



Energy efficiency and waste heat utilization

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Abstract

This paper was developed during the “Interdisciplinary Bilateral Winter and Summer School on Economic, Environmental policy, and Technical aspects of Energy Systems“ between Austrian and Czech students. Its aim was to examine funding systems and subsidies in both countries regarding energy efficiency and in particular waste heat recycling.

In order to achieve the climate targets, the European Union including Austria and the Czech Republic set themselves, incentives to promote energy-saving measures have to be declared. How this goal can be achieved in detail, is in accordance with the subsidiarity principle, responsibility of each country.

To analyse the different laws and regulations various founding guidelines, legislative databases, fact sheets of implementing entities etc. were examined online. The results presented in this paper are rather different for Austria and the Czech Republic, which is the reason a final comparison turned out to be quite difficult.

For Austria, very specific data about payment modalities, level of subsidies or other restrictions was found. The responsible organisation, the Kommunal Kredit Public Consulting, offers detailed information about the whole application process. The funding rates, as a key factor, for waste heat recycling accordingly amount to 160€/kW (0-30 kW) respectively 80€/kW (31-99 kW). The total subsidies are hereby limited to a maximum of 30% of the eligible costs.

For the Czech Republic on the other hand the information found were on a bigger scale. The paper shows different nationwide programs to promote energy saving measures like the operational program “Environment” for the years 2014 to 2020 which includes funding of 70 billions CZK (about 2.600.000.000 €).

Due to the different nature of the found data a clear comparison between Austria and the Czech Republic was not possible. However this paper still shows the different general approaches in these two countries. In conclusion, the research has shown, that the access to specific information about public funding programs has still potential for improvement, especially since mostly public money is involved.

Introduction

Conserving energy is the best way to ensure a secure and sustainable energy supply and to reduce greenhouse gases and emissions. Therefore the EU has set itself the objective of saving 20% energy until 2020 (the so called Europe 2020 strategy).

The shift to renewable energy sources is an important factor to achieve this goal. Another key approach however is just as important: improving energy efficiency. Energy can be saved through increased energy efficiency throughout the whole chain from its generation to its transmission and distribution to more efficient end-use. There are countless possibilities to save energy.

One of them is to utilize waste heat. Even in companies that already conducted various energy saving measures, there often exist a significant potential in utilize unused energy in waste heat. Thereby the possibilities to use that kind of energy ranges from feeding into a district heating grid, to convert it into electricity (Organic Rankine Cycle) or using it to operate refrigerating plants.

The aim of politicians should therefore be to encourage companies, municipalities or individuals to implement such technologies. The involved investment costs represent a more or less serious obstacle for interested parties. Many of these energy saving measures however pay for themselves after some time. Unfortunately, a lot of companies need a faster amortization to be willing to invest in such measures. That is why legislators have to create incentives in form of subsidies. The appropriate legislative basis however can vary for different countries or even different areas of application.

In the following, the situation of funding and subsidies concerning energy efficiency and in particular waste heat recycling is examined for Austria and the Czech Republic.

Funding system in Austria

Environmental support act

Environmental subsidies in Austria are based on the “Umweltförderungsgesetz” (Environmental support act) from 1993. From this year until 2015 subsidies in the amount of 7.697,9 million Euro were distributed due to this law. This sum was used to support 184.903 projects altogether resulting in an environmentally relevant investment sum of 30,12 billion Euro. In 2015 the average funding rate accounted up to 25,6% (BMLFUW 2016).

The application areas of the environmental support act are distinguished between following subareas:

- Water management
- Environmental support in Austria
- Renovation
- Remediation of contaminated sites
- International climate change financing

Regarding waste heat recycling especially the second subarea, environmental support in Austria, is of interest. This group again divided into:

- Renewable energy sources
- Efficient use of energy
- Resource management
- Measures to reduce air pollution
- Hazardous waste
- Noise protection
- Research and demonstration plants

The total environmental support in Austria subsidized over 4000 projects in 2015 with fundings of 83 million Euro (BMLFUW 2016). Efficient use of energy accounts for about one quarter of it. Waste heat recycling is not listed as a separate point by the BMLFUW, but is included in energy saving measures in companies. A detail breakdown of subsidies for efficient use of energy is given in Table 1.

