specific remuneration scheme.** During its regulatory life span, these installations may receive, in addition to the remuneration for the energy sold to the electricity market, a specific remuneration consisting of remuneration for investment and remuneration for the operation. It is important to remark that due to this extra remuneration, most of the cogeneration industrial systems inject all their electricity production into the grid, so there is no electricity self-consumption.

The granting of the specific remuneration scheme will be generally established by a competitive tendering procedure. To receive this remuneration, in the case of cogeneration installations, they must accredit compliance with **minimum energy efficiency levels**, which are defined in **Royal Decree 616/2007.** This Royal Decree defines high-efficiency cogeneration as the one that provides **primary energy savings of at least 10%** compared with the references for separate production of heat and electricity, and it establishes a methodology for calculating the efficiency of the co-generation process.

In addition, the IDAE published in 2008 the **"Guide for the measurement and determination of useful heat, electricity and primary energy savings of high-efficiency cogeneration"**, which presents a methodology for obtaining these parameters.

A **future Ministerial Order** is also being developed to establish the mechanism for granting the specific remuneration scheme in accordance with the Royal Decree, as well as the requirements that the installations have to comply with. This Ministerial Order would apply to installations with a total input of up to 50 MW. It would also make the granting of the specific remuneration scheme conditional on compliance with the high-efficiency requirements established in Royal Decree 616/2007, but it would also include other requirements. For instance, in the case of cogeneration installations using natural gas as fuel (when it accounts for at least 95% of primary energy, or 65% if the rest of it comes from biomass or biogas), this natural gas would have to contain at least 10% of green hydrogen. Furthermore, these installations would have to provide primary energy savings (compared with the references for separate production of heat and electricity) of at least 5% if the total input does not exceed 1 MW and 15% otherwise.

With the aim of promoting self-consumption in cogeneration installations, the Ministerial Order would require those installations to become one of the self-consumption categories defined in **Royal Decree 244/2019**. In addition, they would have to guarantee a self-consumption ratio of at least 30% every 6 months, calculated as the ratio between self-consumed electrical energy and net electrical energy produced by cogeneration. **That means that industrial cogeneration facilities would not be able to sell more than 70% of their electricity production**.

2.7 Sweden

Municipalities and regions are important for Sweden's climate work. Their closeness to the population, their role in town and country planning and the fact that they are major employers make them important operators in the work to meet climate targets. The municipalities work with companies, organisations, and other operators to drive local developments, thus helping to meet national and local targets. The primary aim of the regional energy management agencies is to promote energy efficiency and renewable energy sources locally and regionally. They work with public and private operators on assignments and projects based on international and national energy and environment goals. [9]

- **District heating and cooling networks and energy efficiency in industry**

An inquiry that was carried out in 2005 suggested a specific District Heating Act to increase trust between district heating customers and producers. Up until then, the regulation of district heating was split between different laws: the **Electricity Act, the Pipeline Act and the General Heating Systems Act.** The District Heating Act was implemented in 2008 and states that the district heating company must account for how the price is decided and where that information can be found, and customers have the possibility to terminate their contract if they do not accept the new terms.

On the 21st of April 2022, the Swedish Government decided upon a revision of the district heating law with changes concerning **district cooling and the use of waste heat**. The updated law came into force on the 1st of June 2022. Changes and clarifications are made concerning measuring, invoicing, and the provision of information. For instance, information on **energy performance and share of renewable energy** is supposed to be available to the public and customers. A new district cooling law (2022:332) has been established with rules and regulations concerning measuring and invoicing for district cooling. There are also demands regarding the information on energy use that shall be given in connection with invoicing. An exception to the localization principle in municipal law was implemented for district cooling systems. The result of that exception is for example that municipalities can conduct business in another municipality if it is in the geographical vicinity of the area.[10]

In Sweden, the law that regulates the **cost-benefit analyses** in the energy context was implemented in May of 2014 (2014:268), with the purpose of creating a more efficient energy supply. The law states that cost-benefit analyses shall be carried out to investigate the potential for use of highly efficient combined heat and power, district heating and cooling and waste heat from industries. This law stems from the implementation of article 14.5 in the previously mentioned EED (2012/27/EU) and is also combined with article 14.1 about the potential for highly efficient combined heat and power, district heating and cooling.

