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Abstract

Europe is a global leader in developing low carbon and energy efficiency solutions in a wide range of sectors (e.g. energy efficiency technologies and services, energy management system). However, at current trend, the EU target of 20% reduction of final energy consumption compared to projections for 2020 with energy efficiency practices might not be met for different reasons: technological and non-technological barriers have adversely affected the introduction and spread of more sustainable and energy efficient measures among the systems that allow the recovery of heat for power generation in the energy intensive industries. Heat recovery technologies can play a foundamental role for Europe to reach its objectives. Among these technologies ORC systems can ameliorate the economics of heat recovery installations, thus increasing the possibility of their diffusion in several industrial sectors.

Building upon the results achieved at Italian level by the H-REII project, several initiatives have been undertaken at EU level within the H-REII DEMO project to suggest policy actions and recommendations in the field of waste heat recovery.

As a consequence, the aim of this paper is to **provide an overview** of such initiatives by stressing

- from a quantitative perspective, the **overall EU high untapped potential of Waste Heat Recovery using the ORC technology** evaluated across the EU27 countries in different sectors (cement, steel, glass, gas compressor stations) thanks to audit and test activities carried out in the H-REII DEMO context;
- From the policy side, the respective **EU regulatory framework** as it appeared at the time of the project inception and how it evolved throughtout the project implementation;
- The **actions** that have been **implemented** leading to an increased consideration of the Waste Heat Recovery potential as an important tool to meet the EU challenging targets for energy efficiency and the transition towards a low carbon economy.

The above mentioned efforts brought about positive tangible results. **Prominence has been given to Waste Heat Recovery in the European Efficiency Directive** – EED - (2012/27/EU), which entered into force parallel to the H-REII DEMO starting phase, and which is currently under revision. This paper also aims at providing the specific policy recommendations for Waste Heat Recovery potential to be further taken into account during the EED revision process.

Summary

1. HEAT RECOVERY ESTIMATIONS

1.1. ORC WASTE HEAT RECOVERY IN EUROPEAN ENERGY INTENSIVE INDUSTRIES

1.1.1. INTRODUCTION

A considerable amount of heat is wasted in many industrial plants employing thermal processes. Many industrial processes need a cooling system, like in the treatment of exhausted gases. This equipment involves additional investments and operation and maintenance costs. Waste heat recovery solutions have been developing since many years, both for thermal uses and power generation. If certain quantity and quality requirements of the waste heat are met, it can be economically convenient to convert the recover heat into electricity and one of the most interesting way is to install an Organic Rankine Cycle (ORC) – a closed cycle working with an organic fluid in order to produce electricity. In the last ten years, many ORC turbines have been installed to recover heat from industrial processes, such as cement kilns, metallurgy processes, flat glass plants, gas turbines and internal combustion engines. This application can be considered an excellent example of energy efficiency measure because companies that have made these investments have reduced their electricity consumption, with no additional use of primary energy. Please find below a simplified scheme of a heat recovery system (fig. 1).

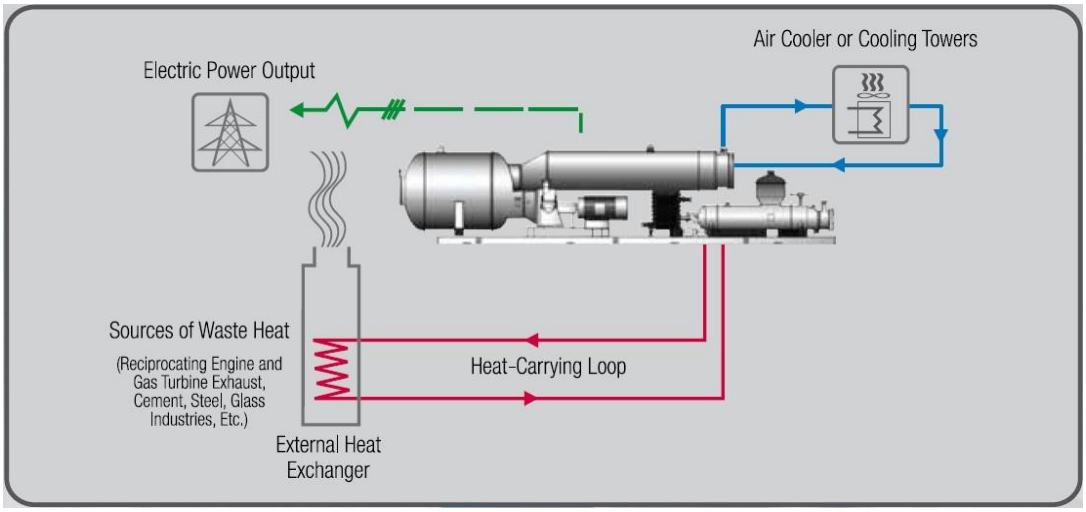


Figure 1: heat recovery scheme

On January 2010 the first European project on mapping the potential for heat recovery with ORC systems in energy intensive industries (in a pilot area) started. This project, funded by the LIFE + program (LIFE08 ENV/IT/000422 acronym "H-REII"), had the goal of promoting policy and governance actions that would support waste heat recovery for power generation in energy intensive industries and quantify the potential CO_2 savings. The H-REII DEMO project (LIFE10 ENV/IT/000397) is the continuation and implementation of the H-REII project aiming at:

- **developing the first ORC heat recovery plant applied to an EAF (Electric Arc Furnace)** in the steel industry completely integrated in a fumes treatment cleaning system;
- **promoting EU policy and governance actions for incentivizing waste heat recovery** for power generation, reducing CO_2 emissions by the valorization of process effluents in Energy Intensive Industries.

Waste heat recovery for power generation (WHRPG) in energy intensive industries by means of ORC is technically feasible: WHRPG plants with ORC technology are operating in the cement, steel and glass industry and in the natural gas transmission and storage sector. An evaluation of the potential electricity generation with this technology was

carried out at European level. Industrial processes considered are: clinker production in the cement industry, Electric Arc Furnaces (EAF) and reheating furnaces for hot rolling mills in the steel industry, flat glass furnaces and gas turbines in gas transmission and storage sector. It has been estimated a theoretical potential of about 2.5 GW of ORC gross power. The heat source is provided by the industrial process, whose operating hours depend on the market fluctuations. Considering 8 000 operating hours a year, ORC plants can generate almost 20 TWh of electric energy. This value represents **4.8% of the total electricity consumption of EU industry in 2009** and implies avoided emissions of almost 7.5 million tonnes of carbon dioxide [1].

Moreover, ORC manufacturer are developing waste heat recovery projects in other industrial processes, particularly in metallurgy.