Efficient use of energy	Amount	Environmentally relevant investment [€]	Cash value of the subsidy [€]	CO ₂ -savings per year [t/a]	Energy savings [MWh/a]
Natural-gas CHP	6	634.907	140.968	192	2.177
District heating connection	180	4.803.854	824.708	14.528	46.660
Heat pumps	100	7.704.651	1.108.512	6.863	22.278
Energy saving measures in companies	314	75.137.581	17.396.878	75.087	331.881
Change to LED systems	540	12.495.315	1.920.673	6.680	18.103
Thermal renovation of buildings	12	6.929.792	995.547	1.432	3.843
New low-energy buildings	13	108.524.008	611.908	965	2.690
Air conditioning and refrigeration	16	6.785.911	1.122.374	3.340	8.638
Total	1.181	223.016.019	24.121.568	109.085	436.269

Table 1: Environmental support in Austria for efficient use of energy in 2015 (source: BMLFUW, 2016)

Federal level

The subsidies for energy efficiency in Austria at federal level (including waste heat recovery) are provided by the Kommunal Kredit Public Consulting (KPC). It distinguishes between private individuals, municipalities and businesses. For private individuals there is funding for photovoltaic systems, electric vehicles and other energy saving measures, but not for waste heat recovery in specific. Therefore this sector is not further described in the following. KPC distinguishes between (KPC 2016):

- Waste heat recovery from cooling and ventilation systems with heat exchangers up to 100 kW_{th} power
- Other kinds of waste heat recovery

Eligible measures

The measures that can be funded are the same for municipalities and businesses. They cover various options for energy and CO₂ saving of existing buildings:

- Waste heat recovery of cooling systems: refrigeration and freezing units as well as process

cooling systems

- Waste heat recovery of ventilation systems: utilization of waste heat to warm up room air
- Other types of waste heat recovery or utilization of unused heat flows: for example air compressors, industry processes or waste heat from waste water
- Heat pumps to access low temperature waste heat
- Optimization of heating systems in existing buildings with at least 10% energy savings: retrofitting of waste heat recovery, more efficient pumps or control technologies
- Optimization of fossil process heat causers (only if the change to renewable energy sources is impossible)
- Optimization of lighting in existing buildings with at least 10% energy savings
- Optimization of lighting on streets or outdoor
- Efficiency improvements in industrial processes and systems with a significant technological and ecological difference to the existing system

Eligible and non-eligible technical equipment and systems

The following list shows the eligible technical equipment and systems which are qualified for funding by the KPC.

- Heat exchanger
- Heat pumps
- Boilers
- Buffer tanks
- Pumps
- Control electronics
- Air handling units with heat exchanger
- Energy saving measures for street lighting
- Other relevant components for operating

The Kommunal Kredit Public Consulting also provides a list of equipment and systems that can not be funded:

- Ordinary replacements of operating facilities or plants
- Waste heat recycling in new buildings
- Lamps
- Plug-in solutions for lighting
- Office equipment
- Air ventilation ducts of suction-extraction systems
- Efficient server and ICT-systems
- Induction cookers
- Efficient engines and pumps in new buildings

Framework conditions

In general the amount of achieved CO₂-savings is crucial concerning subsidies.

Date of application

For waste heat recycling under 100 kW_{th} (of the heat exchanger) the funding application has to be submitted after implementation and 6 months after accounting at latest. Other waste heat recycling systems (greater than 100 kW_{th}), optimization of lighting on streets and outdoor, and other energy saving measures have an earlier deadline for application. In fact the application has to be started before the investment is irreversible. This can be the first legally binding order, the delivery or the start of construction (KPC 2016).