All district heating companies and industries planning for a new plant, or a larger upgrade of their system are obliged to carry out a cost-benefit analysis to scan the possibilities to receive and/or deliver waste heat. The law is applicable during certain prerequisites; those stakeholders are within a certain radius, they can deliver temperatures over a certain level and the plants' effect is over 20 MW. Even thermal electricity production sites, so-called condensing power, are included

[9] https://www.government.se/4a9ef2/contentassets/e731726022cd4e0b8ffa0f8229893115/swedens-draft-integrated-national-energy-and-climate-plan

[10] https://www.energiforetagen.se/medlemsnyheter/2022/april-22/riksdagsbeslut-om-ny-fjarrkylelag-och-andringar-i-fjarrvarmelagen/

in the law and shall at the planning of a new site, or renovation, make a cost-benefit analysis to see if it is economically viable to run the plant as a combined heat and power plant.[11]

- **Combined Heat and Power (CHP) and renewable energy production**

The joint market for **green certificates** for electricity is regulated by the law on electricity certificates (2011:1200). The purpose of the law is to promote renewable electricity in order to reach the goal of 46,4 TWh of new renewable energy. This goal is set together with Norway.[12] Electricity certificates are applicable for production units larger than 50kW.

The Renewable Electricity Certificate (REC) is a market-based support system to increase the amount of renewable electricity produced in Sweden. The sources that are qualified for REC are wind power, certain hydropower, certain biofuels, solar energy, geothermal energy, wave energy and peat in combined heat and power plants. Every producer of renewable energy receives a certificate for each MWh produced energy. The certificates can thereafter be purchased on an open market by stakeholders who are subject to quotas. These companies include the following electricity suppliers:

- electricity users who use the electricity produced by themselves;
- electricity users who import or buy electricity on the Nordic electricity exchange and by the Swedish Energy Agency registered electricity-intensive industries. These stakeholders are obliged to buy a certain share of electricity certificates which is determined in the Electricity Certificates Act.

In addition. the law on energy taxes regulates which taxes for fuels and electric power are to be paid to the state. The electricity law regulates the measuring, calculating, and reporting of transferred electricity. For instance, **solar power plants** with a maximum of 63 amperes and producing electricity with an effect of a maximum of 43,5 kW should not pay a fee to the electricity network company. This only applies if the electricity user, during a year, has a higher outtake of electricity than has been delivered. If you produce more electricity than you consume and have a plant that can produce a maximum of 1500kW (smaller production plant), you pay a reduced network fee for the input.

- **Building and renovation**

If the establishment requires a building permit this is regulated via the Planning and Building Act. This depends on how the installation is designed, if the building is of special importance and where the building is located. Via the law, on guarantees of origin for electricity, the stakeholder who produces electricity gets guarantees issued that shows the origin of the electricity.

The governmental support for solar cells is regulated by 2009:689. It seeks to promote the transition of the energy system and industrial development by increasing the number of stakeholders within solar power systems, reducing costs and increasing the yearly production of solar power.

[11] https://www.energimyndigheten.se/energieffektivisering/lagar-och-krav/lagen-om-vissa-kostnadsnyttoanalyser-pa-energiomradet/

[12] https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/lag-20111200-om-elcertifikat_sfs-2011-1200

2.8 United Kingdom

The UK Industry accounts for a quarter of UK total emissions and the UK government is committed to meeting the net zero target. Following the **UK's Climate Change Act**, passed in 2008, the government is setting new targets into law for reducing the UK's emissions by at least 80% by 2050. The focus for the energy transition in UK's industry is on **utilising renewable** resources and **increasing efficiency**. Therefore, the UK government examined, in 2018, the development of solutions for energy efficiency enhancement to offset the emissions in the heating system through waste heat recovery schemes. The key relevant regulations related to industrial waste heat recovery and industrial energy efficiency are discussed below.

- **Combined Heat and Power (CHP) and renewable energy production**

The European Renewable Energy Directive 2018/2001 (RED II) defines in art. 3(1) the compulsory objective of reaching the threshold of 32% of energy transformation from renewable sources within 2030. **The entry into force of regulation was on December 24, 2018, for the UK[13].**

The **Energy Efficiency Directive (EED) 2012/27/EU** was transposed on the 25th of October 2012 by the Government of the UK by updating the legal directives defined by the European Union for energy efficiency. The directive aims at achieving the objective of reducing by 20% the requirements of primary energy within 2020 and rising this amount after this date through further energy efficiency enhancements. Art. 14.5 expands the scope and replaces the substantive provisions of the Cogeneration Directive 2004/8/EC relating to cogeneration (CHP) for the UK[14]. The EED states that a Cost Benefit Analysis (CBA) needs to be conducted in specific cases occurring after the 5th of June 2014. These instances are identified in the following[15].