Process	Heat source temp [°C]	P_{sORC} [kW/t]	Plants	ORC Power [MW]
Flat Glass	500	2.33	58	79
Clinker Prod.	350	1.01	241	574
EAF	250[2]	27.8	190	438
Rolling mills	400	6.87	209	310
GCS		30%[3]	500	1 155
Total				**2 556**

Table 1: ORC potential in EU energy intensive industries

Sectors	Energy Recovery [GWhh/yr]		Emission avoided [10^3t CO_2/yr]	
	5000h	8000h	5000h	8000h
Flat Glass	393	628	140	225
Cmnt	2 870	4 592	1 213	1 940
Steel	3 740	5 984	1 351	2 162
GCS	5 775	9 240	2 062	3 299
EU 27	12 778	20 444	4 766	7 626

Table 2: Energy generated from waste heat recovery and emission savings in EU27 industries

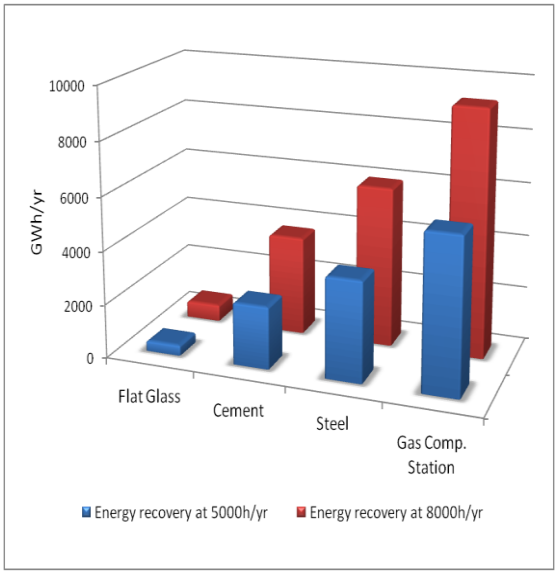


Figure 2: Annual energy recovery in EU27 industries

[1] Considering different emission factor for every EU members: Source: European Environmental Agency, 2010

[2] Steam from heat exchanger

[3] Percentage of Gas Turbine Power

1.1.2. WASTE HEAT RECOVERY IN EU27 CEMENT PLANTS: ESTIMATE ON ORC POWER

Country	No. plants	Nominal Capacity [Mt/year]
Spain	38	48.3
Italy	59	38.6
Germany	33	28.8
France	31	21.6
Greece	8	14.5
Poland	11	14.0
Portugal	6	10.8
UK	12	10.4
Others	61	60.8
Total EU27	**259**	**247.8**

Table 3: EU27 cement plants location and capacity

Over 576 MW of ORC power can be installed in the EU27 cement industry (see Tab.4). The annual energy recovery was also estimated assuming a range between 5000 and 8000 operating hours per year, in order to consider variations in cement production due to market fluctuations. This energy recovery allows avoiding the purchase of electricity from national grid and the consequent greenhouse gases emissions (see Tab.5). Considering only **EU27 cement plants**, **an amount between 2.87 and 4.59 TWh per year can be generated from waste heat recovery**, around 0.46% of the electricity consumption in European Industry in 2010. The corresponding average value of CO_2 avoided emissions, equal to almost 1.5 million metric tons, represents 0.44% of the total amount of CO_2 emitted in 2010 by EU27 industry. There are many factors to take into consideration for further developments in ORC applications in EU27 cement industry: (i) global trend in cement production, consumption and trade, with the increasing importance of developing countries as market players; (ii) energy efficiency policies, supporting such installations; (iii) the increasing interest in alternative fuels, affecting the economic energy scenario.

Country	Daily capacity [10^3t/day]	r_P [(MW·day)/t]	P_{ORC} [MW]
Italy	111.7	0.75	86.7
Germany	69.8	1.01	70.3
Spain	116.5	1.01	117.3
France	49.6	1.01	49.9
UK	25.1	1.01	25.3
Belgium	10.7	1.01	10.7
Austria	10.4	1.01	10.5
Czech Rep.	12.7	1.01	12.8
Others	189.3	1.01	192.5
Total EU27	**595.9**		**575.9**

Table 4: ORC power estimate for EU27 cement factories

Country	Energy Recovery [GWh/yr]		Emission avoided [10^3t CO_2/yr]	
	5000h	**8000h**	**5000h**	**8000h**
IT	433	693	175.5	280.8
GE	351	562	176.7	282.7
ES	586	938	252.1	403.4
FR	250	400	23.0	36.8
UK	126	202	62.7	100.3
BE	54	86	13.6	21.8
AU	52	84	8.4	13.5
CZ	64	102	40.3	64.5
Oth	953	1 525	460.2	736.4
EU 27	**2 870**	**4 592**	**1 212**	**1 940**

Table 5: Power generated from waste heat recovery and emission savings in cement industry

1.1.3. WASTE HEAT RECOVERY IN EU27 STEEL PLANTS: ESTIMATE ON ORC POWER

Country	No. EAF	Capac. [Mt/yr]	No. Rolling mills	Capac. [Mt/yr]
Italy	40	23.4	63	35.8
Spain	29	18.5	42	21.8
Germany	27	16.7	52	50.8
France	20	7.6	38	31.3
UK	8	4.9	31	15.9
Poland	9	4.5	19	9.7
Belgium	7	4.7	9	16.6
Romania	6	3.2	12	9.0
Greece	5	3.5	6	3.2
Czech Rep.	9	0.5	12	7.4
Others	30	14.0	78	50.2
Total	**190**	**101.7**	**362**	**251.8**
Idle	11		14	

Table 6: N. and nominal capacity of EU27 EAF and rolling mills

In the steel sector, ORC application is considered most suitable for recovering exhaust gases from Electric Arc Furnaces (EAF) and from rolling mills.

Potential recovery and savings are reported in Tab. 8. In view of 190 installations in EAFs and 209 in rolling mills, it has been estimated a **power generation from waste heat recovery between 3740 and 5984 GWh every year**: around 0.58% of the final electricity consumption of EU27 industry in 2010. **Avoided emissions of CO_2 are between 1.351 and 2.162 million tonnes**.

WHRPG in the steel industry with ORC unit has been adopted in two processes. On February 2013, Turboden Srl started up **the first ORC that recovers heat from exhausted gases of a reheating furnace in hot rolling mills**. This plant is located in Singapore, but it is very similar to most of the rolling mills spread all over the world. The exhausted gases are clean enough to allow the direct exchange with the organic working fluid, thus the required investments are lower. The ORC net power installed is 700 kW. This case can be replicated for all hot rolling mills, both those at the bottoming of integrated steel plants (blast furnace and converter shop) and those at the bottoming of electric arc furnaces.

A new interesting scenario is represented by waste heat recovery from Electric Arc Furnaces. The first ORC unit for this application is starting up by the end of 2013 in the Feralpi Group plant of Riesa, Germany. A special heat exchanger has been designed to produce 30 tons per hour of steam at 27 bar and 245 °C. 10 tons per hour are delivered to an industrial plant, the remaining part is employed by an ORC unit of about 3 MW, thus this system can be considered a combined heat and power plant. The EAF is not a continuous process: thermal flow varies during the melting cycle and while the scrap material is loaded into the basket there is no thermal power available. In order to solve the thermal power availability, heat absorber are installed and, considering power generation, the ORC properly operates with a steam flow rate between 2 and 22 tons per hour, automatically adapting its operation to the different operating conditions, a performance that traditional steam plant cannot achieve. This plant is part of the H-REII DEMO Project (Heat Recovery in Energy Intensive Industries), co-financed by the LIFE+ program of the European Commission DG Environment for the high technological and environmental value. Many others applications are expected to follow.