Minimum investment

For the retrofitting of a waste heat recycling system greater than 100 kW_{th} the investment sum must be at least 5000€ (about 133000 Czech crown). For smaller systems there is no investment minimum. It is important to mention, that the eligible costs for funding include acquisition costs as well as the expenses for planning and installation (KPC 2016).

Minimum annual CO₂-savings

For optimization of street and outdoor lighting as well as small waste heat recycling systems there is no minimum concerning CO₂-savings. On the contrary, larger waste heat recycling systems and other energy saving measures must achieve CO₂-savings of at least 4 tons per year, in order to be eligible for federal funding by the KPC.

Calculation basis for the amount of subsidies

For smaller waste heat recovery systems eligible costs of the environmental investment form the basis for the calculation of the subsidies.

The calculation basis for other kinds of waste heat recycling is formed by costs that can be directly associated to the desired environmental effect (energy savings, lower carbon emissions,...) or by eligible costs minus costs for a comparable system without the environmental benefit.

In any cases shares for private use are deducted from the calculation basis.

Required documents for the application process

The required documents for both types of waste heat recovery can be seen in Table 2.

	Waste heat recovery from cooling and ventilation systems with heat exchangers up to 100 kW_{th} power	Other kinds of waste heat recovery
Technical description of the measure applied for		✓
Official identification document	✓	
Copy of invoices for the system or installation	✓	
Signed invoice summary	✓	
Offers and cost estimates for the significant parts of the system or installation applied for		✓
Report from the credit institute if the investment volume exceeds 500.000€		✓

Table 2: Required documents for the application process (source: KPC, 2016)

Level of subsidies

Again, here is a distinction between different types of waste heat recovery:

Waste heat recovery from cooling and ventilation systems with heat exchangers up to 100 kW_{th} power

The funding rates (lump sums) depend on the power of the heat exchanger (KPC 2016).

- 0-30 kW: **160€/kW** (4.250 CZK/kW)
- 31-99 kW: **80€/kW** (2.125 CZK/kW)

The total subsidies are limited to a **maximum of 30%** of the eligible costs.

Other kinds of waste heat recovery

In this case the funding rates are **30%** of the calculation basis or **35%** for projects from small and medium-sized enterprises who meet the selection criteria for EU-co-funding (KPC 2016).

Additional **5%** (max. 10.000€ or ~266.000 CKZ) are possible for EMAS-certified (Eco-Management and Audit Scheme) companies.

The **funding limit** (including possible subsidies for EMAS-certification) here is **450€** (~12.000 CKZ) **per saved ton CO₂**.

Land level

Additional to the federal funding system by the KPC, each of Austria's nine provinces provide an environmental support scheme. However most of their subsidies are related to consultation promotion programs (WKÖ 2017).

Those counselling focus most on:

- Waste management
- Mobility management
- Energy efficiency measures

Some states further offer investment subsidies for various environmental measures, that can be combined with the federal funding from Kommunal Kredit Public Consulting. The following table gives an overview of the most significant investment subsidies of each state.

State	Investment subsidies
Burgenland	No current investment subsidies
Kärnten	Solar thermal systems, storage batteries for PV systems, connection to the district heating grid
Niederösterreich	Prevention of environmental pollution (noise, air, water,...), waste avoidance, energy saving measures
Oberösterreich	Energy efficiency measures, use of renewable energy, measures to reduce environmental impact
Salzburg	Use of environmental friendly technologies
Steiermark	No current investment subsidies
Tirol	Energy saving measures or use of renewable energy in small and medium-sized enterprises
Vorarlberg	No current investment subsidies
Wien	Natural-gas powered vehicles, PV systems, solar thermal systems

Table 3: Investment subsidies in Austrian states (source: WKÖ, 2017)

As one can see, they vary widely and are often vaguely formulated. The level of funding as well as the eligible measures are therefore heavily depending on the specific application in the specific state. In any case the funding of single states is always meant as an addition and not a replacement to the federal level funding. Therefore the Kommunal Kredit Public Consulting also organizes the disbursement for some states. If this is not the case, the funding process is performed by the respective chamber of commerce or the state government.