- An industrial facility with a total amount of **thermal input power greater than 20 MW** (GCV) is designed or significantly refurbished as stated by art. 14.5 (c). In this case, the motivation of CBA is assessing the feasibility of exploiting waste heat for satisfying a power request providing economic advantage by means of energy cogeneration or the connection of the installation to a district heating and/or cooling system.
- **A new district heating and/or cooling system is designed,** or an existing system has an installation for power conversion with an overall thermal input over 20MW (GCV) which is new or considerably refurbished as defined by art. 14.5 (d). The target of the CBA is to evaluate the advantages and drawbacks of using waste heat from industrial facilities within reasonable reach.

The CHP regulation is intended to control, evaluate, and boost the quality of this technology in the UK. For this purpose, a plant is considered a 'Good Quality' CHP plant if a quality index of at least 105 is present at the design, specification, tendering and approval stages. **The quality index is a function of their heat efficiency and power efficiency.**

The CHP plants with rated power over 2MWe are exempt from the CPF for fuels utilised in transforming Good Quality electricity for self-supply or being exploited 'on-site'. The CHP plants

[13] Renewable Energy Directive (EU) 2018/2001 (RED II)—snapshot, https://www.lexisnexis.co.uk/legal/guidance/background-to-renewable-energy-directive-2018-2001-ec-01

[14] Consultation on the transposition in England and Wales of Articles 14(5)-(8) of the energy efficiency Directive (2012/27/EU), https://consult.defra.gov.uk/atmosphere-local-environment-team/eed_consultation/

[15] EU Energy Efficiency Directive, https://consult.defra.gov.uk/atmosphere-local-environment-team/eed_consultation/supporting_documents/EE%20Directive%20Article%2014%20Exemption%20Thresholds%20%20Consultation%20version%20Nov%20....pdf

with full or partial certification of Good Quality within the CHPQA and achieved a Secretary of State Exemption Certificate are exempted from the principal rates of the Climate Change Levy (CCL) regarding two aspects. The first is the fuel utilised, under the hypothesis of reaching a threshold of 20% for power efficiency; however, this amount of expenditure exoneration is re-scaled. The second is the direct and self-supply of the power made available under the assumption of reaching the quality required; any other way, the qualifying power output (QPO) is re-scaled.

The systems with certification of Good Quality are suitable for applying for the Enhanced Capital Allowances (ECA) **which is a fiscal advantage enabling a business to write off the total amount of investments in new CHP facilities at the end of the first fiscal year**. Moreover, Good Quality CHP plants have the advantage of being subject to a preferential business rate regime.

Financial support is provided to Micro-CHP installations by the Green Deal, which is a set of regulations for fostering investments for the enhancement of energy efficiency. It is based on the contribution to the payment of loan rates through a charge on the electricity meter. Furthermore, domestic micro-CHP systems are subject to a reduced VAT of 5%, instead of 20%.

- **District heating and cooling networks**

A relevant part of the environmental legislation of the UK is aligned with EU laws. It will take time to develop the transposition of the European legislation after the Brexit. Even though the Governments of England, North Ireland, Scotland and Wales are cooperating for transposing the EU environmental regulations into UK law, a plan for new regulatory measures is not currently present[16].

The Scotland Building Act 2003 (Charging Orders) Regulations 2014 is the legislation establishing the building regulations in Scotland. It gives the Scottish Ministers the possibility of amending UK regulations for certain aspects, including promoting the conservation of fuel and power and fostering the sustainable development of renewable energy. This results in stricter legislation and policies on decarbonisation and DHC for Scotland regarding the rest of the UK[17].

  - **Regulation regarding grid access and usage**: Due to a lack of regulation, the Association for Decentralised Energy has set up a non to profit organisation called Heat Trust that wants to hold the industry to account for the benefit of everyone involved. When a member, heat suppliers have to apply strict customer service standards;
  - **Regulation of prices for consumers**: In the regulation of ownership and operatorship the industry has set up the Heat Trust, a voluntary consumer protection scheme for heat networks, which provides some level of protection to customers on heat networks. Heat Trust has grown to cover 10% of heat network consumers. The industry has also set up the Heat Networks Industry Council (HNIC), which will identify an ask and an offer from the government on behalf of the industry.