Country	ORC Power in EAF [MW]	ORC Power in rolling mills [MW]	Total ORC Power in EU27 steel ind. [MW]
Italy	92.9	21.7	114.6
Germany	74.0	82.2	156.2
Spain	85.8	25.6	111.3
France	43.1	30.1	73.2
UK	27.7	19.7	47.4
Belgium	25.7	28.7	54.5
Austria	4.2	12.2	16.5
Czech Rep.	0.8	9.2	10.0
Others	83.3	81.0	164.3
Total EU27	**437.5**	**310.5**	**748.0**

Table 7: ORC gross power to install in EU27 steel industries

Country	Energy Recovery [GWhh/yr]		Emission avoided [10^3t CO_2/yr]	
	5000h	**8000h**	**5000h**	**8000h**
IT	572	916	206.9	331.0
GE	781	1 250	343.5	549.6
ES	557	891	184.1	294.6
FR	365	583	28.8	46.1
UK	237	379	102.2	163.5
BE	272	436	66.8	107.0
AU	82	132	11.2	17.9
CZ	50	80	27.2	43.5
Oth	824	1 318	380.5	608.8
EU 27	**3 740**	**5 984**	**1 351**	**2 162**

Table 8: Energy generated from waste heat recovery and emission savings in EU27 steel industry.

1.1.4. WASTE HEAT RECOVERY IN EU27 GLASS PLANTS: ESTIMATE ON ORC POWER

Glass industry is divided depending on the manufactured product. **Only flat glass plants have been considered** because energy audits for container glass are not available. Despite the cement and steel cases, it was not possible to access to a database with data for every single glasswork. We mainly referred to BREF for glass manufacturing, related to the 2007-2008 period. This document reports the number of furnaces placed in EU27 (Tab. 9) and their proportion divided into ranges of daily production (Tab. 10). For every range we calculated an average size as shown in Tab.11, for a **total gross ORC power of 78.5 MW with 58 installations**. An **energy generation from waste heat recovery has been estimated from 392.6 GWh to 628.2 GWh per year and avoided emissions of carbon dioxide from 140333 to 224533 tonnes**.

Country	No. plants	Product. [10^3t/yr]
Germany	11	1,425
France	7	907
Italy	7	908
Belgium	7	907
UK	5	645
Spain	5	645
Poland	3	390
Portugal	1	127
Other	9	1,545
Total	**58**	**7,500**

Table 9: EU27 flat glass plant distribution and production

t/day	%	No. of plants
< 400	1%	1
400 – 550	37%	22
550 – 700	48%	28
>700	14%	7
Total	**100%**	**58**

Table 10: EU27 flat glassworks production ranges

Range	Capacity [t/day]	ORC Power [kW]	No. Plants	Total ORC power [MW]
<400	350	1 040	1	1.0
400-550	475	1 040	22	22.9
550-700	625	1 500	28	42.0
>700	750	1 800	7	12.6
Total flat			**58**	**78.5**

Table 11: ORC power to install in EU27 flat glass industry

1.1.5. WASTE HEAT RECOVERY IN EU27 GAS COMPRESSOR STATIONS: ESTIMATE ON ORC POWER

Natural gas transmission infrastructures are typically based on gas turbine (GT) units, used to accomplish natural gas compression in Gas Compressor Station (GCS), placed around every 100–200 km, in order to maintain gas pressure on average around 70 bar, but with cases typically in the range 40–120 bar. Their distribution is depicted in figure 3. Also in Gas Storage Fields (GSF) gas is inserted into the infrastructure by means of gas turbines. These stations use a part of the conveyed gas; the GCS is typically made up of at least two GTs, one of those plays a backup role. GCS can be divided in base load stations, which work continuously, approximately 8000 h per year, and seasonal stations, located in warm regions, working less than 4000 h per year. To exclude backup units (usually one over three GTs) a reducing coefficient of the installed power equal to 0.65 was adopted. In order to consider only base load stations, a cautionary additional coefficient of 0.45 was adopted. ORC power was estimated as a 30% of the corrected GT power. Results are reported in Table 12. Excluding Russia, 1304MW ORC gross power can be installed in EU27 gas plants, with electricity generation up to 10.43 TWh per year and avoided GHG equal to 3.7 million metric tons.

Country	Gas turbines power [MW]	Power corrected [MW]	ORC Power [MW_e]
Germany	2 000	585	176
UK	1 455	426	128
Italy	500	146	44
France	650	190	57
Netherland	900	263	79
Spain	412	121	36
Austria	352	103	31
Belgium	116	34	10
Slovakia	19	6	2
Ireland	94	27	8
Poland	350	102	31
Czech Rep.	297	87	26
Hungary	187	55	16
Finland	13	4	1
Bulgaria	214	63	19
EU 27	**7 559**	**2 211**	**664**
Russia	43 400	12 695	3 808
Ukraine	5 450	1 594	478
Norway	150	44	13
Total Europe	**56 559**	**16 544**	**4 963**

Table 12: Gas turbine power and ORC power in gas compressor station

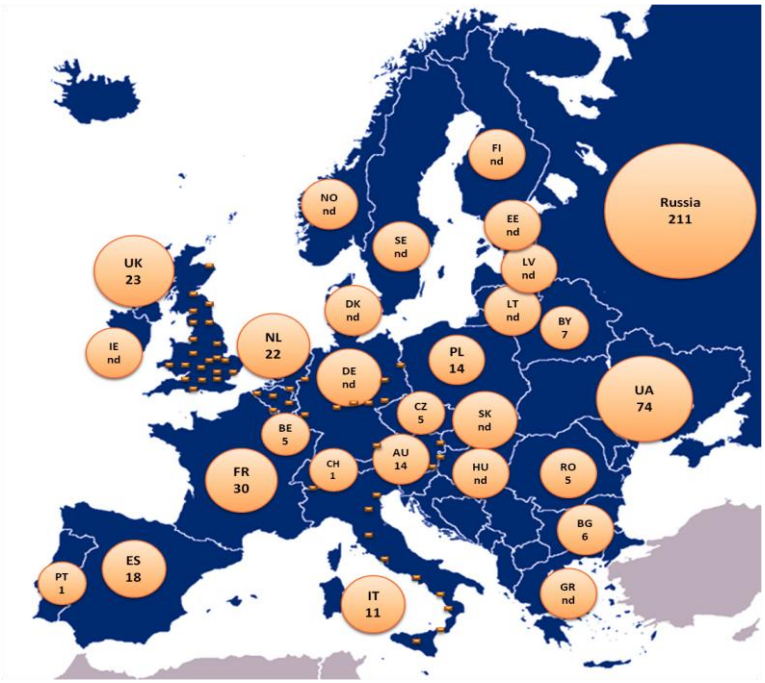


Figure 3: European gas compressor station distribution. Source: www.naturalgas.org

2. REGULATORY FRAMEWORK

2.1. ORC FOR WASTE HEAT RECOVERY APPLICATION. PROPOSAL FOR AN AMBITIOUS IMPLEMENTATION AND PROPOSALS FOR THE RECAST OF THE ENERGY EFFICIENCY DIRECTIVE EED (2012/27/EC)

2.1.1. INTRODUCTION

«On 25 October 2012, the EU adopted the Directive 2012/27/EU on energy efficiency.
This Directive establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union's 2020 20 % headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date. It lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy, and provides for the establishment of indicative national energy efficiency targets for 2020»[4]

The Directive explicitly mentions in articles 8 and 14 the potential of waste heat recovery, which represents a deeply relevant opportunity in industry to recover energy. Nowadays Europe is a global leader in developing low carbon and energy efficiency solutions in a wide range of sectors (e.g. energy efficiency technologies and services, energy management system). However, at current trend, the EU target of 20% reduction of final energy consumption compared to projections for 2020 with energy efficiency practices might not be met for different reasons: technological and non-technological barriers adversely affected the introduction and spread of more sustainable and energy efficient measures among the systems allowing the recovery of heat for power generation in the energy intensive industries. Heat recovery technologies can play a foundamental role for Europe to reach its objectives. Among these technologies ORC systems can ameliorate the economics of heat recovery installations, thus increasing the possibility of their diffusion in various industrial sectors.