Kommunal Kredit Public Consulting

The Kommunal Kredit Public Consulting (KPC) plays an important role for environmental support programs on federal level as well as on state level. Therefore a short overview about this organization is given in the following.



Figure 1: Logo of the Kommunal Kredit Public Consulting (source: KPC, 2017)

The KPC is a subsidiary of the specialized bank Kommunal Kredit Austria AG, which was founded in 1958 to provide Austrian municipalities with low-interest loans. The KPC itself was founded in 2003 and offer consulting concerning energy, environment, climate change, water and financing development projects. Their main business however is the management of environmental promotion programs in Austria. The geographical focus beside Austria reaches from South-East Europe, over Central- and East Europe to Central Asia (Figure 2).



Figure 2: Business area of the Kommunal Kredit Public Consulting (source: KPC, 2017)

The Austrian Federal Ministry for Forestry, Agriculture, Environment and Watermanagement (Österreichisches Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft; BMLFUW) is a major customer for the KPC. Since 1993 federal environmental support is conducted by the KPC on the commission of the BMLFUW (KPC 2017).

Funding system in Czech Republic

General situation

In Czech Republic, the majority of European subsidies are under Operational programs. The main goal of these programs is to get member countries closer to conditions of the European union.

In the Czech Republic, the managing authority of operational program Environment is The Ministry of the Environment, which has overall responsibility for the realization of the program. Ministry of Environment is also responsible for preparation of the operational program and as well for the submission of the operational program to the European commission.

The global goal of the operational program Environment is to protect and improve the quality of the environment as one of the basic principles of sustainable development. The argument for improving the quality of environment is that the environment is a basis of the good health situation of the state's population and increases the attractiveness of the area for life, work and investment.



Figure 3: Logo OPŽP; (source: <http://www.opzp2007-2013.cz> [on-line])

2007-2013

For years 2007-2013, there was the operational program Environment, which focused (in priority axis 3) on reducing the consumption of energy, improvement of the usage of renewable resources during the creation of heat or electricity and on utilization of the waste heat. In this program, there were prepared 673 million euros from the Cohesion Fund.

The subjects who could ask for this subsidy were mostly cities and municipalities, regions, contributory organizations, universities, non-profit organizations, and community-owned companies.

The maximum amount of subsidy was set up to 90% of the total eligible public expenditures. And the minimal total eligible public expenditures were set to 0,3 million CZK (~11.500€).¹

The types of supported projects were:

- Creation of heat (construction and reconstruction of local and central heat sources using renewable energy sources for heating, cooling and heating of hot water)

¹ Source: Operational program Environment, Priority axis 3 [on-line]; <http://www.opzp2007-2013.cz/sekce/369/prioritni-osa-3/> [seen: 27.5.2017]

- Creation of electricity (construction and reconstruction of wind power plants and small hydroelectric power plants. Plus construction of geothermal power plants and biomass power plants.
- Energy savings (reduction of energy consumption by improving the thermal and technical properties of buildings)
- Waste heat utilization (application of waste heat technology)

2014-2020

Now, in the present, there is operational program Environment for 2014-2020. This operational program is built on the basis of previous one.

Due to Richard Brabec, the minister of Environment, in these 7 years, there are more than 70 billions CZK (~2.600.000.000 €) prepared for applicants for these subsidies, however, the most resources are planned to be invested in improvement of quality of air, water purification and measures against flooding and drought. ²

Richard Brabec also provided information that the ministry of Environment has only 60% of resources designated for operational program Environment 2014-2020 then in operational program Environment 2007-2013, which is not the only change. The other changes are that, compared to previous year, the amount of supported activities has lowered and the terminology has changed.