[16] Overview of District Heating and Cooling Markets, https://op.europa.eu/o/opportal-service/download-handler?identifier=30058105-eac0-11ec-a534-01aa75ed71a1&format=PDF

[17] Spatial policy for 4DHC, https://guidetodistrictheating.eu/wp-content/uploads/2020/08/HeatNet-NWE_Spatial-Policy-for-4DHC_District-Heating.pdf

- **Regulation of metering**: The Heat Network (Metering and Billing) Regulations (2014) apply to systems for heating or cooling ambient and for supplying hot water from a district heat network to a building with one or more final customers. In these cases, the energy suppliers must install meters for measuring the energy provided to the building for these purposes. In addition, the existing buildings are subject to the Heat Regulations requiring being registered to the scheme and fulfilling mandatory building level meters if a multi-occupancy level building is present. This duty is not requested when justified reasons for not feasibility are proved or the implementation of the regulations does not meet an adequate level of effectiveness regarding total cost. The installation of sub-meters is mandatory for new buildings according to the Part L of the building regulations. As new dwellings, these are heat meters for each apartment and they are generally installed with Heat Interface Units.
- **Support framework for renewable heat:** Incentives are defined for either domestic or non-domestic renewable systems. The Non-Domestic Renewable Heat Incentive (RHI) is a price-based method for the support of non-domestic renewable energy sources for heating (RES-H) systems with a defined level per energy unit converted, that can be paid for 20 years. The refund is given to industries, businesses and public sector institutions. Aerothermal, hydrothermal, biomass, geothermal and solar thermal systems and CHP plants are eligible technologies for support under technology-specific requirements. More specifically, the CHP plants considered are those generating heat and power from solid biomass, biogas and deep geothermal sources. Price-based mechanisms for Domestic Renewable Heat Incentives for homeowners, private landlords, social landlords and self-builders.

- **Energy efficiency: facilitators and programmes**

The UK Energy Efficiency Strategy is faced with four barriers: the existence of only an anembryonic energy efficiency market, information, misaligned financial incentives, and undervaluing of energy efficiency solutions. For the first barrier, the UK government tried to diversify the market, therefore some schemes and programmes are outlined in the UK to remove any foreseen barriers and increase the chance of industrial waste heat project implementation.

IHRS: The Government of the UK created a competitive grant funding called Industrial Heat Recovery Support (IHRS) for encouraging and supporting investments in structures and devices for recovering heat and cold energy [18].

HNIP: The governmental programme of the Heat Networks Investment Project (HNIP) was finalised to reduce expenditures related to carbon energy and favour the achievement of a sustainable marketable function without direct subsidies by the UK Government.

CHPQA: The Combined Heat and Power Quality Assurance Programme (CHPQA) is an action for defining a monitoring scheme and evaluating and improving all typologies and sizes of Combined

[18] Industrial Heat Recovery Support Programme, https://www.gov.uk/government/consultations/industrial-heat-recovery-support-programme
Department for Business Energy & Industrial Strategy,
https://committees.parliament.uk/writtenevidence/109605/pdf/
Barriers and Enablers to Recovering Surplus Heat in Industry,
https://www.gov.uk/government/publications/barriers-and-enablers-to-recovering-surplus-heat-in-industry-a-qualitative-study

Heat and Power (CHP) systems in the UK. Participation in the CHPQA programme is spontaneous. However, the Government commits to enhancing the CHP implementation owing to the significant environmental, economic and social advantages provided [11]. Therefore, obtaining a CHPQA certification grants eligibility for different benefits, including Renewable Obligation Certificates, Renewable Heat Incentives, Carbon Price Floor heat relief, Climate Change Levy privilege, Enhanced Capital Allowances, and convenient Business Rates [19].

3 Barrier Analysis

Some industries generate heat as a by-product. Much more of this could be reused within plants or sold to heat buildings nearby. Waste cold is generated in sites such as liquefied natural gas terminals and gas grids. It is rarely reused, although the technology to do so is already used on a commercial basis in some district cooling systems. Integrating the production, consumption and reuse of waste heat/cold creates environmental and economic benefits and reduces the primary energy demand.

The barriers to the use of these resources are a lack of awareness and information on the resource available, inadequate business models and incentives, a lack of heat networks and lack of cooperation between industry and district heating companies. [20]

3.1 Main Regulatory Barriers Identified

It can be considered that there are no regulatory restrictions for the supply of waste heat into DH networks. In some countries, all waste heat supply situations are regulated using bilateral contracts between the DH network operator and the company that produces the waste heat. But in other countries, t**here is no specific regulation about thermal energy sales** to third parties. The only requirement is to become an **energy services provider**, that provides energy services or applies measures to improve the energy efficiency of an end customer.

Long in the past, the heat was considered more of a local issue and district heating a local infrastructure. There were nevertheless European texts on energy efficiency and efficient cogeneration (CHP) affecting the sector.

The situation has been evolving and heat came into the spotlight. First with the Commission Communication on a Heating and Cooling Strategy in 2016, then followed by the publication of the Energy Package the same year. The decarbonisation of heating and cooling is becoming a key for the energy transition. EU legislation has now started to incentivise Member States (MS) to step up heating and cooling decarbonisation and recognise the role of waste heat.