In order to take these opportunities, the European Union shall evaluate the introduction of new policies to **promote and incentivize heat recovery in the energy efficiency policies framework** due to its overall **benefits**:

- **decarbonisation and sustainable growth**: heat recovery can increase the environmental and energy sustainability of the industrial processes, and also contribute to reduce GHG emissions since power is generated through the waste heat recovery without using any fuels;
- **job creation**: (i) *jobs in the manufacture of waste energy recovery equipment*: the companies involved range from large multinational corporations to small, specialized firms; (ii) *jobs in creating on-site "energy islands" in host facilities* including welders, pipefitters, design engineers and construction workers; (iii) *jobs in operating on-site energy islands*; (iv) *jobs resulting from increased competitiveness*.
- **industrial leadership, productivity and competitiveness**: heat recovery as an instrument of industrial policy to boost competitiveness and investments in the manufacture sectors, it's able to collect different industrial actors; it's possible to foreseen a potential investment of 8 billion euro in the new sector of heat recovery in the EU.
- **R&D**: Important results would be reached with the introduction of innovation policies in order to increase and coordinate European R&D spending to support promising technologies in energy intensive industries.

[4] Source: European Commission. http://ec.europa.eu/energy/efficiency/eed/eed_en.htm

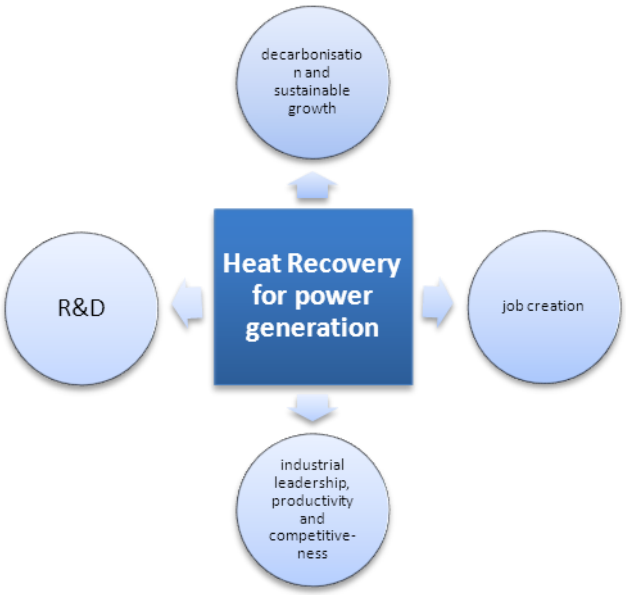


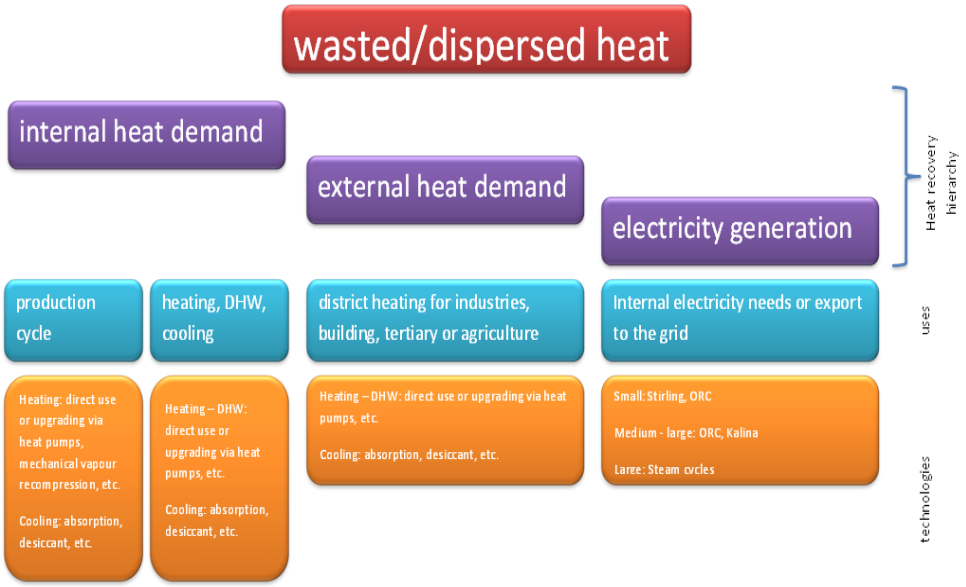
Figure 4: Waste Heat Recovery benefits

To put the above mentioned benefits into effect, targeted measures shall be considered by the European institutions and Member States.

Firstly, the lack of certain long-term EU regulatory framework and binding targets for energy efficiency could hinder the development of a European energy efficient market. The Energy Efficiency Directive is a step towards the good direction but **it is necessary that Member States consider the potential of heat recovery applications during the implementation phase**, especially referring to article 8.7[5] and article 14[6]: **compulsory energy audits and supported waste heat recovery for power generation system, whenever technically and economically workable, could catalyze investment in the energy efficiency market, helping reach the objective of 20% reduction in energy consumption**. Figure 5 below depicts the priority in the utilization of waste heat recovery.

[5] Directive 2012/27/UE, article 8.7: "Energy audits may stand alone or be part of a broader environmental audit. Member States may require that an assessment of the technical and economic feasibility of connection to an existing or planned district heating or cooling network shall be part of the energy audit. Without prejudice to Union State aid law, Member States may implement incentive and support schemes for the implementation of recommendations from energy audits and similar measures".

[6] Directive 2012/27/UE, article 14.5 lett. 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 utilizing 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".



Legend: DHW: Domestic Hot Water
ORC: Organic Rankine Cycle

Figure 5: Waste heat recovery priority

Secondly, **the economic obstacle is a key issue**: investment payback time for the implementation of technologies related to WHR to electricity generation are usually too long for the industrial sector, for this **reason the creation of *ad hoc* incentives mechanism or the inclusion in existing supporting schemes** (e.g. white certificates**) could help in overtaking this barrier**. Considering the role played by the energy intensive industries in the overall energy consumption**, the European Union should increase a specific provision to finance investments in WHRPG, as is mentioned in the European Investment Bank (EIB) Energy Lending Criteria**[7]. The energy services providers (art. 18 of EED) active in the industrial sector and offering third party financing could also be a solution. Nevertheless, in many Member States the energy services market is still underdeveloped and incentives and financial provision could contribute to its growth

Thirdly, it is necessary to increase the awareness - through an intensive dissemination campaign, a proper education and training path - of the energy efficiency potential of the waste heat recovery system in the industrialists' mind as a solution to raise investments, to create jobs and to boost sustainability.

In addition, in order to make the EED objectives more achievable a **binding target of 30% of energy savings** should be introduced. Given its comprehensive benefits in energy efficiency, WHRP could play an essential role in helping achieve this target. A **recent report[8] published by the International Financial Corporation (IFC)**, part of the World Bank Group, **effectively shows how a good mixture of policy, regulation and finance in the waste heat recovery in the energy intensive industries field represent a key element to achieve energy efficiency and industrial competitiveness of manufacturers issues as well as a driver to develop technologies for domestic and foreign markets**. Taking China's strategy as a successful example, the IFC report demonstrates that regulatory measures, lower capital costs coupled with financial incentives led the country to become leader in "big size" heat to power recovery plants in the cement industry with more than 700 units installed in the past years for the domestic field. In this respect, the European industrial market also represents a significant potential, although still untapped. Considering that "small size" heat-to-power recovery plants addressed to revamp the efficiency of the old existing manufacturers plants represent a peculiarity of the European industrial market, **the EU Energy Efficiency Directive (2012/27/EU)**, currently under revision, **could be a "driver" in further exploiting this potential in Europe.**

Finally, the European Union should consider the wast heat recovery technology as an important tool in achieving energy targets set out in the new 2030 climate and energy framework[9].