In the operational program 2014-2020, the highest concentration of subsidy prepared for improvement of energy efficiency and waste heat utilization is in Priority axis 5.



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Figure 4: Logo MŽP; (source: <http://www.mzp.cz/> [on-line])

Program: Low-energy buildings

What concerns another issues connected to energy efficiency and waste heat utilization, in the Czech Republic, there is a new program, which is focused on construction of residential houses with very low energy intensity. This program was created by Ministry of environment and it is planned to work during years 2017-2021 (or up to the situation, when there will be no money left for another subsidies). The amount of money allocated for this program is 100 millions of CZK (~3.800.000 €).³

² Source: Ministry of Environment of the Czech republic; Report about operational program [on-line]; http://www.mzp.cz/cz/news_1508014_opzp_vyzva [seen: 27.5.2017]

³ Source: Ministry of Environment of the Czech republic; Report on program [on-line]; http://www.mzp.cz/cz/news_161121_nzu [seen: 27.5.2016]



Figure 5: Logo NZÚ; (source: <http://www.novazelenausporam.cz/> [on-line])

Except the standard elements of these low energetic residential houses, the program tries to motivate the people to use heat from waste water.

In nowadays, there is around 700 energy-saving residential houses.

Due to the one part of this program, the builders of new residential houses can cover up to 15% of their expenditures for one project.

In the program, there is also included the support for green roofs. Green roofs are special roofs, covered with vegetations or bearing the garden. These save energy for heating and cooling, have a positive effect on the natural water cycle and improve the microclimate.



Figure 6: Green roof 1; (source: <http://www.zelenestrechy.info> [on-line])

What concerns the green roofs, the program offers a subsidy for applicants in amount of 500 CZK/m². The maximum amount of subsidy per one family house is 15 000 CZK (~570 €).

Apart the green roofs, the program as well adjust the conditions for fotovoltaic panels. It allows the applicants, who could not install standart photovoltaic panels on their roofs, to install special kind of photovoltaic roofing.

The first wave of this program started in 2014. Untill now, the State fund of Environment accepted around 21 000 of requests with the total amount of subsidy requested of 4,8 billions of CZK (~184.000.000 €).⁴

⁴ Source: Ministry of Environment of the Czech republic; Report on program [on-line]; http://www.mzp.cz/cz/news_161121_nzu [seen: 27.5.2016]



Figure 7: Green roof 2; (source: <http://www.zelenestrechy.info> [on-line])

Program: Waste heat recuperation

What concerns subsidies for waste heat utilization, there is a program focused on installing the recuperation units into houses.

Recuperation is recovery of waste heat and than utilization of this heat, mostly for purpose of preheating. The recuperation itself consists of recuperation unit and the system of ventilation piping. This serves for keeping the heat inside the building. This helps to significantly reduce the costs of energy.