The next relevant EU Directives must be considered:

- **Renewable Energy Directive (RED II) - 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 (the new consolidated version on the 7th of June 2022)**
    - The new Renewable Energy Directive provides a **broad definition of "waste heat and cold"** in its Article 2-Def 9 it states that: *waste heat and cold means **unavoidable** heat or*

[19] Combined Heat and Power Quality Assurance Programme, https://www.gov.uk/guidance/combined-heat-power-quality-assurance programme#:~:text=CHP%20%2C%20the%20simultaneous%20generation%20of,UK%20Combined%20Heat%20and%20Power.

[20] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0051&from=EN

cold generated as a by-product in industrial or power generation installations, or the tertiary sector, which would be dissipated unused in air or water without access to a district heating or cooling system, where a cogeneration process has been used or will be used or where cogeneration is not feasible.[21]

In this definition, the term "**unavoidable**" is difficult to define since it could relate to technical or economic feasibility. It could also be a source of difficulties looking into the medium- and long-term future of the waste heat owner. For example, future new technologies might change the process and what was initially unavoidable might be avoidable with new technologies.

- In this directive **Article 23 "Mainstreaming renewable energy in heating and cooling"** it is stated that: *in order to promote the use of renewable energy in the heating and cooling sector, each Member State shall endeavour to* ***increase the share of renewable energy*** *in that sector by an indicative 1,3 percentage points as an annual average calculated for the periods 2021 to 2025 and 2026 to 2030, starting from the share of renewable energy in the heating and cooling sector in 2020.*

  However, it also creates **a discrimination of waste heat versus renewable energies**. *That increase shall be limited to an indicative 1,1 percentage points for Member States where waste heat and cold are not used. (art. 23-1).* In addition, *Member States may count waste heat and cold, but this is subject to a limit of 40% of the average annual increase (art. 23 -2-a).*

  So, those Member states who do not foster waste heat recovery will be required to have a lower value of increase of the share of renewable energy. **This article remains unchanged in the 2022 RED update.** This might result in an u**nbalanced treatment of the different waste heat sources** when it comes to implementation at a national level. Moreover, the higher target when waste heat is included for the calculation of the share of renewable energy in heating and cooling could deter some Member States from including it.

- **Energy Performance of Buildings Directive (EPBD) - Directive (EU) 2018/844 of the European Parliament and the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings**

This last 2018 amending foresees **minimum requirements** for the energy performance of new and renovated buildings, including the replacement or retrofit of heating and cooling systems. *The calculation of the energy performance is based on primary energy factors (PEF), which values are set by the Member States. (Annex I – Point 2)*[22].

This could mean difficulties concerning waste heat and Energy Performance of Buildings due to PEF values. Specifically in those countries where the electricity used to upgrade the temperature of waste heat is not always renewable and can consequently have a high PEF value. **Under these circumstances, the use of waste heat may then appear unfavourable for the energy performance of a building.**

Another possible problematic issue would appear when **waste heat is recovered from an industrial activity using fossil fuel and a high PEF** can be attributed to the waste heat, which appears detrimental to the energy performance of the building. In this scenario, connecting industrial waste

[21] https://joint-research-centre.ec.europa.eu/welcome-jec-website/reference-regulatory-framework/renewable-energy-recast-2030-red-ii_en

[22] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en

heat becomes meaningless in some cases, as a building will need additional on-site renewables and thus additional investments to meet EPBD performance requirements.

- **Directive 2012/27/EU on energy efficiency on high-efficiency cogeneration**

The EED lays down a common definition of **high-efficiency cogeneration**. To fit the definition, a cogeneration plant must achieve primary energy savings compared to the separate production of heat and electricity in contemporary power plants and boilers. To determine the primary energy savings of the cogeneration, the directive **establishes a calculation methodology** that involves a comparison of the electrical and thermal efficiency of the cogeneration plant, with the reference values for the separate production of electricity and heat. The Commission regularly reviews these reference values based on the latest developments in electricity and heat generation. Therefore, in the evaluation for the installation of a cogeneration plant powered by waste heat, it is important to comply with the minimum parameters imposed by local regulations to reach the high-efficiency cogeneration definition.

Another issue is that the sector faces barriers such as the **complex need to comply with both electricity and heat supply regulations**. Smaller units face grid connection and grid access barriers, such as slow processes for granting permits and high charges. These regulatory and administrative barriers have not been fully addressed yet by Member States.