[7] European Investment Bank, EIB Energy Lending Criteria, 2013, http://www.eib.org/attachments/strategies/eib_energy_lending_criteria_en.pdf, p.21.
[8] IFC, "*Waste Heat Recovery for the Cement Sector: Market and Supplier Analysis*", June 2014, http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/publications/report_waste_heat_recovery_for_the_cement_sector_market_and_supplier_analysis
[9] European Commission COM(2014) 15 final http://eurlex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:52014DC0015 &from=EN

The ORC systems in waste heat recovery seems a new effective solution due to their low diffusion in industrial sector. Their big expansion in the renewable sector in the last decades proves their reliability and the ongoing energy market conditions make them an interesting solution in many Member States.

2.1.2. FOCUS ON ARTICLE 7

CHAPTER II: EFFICIENCY IN ENERGY USE - **Article 7**: Energy efficiency obligation schemes

"1. Each Member State shall set up an energy efficiency obligation scheme. That scheme shall ensure that energy distributors and/or retail energy sales companies that are designated as obligated parties under paragraph 4 operating in each Member State's territory achieve a cumulative end-use energy savings target by 31 December 2020, without prejudice to paragraph 2. That target shall be at least equivalent to achieving new savings each year from 1 January 2014 to 31 December 2020 of 1,5 % of the annual energy sales to final customers of all energy distributors or all retail energy sales companies by volume, averaged over the most recent three-year period prior to 1 January 2013. The sales of energy, by volume, used in transport may be partially or fully excluded from this calculation.

Member States shall decide how the calculated quantity of new savings referred to in the second subparagraph is to be phased over the period.

2. Subject to paragraph 3, each Member State may:

(a) carry out the calculation required by the second subparagraph of paragraph 1 using values of 1 % in 2014 and 2015; 1,25 % in 2016 and 2017; and 1,5 % in 2018, 2019 and 2020;

(b) exclude from the calculation all or part of the sales, by volume, of energy used in industrial activities listed in Annex I to Directive 2003/87/EC;

(c) allow energy savings achieved in the energy transformation, distribution and transmission sectors, including efficient district heating and cooling infrastructure, as a result of the implementation of the requirements set out in Article 14(4), point (b) of Article 14(5) and Article 15(1) to (6) and (9) to be counted towards the amount of energy savings required under paragraph 1; and

(d) count energy savings resulting from individual actions newly implemented since 31 December 2008 that continue to have an impact in 2020 and that can be measured and verified, towards the amount of energy savings referred to in paragraph 1.

3. The application of paragraph 2 shall not lead to a reduction of more than 25 % of the amount of energy savings referred to in paragraph 1. Member States making use of paragraph 2 shall notify that fact to the Commission by 5 June 2014, including the elements listed under paragraph 2 to be applied and a calculation showing their impact on the amount of energy savings referred to in paragraph 1.

[…]

2.1.3. ARTICLE CONTENTS[10]- PROPOSALS art.7

Article 7 sets an Energy Efficiency Obligation Scheme establishing the annual target of 1.5% new savings on energy suppliers. In addition, article 7 mentions training and education, including energy advisory programs, that lead to the application of energy - efficient technology or techniques. Amid its essential contents, article 7:

- Gives full latitude to Member States to design the scheme based on primary or final energy savings;
- Sets out a 1,5% energy saving target per year for obligated parties which shall be designated by each Member State;
- Aims at changing the way companies retail energy through the promotion of energy services;
- Foresees the possibility for installations covered by the ETS to be excluded from the obligation;

[10] Source: Dr Fiona Riddoch – Cogen Europe. CODE2 Workshop "Developing a CHP Roadmap for italy".

- Allows Member States to take into account the energy savings achieved in the supply side in calculating the savings quantity (par. 2.c). Member States are allowed to use this approach provided that no double counting is made;
- At the same time article 7 par.3 caps at 25% the bundle effect of all the flexible measures;
- Provides linkages to the EPB Directive;
- Urges Energy Services Companies to take part in the “energy efficiency obligation schemes”.

In this respect, possible actions to further undertake are:

- Implement the Energy Efficiency Obligation Scheme with a view to administrative simplification and incentive awards from the authorities in charge. In particular, the energy savings achieved through investments in energy efficiency for third industrial uses (ESCo) should be rewarded and compensated by tax exemption, public funding used as a guarantee against risks of industrial counterparts, favorable financial loans for the investments realization;
- Ensure that counting measures are harmonized at EU level;
- Article 7.2 shows the need for an evaluation of the energy efficiency potentials of the gas and electricity infrastructure. Within this evaluation Waste Heat Recovery should be considered as well.

2.1.4. FOCUS ON ARTICLE 8

***CHAPTER II**: EFFICIENCY IN ENERGY USE - **Article 8**: Energy audits and energy management systems*

1. Member States shall promote the availability to all final customers of high quality energy audits which are cost-effective and:
(a) carried out in an independent manner by qualified and/or accredited experts according to qualification criteria; or
(b) implemented and supervised by independent authorities under national legislation.
The energy audits referred to in the first subparagraph may be carried out by in-house experts or energy auditors provided that the Member State concerned has put in place a scheme to assure and check their quality, including, if appropriate, an annual random selection of at least a statistically significant percentage of all the energy audits they carry out.
[…]
2. Member States shall develop programmes to encourage SMEs to undergo energy audits and the subsequent implementation of the recommendations from these audits.
On the basis of transparent and non-discriminatory criteria and without prejudice to Union State aid law, Member States may set up support schemes for SMEs, including if they have concluded voluntary agreements, to cover costs of an energy audit and of the implementation of highly cost-effective recommendations from the energy audits, if the proposed measures are implemented.
Member States shall bring to the attention of SMEs, including through their respective representative intermediary organisations, concrete examples of how energy management systems could help their businesses. The Commission shall assist Member States by supporting the exchange of best practices in this domain.
3. Member States shall also develop programmes to raise awareness among households about the benefits of such audits through appropriate advice services.
Member States shall encourage training programmes for the qualification of energy auditors in order to facilitate sufficient availability of experts.
4. Member States shall ensure that enterprises that are not SMEs are subject to an energy audit carried out in an independent and cost-effective manner by qualified and/or accredited experts or implemented and supervised by independent authorities under national legislation by 5 December 2015 and at least every four years from the date of the previous energy audit.
5. Energy audits shall be considered as fulfilling the requirements of paragraph 4 when they are carried out in an independent manner, on the basis of minimum criteria based on Annex VI, and implemented under voluntary agreements concluded between organisations of stakeholders and an appointed body and supervised by the Member State concerned, or other bodies to which the competent authorities have delegated the responsibility concerned, or by the Commission. Access of market participants offering energy services shall be based on transparent and non-discriminatory criteria.
6. Enterprises that are not SMEs and that are implementing an energy or environmental management system - certified by an independent body according to the relevant European or International Standards - shall be exempted from the requirements of paragraph 4, provided that Member States ensure that the management system concerned includes an energy audit on the basis of the minimum criteria based on Annex VI.
7. Energy audits may stand alone or be part of a broader environmental audit. Member States may require that an assessment of the technical and economic feasibility of connection to an existing or planned district heating or cooling network shall be part of the energy audit.
Without prejudice to Union State aid law, Member States may implement incentive and support schemes for the implementation of recommendations from energy audits and similar measures.

