Adequate incentive-schemes for polygeneration technologies – possibilities & practical experiences

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Abstract

The realisation of polygeneration units in the CONCERTO-region Hartberg/Ecoregion Kaindorf (AT) needs adequate incentive-schemes to be successful. By investigating and analysing the regional framework conditions appropriate schemes (financial subsidies, trainings, voluntary CO_2-certificate system, vouchers etc.) have been worked out and its influence on the realisation rate are tested for the time being. Comprehensive communication and awareness campaigns underpin all related actions.

Keywords

polygeneration, incentive-schemes, incentive-strategies, practical experiences

Introduction

The EU-CONCERTO project SOLUTION (Sustainable oriented and long-lasting unique team for energy self-sufficient communities) aims to demonstrate that communities can reach self sufficiency in terms of thermal and electric energy requirements for buildings. The objective will be attained through energy saving measures, the production of renewable energy, energy storage by using polygeneration technologies as well as by monitoring consumption, optimising installations and the management of supply and demand. SOLUTION is a European consortium made up of four involved communities: Cernier (Switzerland), Hartberg (Austria), Hvar (Croatia) and Lapua (Finland), and of an observer community: Preddvor (Slovenia). They have all demonstrated strong commitment and motivation for sustainable development; however each one has its specific constraints and characteristics.

In Austria the community Hartberg is involved, that is situated East of the Austrian province Styria and consists of the city Hartberg, the commune Hartberg "Umgebung" and the "Ökoregion" Kaindorf. The City Hartberg has 6.583 inhabitants, Hartberg Umgebung 2.170 and the Ökoregion Kaindorf with its village of the same name as well as the also participating villages Dienersdorf, Ebersdorf, Hartl, Hofkirchen and Tiefenbach accumulate to 5.415 inhabitants. All in all 14.168 people live in the community of Hartberg on an area of about 120 km^2.

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The overall aims of the Austrian region Hartberg/Ecoregion Kaindorf are

- energy savings of 33 %,
- 44 % renewables in the energy mix and
- a zero carbon emission area achieved on long-term.

For achieving these ambitious targets the promotion of polygeneration represents the essential glue to match the gap between limited local energy sources and the future energy demand of the region. Based on a underlying polygeneration concept it could have been identified, that without adequate incentive-schemes the available polygeneration technologies could not be implemented at the intended level because investigations have shown that a critical amount of innovative technologies is necessary [1, 2, 3]. In order to overcome the mentioned challenges the following scientific questions are raised:

- What are the actual financial, legal, ecological and technical framework conditions for the integration of polygeneration technologies in the region?
- What are the adequate funding/promotion regimes that fit to the regional characteristics?
- Does a comprehensive communication and implementation strategy exist, and is it widely acknowledged by the targeted stakeholders?

Methods: A multidisciplinary approach

SOLUTION encompasses a multidisciplinary approach by using the following investigation steps:

- Comprehensive investigations concerning relevant basics like the current situation (financial, legal, ecological and technical regional framework conditions of polygeneration technologies), the necessary input material (e. g. biomass potential and supply) and relevant information for integrating polygeneration technologies (CHP, CCHP, DH).
- Based on the surveyed basics analysis and evaluations have been conducted. In this context extensively consultations with the local stakeholders and the project relevant partners have been conferred with.
- Furthermore SWOT analyses of the foreseen applications have been conducted in order to refine the original planning and to determine its risks as well as opportunities (classifying its strengths, weaknesses, opportunities and threats / SWOT-Analyses); evaluation and assessing of the SWOT-analysis results.
- Working out adequate promotion regimes.
- Approval of the worked-out supporting schemes incl. revision loops.
- Elaboration and realisation of a communication and implementation strategy.
- Finally the results have been prepared and consolidated to define a new concept for polygeneration technologies in the CONCERTO-zone.

Framework conditions for the integration of polygeneration technologies

Legal and ecological

At the moment in the CONCERTO zone there are no legal regulations regarding the improvement of polygeneration technologies. It could be detected, that without certain regulations an expansion of polygeneration technologies in Austria proceeds very slow. In

several cities obligations and subsidies lead to a significant increasing of this technology share. To increase the share the local municipal government of Hartberg established a regional energy concept. The following was determined:

- Initiation of specific subsidies for district heating connection (this has an significant effect on the indirect promotion of polygeneration technologies).
- Information campaign for target groups regarding current subsidies.
- Evaluation of the existing heating technology and the corresponding (energy) savings through alternative technologies, like polygeneration (advanced energy consulting)
- (Advanced) education and information of house owners.
- Densification of the current district heating network.

There are strong legal and political commitments to the enhancement of polygeneration technologies in the SOLUTION-area. However time consuming regulations exist that block a fast penetration of these technologies. Thus simplifications would be advantageable.

Respecting the ecological effects the CO_2-emissions are good indicators for the ecological relevance of polygeneration technologies. In the SOLUTION-community the share of oil is about 51 % and the share of coal amounts about 6 % of the heat supply. This shows the significant reduction potential through CO_2-emissions by polygeneration supplies in the CONCERTO zone.

Technical

The Austrian SOLUTION area with its large forests is a classical region for large-scaled biomass polygeneration. Thus combined heat and power systems are used with a broad range of capacities to obtain the energy consumption of self-sustaining households, and partly of commercial zones as well as industrial areas. Using combined heat and power systems for large-scale applications as well as small powers to obtain self-sustaining households is a well-known utilization in the area. Because of these experiences the technological framework conditions concerning biomass based polygeneration technologies are good.