In conclusion, regarding the regulatory scope of DH/C and waste heat/cold recovery, an important disparity must be taken into account in terms of the existence of individual regulations for DH/C depending on each country. Therefore, in EU countries such as Spain and Portugal, where there has not been a firm commitment to the development of this technological solution, there is a large regulatory gap in terms of DH/C, compared, for example, with countries such as Sweden or Italy, where the commitment and the development of DHN have been carried out successfully for several years. From all this, it can be concluded that the main regulatory barrier for DHN occurs when there is no clear regulation in this regard.

3.2 Matrix Barriers / Countries

In the following table are summarized the main issues identified in the regulatory framework that could represent barriers to the implementation of the solutions promoted by the SO WHAT tool.

Each barrier is briefly described and for each, the level of importance (high/medium/low) related to each country is shown.

Table 3.1 - Matrix Barries/Countries

BARRIERS	LEVEL OF IMPORTANCE FOR EACH COUNTRY						
	Belgium	Italy	Portugal	Romania	Spain	Sweden	United Kingdom
Lack of a correct definition of "Waste Heat and Cold" that support medium- and long-term planning	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
Difficulty of Waste Heat/Cold use in integrating with the scope	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

BARRIERS	LEVEL OF IMPORTANCE FOR EACH COUNTRY						
	Belgium	Italy	Portugal	Romania	Spain	Sweden	United Kingdom
to increase the share of renewable energy							
Low exploitation of Recovered Heat/Cold in Building Energy Performance calculation	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Low*	*Not available*
Strict values on high-efficiency cogeneration definition	*Medium*	*Medium*	*Low*	*Medium*	*High*	*Low*	*Not available*
Administrative barriers in regulation of the cogeneration connection to electricity grid and DH/C networks	*Low*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*
Regulatory and technological gaps for DH/C implementation	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Low*	*High*
Economic parameters not favourable for the sale of heat/cold to the network	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*

3.3 Recommendations to overcome barriers

The main barriers identified and described in the previous sections represent some of the first difficulties that the industry faces when trying to develop solutions for thermal recovery or installation of RES, described and promoted by the SO WHAT project.

- The first recommendation concerns the regulation of DH/C networks. As described, in some countries this type of infrastructure is not fully regulated. More regulatory provisions are recommended to facilitate the waste thermal energy supply to the network and the sale to local users. Through the official definition of a thermal energy producer from waste heat/cold, it would be possible to officially define this entity and provide for the facilitation at the bureaucratic level, as well as economic, to support the implementation of such technical solutions.
- With the aim of making the reuse of waste heat/cold through the DH/C networks increasingly feasible at the economic level, is recommended a review of the sales prices of heat/cold to the network. Sometimes, some local policies set fixed prices for citizens to protect them from spending too much. Such fixed prices may not invest in new waste heat/cold recovery solutions economically feasible. It is recommended that some solutions or incentives be found which could simultaneously guarantee the minimum price for citizens and at the same time the economic viability of new technological systems.

- Moreover, when waste heat is used for new users such as buildings, this solution while contributing to the decarbonisation of the entire system for the energy performance of the building analysis is not so. It is therefore recommended to integrate new parameters to positively include waste heat supply. Overcoming this barrier could lead to a new interest in the distribution of waste heat, especially within urban regeneration and re-planning contexts.
- Finally, it is recommended to include heat/cold recovery more carefully in the national plans as well as the use of energy from renewable sources. It is important to act on the scopes to be respected at the national level and especially on the methodology for calculating the energy produced by waste heat that to date is still penalized compared to energy produced from renewable sources.

4 Proposal of a Standardisation/Certification procedure for WH/C recovery

With the aim of promoting the standardisation and replication of the interventions identified in the SO WHAT project, it is necessary to define a standard calculation methodology and the related certification procedure for heat or cold recovered and reused for each intervention. This procedure presented below has been drawn based on the SO WHAT project experience and the data collected in previous deliverables. It is important to highlight that the following procedures would be useful also to obtain local incentives, if present.

At first, it is necessary to define the unit of measurement that will be the basis of periodic reporting, for example annual, and the basis of calculation for the economic savings obtained, the possible recognition of local incentives or agreements between the DH/C network operator and the company that produces the waste heat/cold. For this project, the Ton of Oil Equivalent (TOE) will be used to represent the final energy consumption,[23] and will be converted, according to the local conversion factors, in order to calculate the primary energy quantity.