2.1.5. ARTICLE CONTENTS[11] - PROPOSALS art.8

Article 8 requires auditing and empowerment of customers. Among its essential contents, article 8:

[11] Source: Marcello Capra's Presentation "The new European Energy Efficiency Directive: opportunities and challenges for Italy" at Energy Efficiency Campus, EDF Fenice.

- Establishes compulsory energy audit every 4 years for large enterprises which shall be conducted by qualified experts on the basis of criteria defined by national legislation;
- Sets up Information and Compensation Programmes for SMEs and households in order to promote the implementation of energy audits and the diffusion of best practices.

In this respect, possible actions to further undertake are:

- **Require compulsory energy audit for large enterprises and incentives for SMEs by creating an incentive system for those who realize investments within the time and modalities established by the audit** or, alternatively, within a period not exceeding 24 mounths (for enterprises or ESCo);
- Outsource audits as a guarantee of independence;
- Ensure a system of selection of experts that is at least recognized at European level and works as a guarantee of technical and financial qualifications in line with the scope of energy efficiency projects.
- Energy audits shall not include clauses preventing the findings of the audit from being transferred to any qualified/accredited energy service provider, on condition that the customer does not object. As such, energy operators might access audit information and offer services. Audit outcomes might also be used to complete GIS database with targated information on heat, such as supply and demand of waste heat.
- In line with par. 7, ORC systems make the realization of district heating or cooling more efficient because they would be powered through recovered waste heat[12].

2.1.6. FOCUS ON ARTICLE 14

***Article 14**: Promotion of efficiency in heating and cooling - **CHAPTER III** : EFFICIENCY IN ENERGY SUPPLY*

1. By 31 December 2015, Member States shall carry out and notify to the Commission a comprehensive assessment of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling, containing the information set out in Annex VIII. If they have already carried out an equivalent assessment, they shall notify it to the Commission.

[…]

3. For the purpose of the assessment referred to in paragraph 1, Member States shall carry out a cost-benefit analysis covering their territory based on climate conditions, economic feasibility and technical suitability in accordance with Part 1 of Annex IX. The cost-benefit analysis shall be capable of facilitating the identification of the most resource-and cost-efficient solutions to meeting heating and cooling needs. That cost-benefit analysis may be part of an environmental assessment under Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment.

4. Where the assessment referred to in paragraph 1 and the analysis referred to in paragraph 3 identify a potential for the application of high-efficiency cogeneration and/or efficient district heating and cooling whose benefits exceed the costs, Member States shall take adequate measures for efficient district heating and cooling infrastructure to be developed and/or to accommodate the development of high-efficiency cogeneration and the use of heating and cooling from waste heat and renewable energy sources in accordance with paragraphs 1, 5, and 7.

Where the assessment referred to in paragraph 1 and the analysis referred to in paragraph 3 do not identify a potential whose benefits exceed the costs, including the administrative costs of carrying out the cost-benefit analysis referred to in paragraph 5, the Member State concerned may exempt installations from the requirements laid down in that paragraph.

5. Member States shall ensure that a cost-benefit analysis in accordance with Part 2 of Annex IX is carried out when, after 5 June 2014:

12 See also Campana F., Di Santo D., Forni D, "Innovative system for electricity generation from waste heat recovery", eceee 2014 Industrial Summer Study on energy efficiency, Papendal – Arnhem, 4th June 2014.

(a) a new thermal electricity generation installation with a total thermal input exceeding 20 MW is planned, in order to assess the cost and benefits of providing for the operation of the installation as a high-efficiency cogeneration installation;
(b) an existing thermal electricity generation installation with a total thermal input exceeding 20 MW is substantially refurbished, in order to assess the cost and benefits of converting it to high-efficiency cogeneration;
(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;
(d) a new district heating and cooling network is planned or in an existing district heating or cooling network a new energy production installation with a total thermal input exceeding 20 MW is planned or an existing such installation is to be substantially refurbished, in order to assess the cost and benefits of utilising the waste heat from nearby industrial installations.
The fitting of equipment to capture carbon dioxide produced by a combustion installation with a view to its being geologically stored as provided for in Directive 2009/31/EC shall not be considered as refurbishment for the purpose of points (b), (c) and (d) of this paragraph.
Member States may require the cost-benefit analysis referred to in points (c) and (d) to be carried out in cooperation with the companies responsible for the operation of the district heating and cooling networks.
6. Member States may exempt from paragraph 5:
(a) those peak load and back-up electricity generating i nstallations which are planned to operate under 1 500 operating hours per year as a rolling average over a period of five years, based on a verification procedure established by the Member States ensuring that this exemption criterion is met;
(b) nuclear power installations;
(c) installations that need to be located close to a geological storage site approved under Directive 2009/31/EC.
Member States may also lay down thresholds, expressed in terms of the amount of available useful waste heat, the demand for heat or the distances between industrial installations and district heating networks, for exempting individual installations from the provisions of points (c) and (d) of paragraph 5.
Member States shall notify exemptions adopted under this paragraph to the Commission by 31 December 2013 and any subsequent changes to them thereafter
[…]
8. Member States may exempt individual installations from being required, by the authorization and permit criteria referred in paragraph 7, to implement options whose benefits axceed their costs if there are imperative reasons of low, ownership or finance for so doing. […]
10. On the basis of the harmonised efficiency reference values referred to in point (f) of Annex II, Member States shall ensure that the origin of electricity produced from high- efficiency cogeneration can be guaranteed according to objective, transparent and non-discriminatory criteria laid down by each Member State. They shall ensure that this guarantee of origin complies with the requirements and contains at least the information specified in Annex X. Member States shall mutually recognise their guarantees of origin, exclusively as proof of the information referred to in this paragraph. Any refusal to recognise a guarantee of origin as such proof, in particular for reasons relating to the prevention of fraud, must be based on objective, transparent and non- discriminatory criteria. Member States shall notify the Commission of such refusal and its justification. In the event of refusal to recognise a guarantee of origin, the Commission may adopt a decision to compel the refusing party to recognise it, in particular with regard to objective, transparent and non- discriminatory criteria on which such recognition is based.
The Commission shall be empowered to review, by means of delegated acts in accordance with Article 23 of this Directive, the harmonised efficiency reference values laid down in Commission Implementing Decision 2011/877/EU (1) on the basis of Directive 2004/8/EC by 31 December 2014.
11. 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.