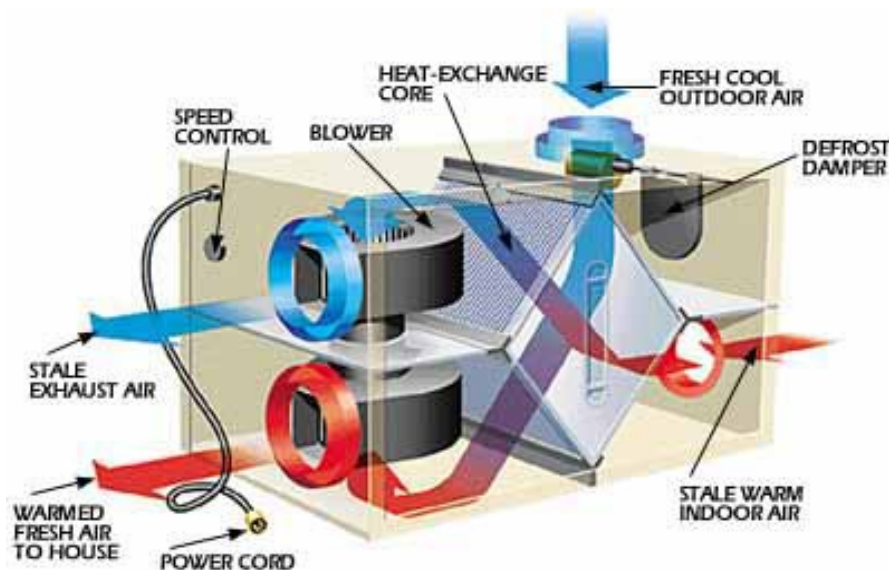


Figure 8: Recuperation; (source: www.popularmechnics.com [on-line])

The other positive outcome of recuperation is improvement of the quality of air, due to the capability of recuperation units to filter it. As well the recuperation unit can help against wetness and therefore against bacteria and mold.

There are two types of recuperation. The recuperation active and the recuperation passive.

The passive one only serves for a purpose of energy saving, because it has no other use than exchange of heat. On, the other hand, the active one can also work as heating. That means that the active one can increase the temperature of this heat, while the passive one cannot.

The real efficiency of recuperation units is between 30% - 90%. When the efficiency is bigger than 80% than it is possible to talk about good quality of the unit.

The price of recuperation unit for usual family house is set between 100 000 - 200 000 CZK (~3.800 - 7.700 €). Operating costs are not exactly high, but are usually hard to predict. In overall, the recuperation units help lower the costs of energy a lot.⁵



Figure 9: Recuperation unit; (source: <https://sustainabilityworkshop.autodesk.com> [on-line])

An individual can ask for a subsidy for purchase of a recuperation unit for usual family house. The amount of money allocated, which can be obtain for one project, was set maximally up to 50% of eligible expenditures and up to 100 000 CZK (~3.800 €) per recuperation unit in year 2016. This changed in year 2017. Now the maximum percentage of eligible expenditures is 75%.

Considering the usual cost of recuperation units, many individuals will not be able to obtain the maximum amount of subsidy possible.

Program: Subsidies for construction of passive houses

The program "Nová zelená úsporám" also offers a subsidy for people, who want to start building a new house. The applicants can ask up to 550 000 CZK (~21.000 €). However, the requirement the applicant has to accomplish are strict. The house has to namely fulfill the requirement of the maximum amount of 15 kWh/m² of heat consumption for heating per year.⁶

The passive house is a house, with perfect thermal-physical properties. And with very low energy consumption.

5 Source: Magazine iDnes [on-line]; http://bydleni.idnes.cz/vytapeni-a-chlazení-pomoci-rekuperace-dx3-/uspory-energii.aspx?c=A150213_110209_uspory-energii_rez [seen: 27.5.2017]

6 Source: Program Jak na zelenou; Subsidies for construction of family houses [on-line]; <http://www.jaknazelenou.cz/dotace-na-vystavbu-rodinnych-domu/> [seen: 27.5.2017]

Conclusion

The main goal of subsidies into energy efficiency is to serve as incentives for an improvement of the environment. However, the main problem of these subsidies is, that the data for subsidies for energy efficiency and waste heat utilization programs are hard to find. There are usually no simple tables with unified information and in case of there is someone searching for these unified information, he has to put the individual parts together.

This means that the system of providing information about the subsidies into the environment is not as clear as it should be. Because, due to this situation, the regular internet user would possibly never find the information, which he was searching for. And since the main goal of these subsidies is to serve as an incentive, they do not work properly, because there is the possibility they will not influence this kind of internet user.

Due to this lack of information, there is a difference in set of data for the Czech republic and Austria. And due to this, any detailed comparison between these two countries is not possible.

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