The main information to be provided (some of which has already been collected to carry out SO WHAT tool simulations) to describe a heat/cold recovery project are as follows:

- **Context description**
  A description of the industrial production activity (e.g.: raw materials and energy carriers used, products manufactured, etc.) and of the main activities carried out in buildings or sites. It will be useful to provide annexes identifying the areas of intervention; the schematics of the electrical and thermal energy production systems and report the energy/material flow patterns of the process in the ante and post-intervention situation.
- **Project description:**
  A detailed description of the heat/cold recovery project and the actions that constitute it, as well as the processes involved. It will be highlighted also the differences before/after reference and intervention, indicating the contribution of each system/technology to energy optimization compared to the reference configuration.

[23] The ton of oil equivalent (toe) represents the quantity of energy contained in a ton of crude oil, that is gigajoules 41.868. This unit is used to express and compare energies of different sources. About final energy, and not primary energy, according to the international conventions, one ton of oil equivalent amounts for example in 1,616 kg of coal, 1,069 m³ of gas from Algeria or 954 kg of gasoline. For electricity, 1 toe is worth 11.6 MWh of final energy.

This description must be accompanied by technical annexes such as documentation showing the technical characteristics of the systems (data sheets, technical manuals, etc.); plant diagrams highlighting the measurement instrumentation; synthesis material/energy balances that influence the production process.

- **Project boundaries and measurement program definition**
  It is important to define the technological and geographical project boundaries. In addition, it is necessary to define a measurement program that will be implemented for the measurement of consumption in the pre-intervention situation. All the quantities necessary to determine the primary energy savings achieved by the project have to be measured. Based on local regulations and the production processes included in the project area, the period (e.g., 6 months, 12 months) of measurement prior to the start of the project should be agreed upon.
  In the measurement programme description, the measuring instrument used for each measured quantity must be highlighted, with each of them associated with a progressive code that allows its unique identification.
  Also, for each measuring point, it is necessary to indicate:
    - progressive numbering;
    - type of measuring instrument;
    - measurement unit of measured/derived parameter (e.g., temperature, flow rate, electricity/fuel consumption, pressure);
    - determination criterion (measured/derived): each quantity can be measured directly or derived, where possible, from direct measurements of other quantities of the same type (e.g., the steam flow from a collector may be calculated as a difference between the measurements of the steam flow in the collector and that of the other samples). It should be noted that if some of the quantities used in the calculations have been derived, all the measuring points used must be indicated in the program, to verify the correctness of the derivation criteria used.

  The instrumentation position must ensure the correct measurement of the necessary quantities, excluding the effects of other projects not subject to evaluation.
- **Operational process variables**
  An investigation of the operating variables impacting energy consumption is needed. This analysis is useful to carry out the baseline normalisation of consumption corresponding to the actual operating conditions in the post-intervention configuration. The study will enable the identification of these factors and the formulation of qualitative and quantitative linkages, with the energy consumption of the intervention system, based on measurements made under the pre-intervention conditions and on reference technical documents.
  These variables can be either Boolean, (referring to the presence or not of certain conditions), or qualitative, (referring to assumed parameters such as flue gases temperature, production capacity, and product type).
- **Baseline consumption**
  The definition of baseline consumption depends on the type of heat/cold recovery project that has been reported.
  Generally, baseline consumption is the primary energy consumption of the technological system taken as a reference point for calculating the energy savings obtained. This definition can be applied in the case of internal reuse of recovered heat/cold, as the savings obtainable will affect the primary energy consumption of the considered system.

In case of external use (e.g., district heating/cooling network or to other industrial sites) of the recovered heat/cold, it is advisable to use as a benchmark the ratio of specific consumption/ performance of the technological reference system.
In both conditions, an "additional energy saving" is generated, understood as the difference, in terms of primary energy (expressed in TOE) between the baseline consumption and the post-intervention consumption. This saving is determined, with reference to the same production service provided, ensuring a normalization of conditions that affect energy consumption. Therefore, during the definition of a project, it is essential to identify the variables that affect energy consumption to ensure a comparison of the same service provided.

- **Saving calculation algorithms and post-intervention consumption**
  Based on the measurements made before the project, it is important to define algorithms to estimate future savings. After the intervention, the parameters measured by the installed instruments will allow the validation of the algorithms defined before the intervention. The calculation models will be useful both to evaluate the economic feasibility of the project and to report the savings obtained. This data will be used also to receive local incentives or to report in a private contract with other entities (e.g., DH/C network operators; industrial companies).

This procedure would support the process of certification and standardization of the heat/cold recovery project and the subsequent enhancement. Although each project is different, it will be possible to define a list of actions and data to be collected to better define the savings obtainable.

In this way, the results get from the So What tool simulation will be able to communicate with local authorities and third-party companies that will be involved in future projects.