2.1.7. ARTICLE CONTENTS[13] - PROPOSALS art.14

Article 14 and the correspondent annexes urge Member States to make heating-and-cooling plans and build cogeneration plants above 20 MW_e after carrying out a cost-benefit analysis in order to identify the most cost-efficienct solutions. More specifically, article 14 establishes that:

- Member States shall carry out a « comprehensive assessment » (CA) of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling by 31 December 2015;
- CA shall contain the information set out in Annex VIII expressly dedicated to the potential for efficiency in heating and cooling. According to the latter, the CA *"shall include […] Strategies, policies and measures that may be adopted up to 2020 and up to 2030"* and clearly indicate the potential identified under Directive 2004/8/CE and Primary Energy Savings*;*
- As part of the CA, Member States shall carry out a cost-benefit analysis (CBA) according to Annex IX part 1
    - Covering their territory
    - Based on climate conditions, economic feasibility and technical suitability

- If the outcome of CBA is positive then:
    - **"Member States shall take adequate measures […] to accommodate the development of high-efficiency cogeneration […]"**
    - Every installation above 20 MW thermal input shall carry out a CBA according to Annex IX part 2
    - Authorisation/permitting decision shall take into account the outcome of the CBA

Figure 6 shows how Article 14 works:

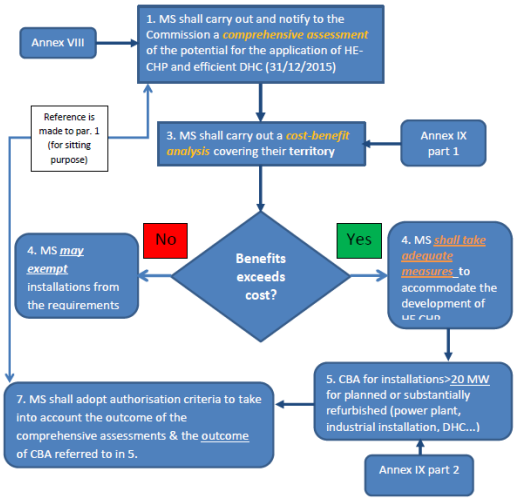


Figure 6: Article 14

As regards article 14, the suggested proposals are the following:

- Make it possible that the **cost-benefit analysis** for new installations with a total thermal input exceeding 20 MW is based **on a comprehensive perspective** where economic, social and environmental conditions are taken in due account. Tha CBA should also take ORC systems in consideration as a measure to make the investment economically more attracting;
- Create electric grids within the European regulatory framework, in contrast with limited national policies;

[13] Source: Dr Fiona Riddoch – Cogen Europe. CODE2 Workshop "Developing a CHP Roadmap for italy".

- As for par 4**, adequate measures for application of high-efficiency cogeneration and/or efficient district heating and cooling infrastructure shall be supported by Member States through simplified authorization systems, economic support, tax exemptions**;
- Exemptions as indicated in par 8 shall be harmonized at European level.

2.1.8. FOCUS ON ARTICLE 15

CHAPTER III *: EFFICIENCY IN ENERGY SUPPLY -* ***Article 15****: Energy transformation, transmission and distribution*

"1. Member States shall ensure that national energy regulatory authorities pay due regard to energy efficiency in carrying out the regulatory tasks specified in Directives 2009/72/EC and 2009/73/EC regarding their decisions on the operation of the gas and electricity infrastructure.

Member States shall in particular ensure that national energy regulatory authorities, through the development of network tariffs and regulations, within the framework of Directive 2009/72/EC and taking into account the costs and benefits of each measure, provide incentives for grid operators to make available system services to network users permitting them to implement energy efficiency improvement measures in the context of the continuing deployment of smart grids.

Such systems services may be determined by the system operator and shall not adversely impact the security of the system.

For electricity, Member States shall ensure that network regulation and network tariffs fulfil the criteria in Annex XI, taking into account guidelines and codes developed pursuant to Regulation (EC) No 714/2009.

2. Member States shall ensure, by 30 June 2015, that:

(a) an assessment is undertaken of the energy efficiency potentials of their gas and electricity infrastructure, in particular regarding transmission, distribution, load management and interoperability, and connection to energy generating installations, including access possibilities for micro energy generators;

(b) concrete measures and investments are identified for the introduction of cost-effective energy efficiency improvements in the network infrastructure, with a timetable for their introduction.

3. Member States may permit components of schemes and tariff structures with a social aim for net-bound energy transmission and distribution, provided that any disruptive effects on the transmission and distribution system are kept to the minimum necessary and are not disproportionate to the social aim.

4. Member States shall ensure the removal of those incentives in transmission and distribution tariffs that are detrimental to the overall efficiency (including energy efficiency) of the generation, transmission, distribution and supply of electricity or those that might hamper participation of demand response, in balancing markets and ancillary services procurement. Member States shall ensure that network operators are incentivised to improve efficiency in infrastructure design and operation, and, within the framework of Directive 2009/72/EC, that tariffs allow suppliers to improve consumer participation in system efficiency, including demand response, depending on national circumstances.

5. Without prejudice to Article 16(2) of Directive 2009/28/EC and taking into account Article 15 of Directive 2009/72/EC and the need to ensure continuity in heat supply, Member States shall ensure that, subject to requirements relating to the maintenance of the reliability and safety of the grid, based on transparent and non-discriminatory criteria set by the competent national authorities, transmission system operators and distribution system operators when they are in charge of dispatching the generating installations in their territory:

(a) guarantee the transmission and distribution of electricity from high-efficiency cogeneration;

(b) provide priority or guaranteed access to the grid of electricity from high-efficiency cogeneration;

(c) when dispatching electricity generating installations, provide priority dispatch of electricity from high-efficiency cogeneration in so far as the secure operation of the national electricity system permits.

Member States shall ensure that rules relating to the ranking of the different access and dispatch priorities granted in their electricity systems are clearly explained in detail and published. When providing priority access or dispatch for high-efficiency cogeneration, Member States may set rankings as between, and within different types of, renewable energy and high-efficiency cogeneration and shall in any case ensure that priority access or dispatch for energy from variable renewable energy sources is not hampered.

In addition to the obligations laid down by the first subparagraph, transmission system operators and distribution system operators shall comply with the requirements set out in Annex XII.

Member States may particularly facilitate the connection to the grid system of electricity produced from high-efficiency cogeneration from small-scale and micro-cogeneration units. Member States shall, where appropriate, take steps to encourage network operators to adopt a simple notification 'install and inform' process for the installation of micro-cogeneration units to simplify and shorten authorisation procedures for individual citizens and installers.

6. Subject to the requirements relating to the maintenance of the reliability and safety of the grid, Member States shall take the appropriate steps to ensure that, where this is technically and economically feasible with the mode of operation of the high-efficiency cogeneration installation, high-efficiency cogeneration operators can offer balancing services and other operational services at the level of transmission system operators or distribution system operators. Transmission system operators and distribution system operators shall ensure that such services are part of a services bidding process which is transparent, non-discriminatory and open to scrutiny.

Where appropriate, Member States may require transmission system operators and distribution system operators to encourage high-efficiency cogeneration to be sited close to areas of demand by reducing the connection and use-of- system charges.

7. Member States may allow producers of electricity from high-efficiency cogeneration wishing to be connected to the grid to issue a call for tender for the connection work.

[…]

2.1.9. ARTICLE CONTENTS[14] - PROPOSALS art.15

In Article 15 Demand Side Management provisions and balancing potential of High Efficiency CHP are clearly mentioned (with penalties for those hampering the development of those markets). This shall provide incentives to transmission and distribution system operators to improve the network infrastructure and to simplify and shorten authorization procedures.
In particular, Article 15 forces Member States to ensure that cogenerated electricity from high efficiency CHP gets:

- a guaranteed transmission and distribution
- priority or guaranteed access to the grid
- priority of dispatch in so far as the secure operation of the national electricity system permits.

Moreover, explicit references are made to the Electricity Directive 2009/72/EC and the RES-R provisions in Directive 2009/28/EC. Therefore, when ranking different types/classes of generators, variable RES-E shall be first but high efficiency CHP may be on a parity level. However, article 15 clearly states that Member States shall take into account the need to ensure continuity in heat supply.

In the light of article 15 contents, proposals in the industrial sector for the EED revision process are:

- Harmonize technical constraints (ex par 8) at EU level so that to avoid market distortions;
- Avoid discrimination of tax regimes applied to energy distribution, in particular to cogeneration and heat recovery, compared to the production of electric energy. In particular, in case of non achievement of high-efficiency cogeneration and in industrial areas and in period of crisis taxes for distribution in internal grids and efficiency systems should be eliminated.
- Confirm the priority of dispatching the Electric Energy in Cogeneration on public grids.
- Opening of the market of Distributed Generation (DG) in the view of "smartgrids" (SG).

[14] Source: Dr Fiona Riddoch – Cogen Europe. CODE2 Workshop "Developing a CHP Roadmap for Italy".

2.2. ENERGY TAXATION DIRECTIVE

2.2.1. INTRODUCTION

«On 27 October 2003, the European Union's Council of Ministers adopted Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity. This was published in the Official Journal L 283 of 31.10.2003. The Directive widens the scope of the EU's minimum rate system for energy products, previously limited to mineral oils, to all energy products including coal, natural gas and electricity.
In particular, the Directive will:

- *reduce distortions of competition that currently exist between Member States as a result of divergent rates of tax on energy products;*
- *reduce distortions of competition between mineral oils and the other energy products that have not been subject to Community tax legislation up to now;*
- *increase incentives to use energy more efficiently (to reduce dependency on imported energy and to cut carbon dioxide emissions); and*
- *allow Member States to offer companies tax incentives in return for specific undertakings to reduce emissions.*

The Directive entered into force on 1st January 2004»[15]

In the light of the EU climate and energy targets for 2020, **on 13 April 2011** the Commission further issued a proposal[16] to update rules on the taxation of energy products in the EU in order to remove current imbalances and take into account their CO_2 emissions and energy content. Indeed, the 2003 ETD version raises a number of problems, such as:
*a)*minimum levels of taxation vary substantially according to the product concerned. Hence, some products are favoured over others, the most favourable treatment being reserved to coal; *b)* the price signal the ETD introduces via its minimum levels of taxation is not properly related to the need to combat climate change; *c*) in spite of the growing market relevance of renewable fuels, their tax treatment still relies on rules developed at a time when these fuels were niche alternatives without major market significance; *d)* taxes on energy are levied in the same way whether or not the limitation of CO_2 emissions is ensured through the EU Emission Trading Scheme (ETS Directive 2003/87/EC). As a result, ETD and ETS sometimes overlap while in other case they may be completely missing.
Therefore, by revising the taxation regulatory framework, the Commission aims at combating climate change, improving energy efficiency, stimulating renewable energy sources while ensuring fair competition within the internal market. In this way a more coherenet energy taxation will result and overlaps wit the ETS will be finally removed. In particular, the main features of the European Commission proposal include:

- An explicit distinction between a CO_2-related taxation (specifically linked to CO_2-emissions attributable to the consumption of the products concerned) and general energy consumpion taxation (based on the energy content of each product)
- The revision of the minimum levels of taxation in the way that they reflect CO_2 emissions and net calorific value in a consistent manner for the various energy sources

The proposal for amending Directive 2003/96/EC is still under discussion.

2.2.2. FOCUS ON ARTICLE 17

"1. Provided the minimum levels of taxation prescribed in this Directive are respected on average for each business, Member States may apply tax reductions on the consumption of energy products used for heating purposes or for the purposes of Article 8(2)(b) and (c) and on electricity in the following cases:
(a) in favour of energy-intensive business
An "energy-intensive business" shall mean a business entity, as referred to in Article 11, where either the purchases of energy products and electricity amount to at least 3,0 % of the production value or the national energy tax payable amounts to at

[15] Source: European Commission, http://ec.europa.eu/taxation_customs/taxation/excise_duties/energy_products/legislation/
[16] Commission proposal COM(2011)169 for a Council Directive amending Directive 2003/96/EC, http://ec.europa.eu/taxation_customs/resources/documents/taxation/com_2011_169_en.pdf

least 0,5 % of the added value. Within this definition, Member States may apply more restrictive concepts, including sales value, process and sector definitions.
"Purchases of energy products and electricity" shall mean the actual cost of energy purchased or generated within the business. Only electricity, heat and energy products that are used for heating purposes or for the purposes of article 8(2)(b) and (c) are included. All taxes are included, except deductible VAT.
"Production value" shall mean turnover, including subsidies directly linked to the price of the product, plus or minus the changes in stocks of finished products, work in progress and goods and services purchased for resale, minus the purchases of goods and services for resale.
"Value added" shall mean the total turnover liable to VAT including export sales minus the total purchases liable to VAT including imports.
Member States, which currently apply national energy tax systems in which energy-intensive businesses are defined according to criteria other than energycosts in comparison with production value and national energy tax payable in comparison with value added, shall be allowed a transitional period until no later thatn 1 January 2017 to adapt to the definition set out in point (a)first subparagraph;
(b) where agreements are concluded with undertakings or associations of undertakings, or where tradable permit schemes or equivalent arrangements are implemented, as far as they lead to the achievement of environmental protection objectives or to improvements in energy efficiency.
2. Notwithstanding Article 4(1), Member States may apply a level of taxation down to zero to energy products and electricity as defined in Article 2, when used by energy-intensive businesses as defined in paragraph 1 of this Article.
3. Notwithstanding Article 4(1), Member States may apply a level of taxation down to 50 % of the minimum levels in this Directive to energy products and electricity as defined in Article 2, when used by business entities as defined in Article 11, which are not energy-intensive as defined in paragraph 1 of this Article.
4. Businesses that benefit from the possibilities referred to in paragraphs 2 and 3 shall enter into the agreements, tradable permit schemes or equivalent arrangements as referred to in paragraph 1(b). The agreements, tradable permit schemes or equivalent arrangements must lead to the achievement of environmental objectives or increased energy efficiency, broadly equivalent to what would have been achieved if the standard Community minimum rates had been observed."

2.2.3. ARTICLE CONTENTS - PROPOSALS

Article 17 prescribes the possibility for Member States **to apply tax reductions on the consumption of energy products used for heating purposes and on electricity in favour of energy-intensive business and in case tradable permit schemes are arranged among parties and implemented**, provided that they aim to achieve environmental protection objectives or improvements in energy efficiency.
Moreover, **the possibility of tax reductions down to 50% of the minimum levels for non energy intensive business entites** is also envisaged.
The above mentioned provisions should become compulsory in the revision process of the Energy Taxation Directive **in order to allow increased investments in energy efficiency technologies, such as Waste Heat Recovery to Power, to further contribute to the energy savings and GHG reductions**. Binding tax reductions could in turn lead to **positive externalities such as an increase of industrial competitiveness through an energy bill reduction that would also support EU industries in overcoming the current economic crisis.**

3. SUPPORTING DOCUMENTS

Within the H-REII DEMO Project the following research documents have been realized:

- **Waste Heat Recovery for a more Competitive and Sustainable Steel Industry.**

  Following the publication of the European Commission's Action Plan for a competitive and sustainable steel industry in Europe, the document in question was realized as a proposal for the inclusion of waste heat recovery within the technologies aiming to increase the industrial processes' environmental sustainability.

- **Waste Heat Recovery. Analysis of gas storage fields and gas compression stations ORC potential in Europe.**
  Author: G.Bucci.

  This document offers an overview of the European gas market structure with the objective to show the potential sustainability achievable through waste heat recovery in gas compressor stations.