5 Conclusions

In conclusion, the analysis of regulatory barriers that influence the development of the solutions proposed by the SO WHAT tool defines that the European Union has already issued guidelines for the support of heat/cold recovery and to facilitate the use internally or at a Community level. However, although each country has independently developed the local transpositions of European Directives adapting them to its own geographical and regulatory context, some regulatory barriers are the same for all countries, others only for some.

As explained in Section 3 of this report the main barriers to overcome and the relative recommendations are the following:

- DH/C networks and thermal energy sale regulation;
- economic support tools for the creation of new infrastructure networks for DH/C;
- new parameters within building energy performance evaluation in order to include positive waste heat/cold supply;
- integration between waste thermal/cooling energy and renewable sources of energy use.

For example, for all the countries considered in this report, there is no clear integration of the use of waste heat/cold in decarbonisation plans and no clear valorisation in the building energy performance evaluation. Also, it is important to align the DH/C regulations to encourage industrial waste heat/cold use at nearby users and regulate thermal energy sales, especially in countries such as Spain and Portugal where such regulation is absent.

Finally, through the definition of a process of certification and standardisation of heat/cold recovery project, as shown in Section 4, it will be possible to use the outputs get from the SoWhat tool to communicate with local authorities and third-party companies that will be involved in future projects.

References

"An EU Strategy on Heating and Cooling" (2016)
https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1575551754568&uri=CELEX:52016DC0051
https://energy.ec.europa.eu/topics/energy-efficiency/heating-and-cooling_en

Belgian ESCo Association
https://www.belesco.be/about-belesco/mission

DECRETO LEGISLATIVO 4 luglio 2014, n. 102 (EED 2012/27/UE italian application)
https://www.gazzettaufficiale.it/eli/id/2014/07/18/14G00113/sg

"Guida alla Cogenerazione ad Alto Rendimento – CAR" issued by Gestore dei servizi energetici
https://www.gse.it/documenti_site/Documenti%20GSE/Servizi%20per%20te/COGENERAZIONE%20AD%20ALTO%20RENDIMENTO/Guide/Aggiornamento%20Guida%20CAR%20-%20revisione%202019.pdf

"Assessment of national and regional potential efficient heating" (2021)
https://energy.ec.europa.eu/system/files/2022-05/IT%20CA%202020%20en.pdf

"Sweden's draft integrated national energy and climate plan" (2019)
https://www.government.se/4a9ef2/contentassets/e731726022cd4e0b8ffa0f8229893115/swedens-draft-integrated-national-energy-and-climate-plan

https://www.energimyndigheten.se/energieffektivisering/lagar-och-krav/lagen-om-vissa-kostnadsnyttoanalyser-pa-energiomradet/

Lag (2011:1200) om elcertifikat
https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/lag-20111200-om-elcertifikat_sfs-2011-1200

Renewable Energy Directive (EU) 2018/2001 (RED II)—snapshot,
https://www.lexisnexis.co.uk/legal/guidance/background-to-renewable-energy-directive-2018-2001-ec-01

Consultation on the transposition in England and Wales of Articles 14(5)-(8) of the energy efficiency Directive (2012/27/EU), https://consult.defra.gov.uk/atmosphere-local-environment-team/eed_consultation/

EU Energy Efficiency Directive https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en

Overview of District Heating and Cooling Markets, https://op.europa.eu/o/opportal-service/download-handler?identifier=30058105-eac0-11ec-a534-01aa75ed71a1&format=PDF

Spatial policy for 4DHC, https://guidetodistrictheating.eu/wp-content/uploads/2020/08/HeatNet-NWE_Spatial-Policy-for-4DHC_District-Heating.pdf

Industrial Heat Recovery Support Programme, https://www.gov.uk/government/consultations/industrial-heat-recovery-support-programme

Department for Business Energy & Industrial Strategy,
https://committees.parliament.uk/writtenevidence/109605/pdf/

Barriers and Enablers to Recovering Surplus Heat in Industry,
https://www.gov.uk/government/publications/barriers-and-enablers-to-recovering-surplus-heat-in-industry-a-qualitative-study

Combined Heat and Power Quality Assurance Programme, https://www.gov.uk/guidance/combined-heat-power-quality-assurance programme#:~:text=CHP%20%2C%20the%20simultaneous%20generation%20of,UK%20Combined%20Heat%20and%20Power.

"Renewable Energy – Recast to 2030 (RED II)" https://joint-research-centre.ec.europa.eu/welcome-jec-website/reference-regulatory-framework/renewable-energy-recast-2030-red-ii_en