To enhance biomass based polygeneration technologies a significant technical potential should given. On the one hand the supply / combustion plants can be optimized / upgraded. On the other hand new applications can be installed for the replacement of fossil / conventional operated facilities. Thus with respect to the facts shown a significant expansion potential can be determined for the whole project region.

At the moment all of the biomass potential in the CONCERTO zone is used for heating (especially for direct heat supply). It could have been identified, that there is a significant biomass import into the project region. Especially the high biomass demand of the major district heating plant in Hartberg can't be provided locally. Without a significant increase of energy savings for heating, the additional necessary biomass for the expansion of polygeneration can't be provided through the region. Thus the comprehensive implementation of polygeneration is also related to activities and measures of modernising the insulation of buildings which may result in a lower heat demand. Because of this fact, apart from a cost reduction, improvements of efficiency are supported and hence expected in the local biomass sector. This will lead to a larger polygeneration supply in the whole life cycle of biomass-to-energy systems. It is also expected that from the same amount of biomass the diversity of energy services will increase.

The high cooling demand in industrial processes and the increased demand of cooling for the air conditioning of office- and commercial buildings due to modern architecture (glass fronts) as well as the climatic increase of the ambient temperatures lead to the increased installation of local cooling plants. Thus, concerning the cooling demand in the region a rapid increase can be identified. This results in a higher electric power demand during the summer season. The centralised supply of several consumers with cooling energy and the application of combined cooling, heat and power production plants with absorption chillers are promising alternative options for the urban or commercial SOLUTION-areas. This will also allow optimising the yearly supply balance of renewable CCHP plants. The measure allows the reduction of the electric power demand and the utilisation of renewable energy based on biomass or waste heat for cooling.

Based on these facts the technical potential / framework conditions of centralised cooling plants also allow an economically and ecologically feasible option in the project region with potential cooling consumers (office, commercial and public buildings, hospital, train station etc.) compared to decentralised chillers (e.g. split coolers). At the moment possible large consumers are evaluated concerning cooling, but the future potential also shows a significant cooling demand for small-scale consumers. The technology experiences and potentials are known and this results in a significant economical interest of potential investors.

Finally it can be determined that the technological potentials (regional RES-sources, increasing electricity and cooling demand) and experiences in the Austrian SOLUTION area about polygenerated RES applications are available as well as that the technical framework conditions are sufficient for the integration of polygeneration technologies.

Financial

The supply costs from poly-generated RES applications are still higher than those of conventional technologies and are therefore the main barrier for its fast market penetration in the CONCERTO-zone. The main parameters characterising the costs of the energy services are investment costs, operation and maintenance cost of the plants and costs for the input material. The most promising cost reduction options are therefore: To use technological improvements (e. g. efficiency improvements), to develop an optimum design for each particular site and to promote a switch to technologies in which the diverse local available input material can be utilised in a coordinated manner. For the enhancement of the polygeneration share it is very important to consider these economical framework conditions.

Discussion of the framework conditions

The cost aspects are challenging the interest of potential investors. The available support schemes do not have the expected sustainable impact on the market as there is a lack of reconciliations among the communal, regional and national institutions as well as no security regarding pay back time periods for willing investors. Due to frequent amendments of federal incentives the local financial promotion schemes need to be adapted accordingly as well.

Because of these facts the technological framework conditions concerning polygeneration are good, the legal perspective is neutral and the financial aspects are worse. This underlines the implementation of adequate incentive schemes in the CONCERTO-zone.

SWOT-Analysis

The SWOT analysis has been conducted for meeting the particular requirements of the SOLUTION-area, for preparing access to finance, to implement local energy innovation grants in accordance with project performance criteria as well as to integrate innovative SMEs, technology providers of the region in an efficient way. In this context 3 different levels have been addressed:

- Concerning the common polygeneration situation (table 1)
- Concerning a certain technology application (table 2 and 3)
- Concerning the implementation at a certain site (table 4)

Concerning the common polygeneration situation

To get a view of the overall situation of the integration of polygeneration technologies a common SWOT Analysis was carried out (see table 1).

Table 1: SWOT-Analysis of the integration of polygeneration technologies

Strengths	**Weaknesses**
Co-ordinated actions for RTD / polygeneration technology transfer; high use of project results; focus on local demand and market in renewable energy / polygeneration; successful products on the national market; good networking culture.	Stop or go policy in terms of grants for polygeneration technologies; high competitions among entrepreneurs; few European market preparation / development; few connections to private finance i. e. venture capital.
Opportunities	**Threats**
Legal framework in favour of polygeneration technologies; Styrian energy master plan schedules to gain an increased use of polygeneration; high level of RTD research / innovative capability in polygeneration technologies.	Strong dependency on public funds; funding schemes remain discontinuously; access to private capital remain limited.

Concerning a certain technology application

Furthermore SWOT-Analysis has been carried out for certain polygeneration technology applications. In table 2 a selected SWOT-Analysis is carried out for CHP. In table 3 a SWOT-Analysis is presented of the DH Enlargements for thermally driven chillers.

Table 2: SWOT-Analysis of the CHP

Strengths	**Weaknesses**
High efficiency and environmental friendly electrical and thermal power production possible; generally CHP-technology is well known and developed; economies of scale enables low specific electrical power production and longer operation duration (> 20 a); the local installed screw-type engine (< 1,000 kW_{el}) shows a good electrical efficiency at partial load; power fluctuations between 30 % and 100 % cant be handled without difficulties (important for heat-	High investment necessary; the current frame-work conditions of the plants are few eco-nomical (e. g. high annual full load duration is necessary); complex system requires experts, if problems arise; for small-scale plants only prototypes with low practical experience exist and several units are under development; design and construction trend to last longer; short-term consideration of industrial consumers result in decisions against CHP-units; centralised energy production

operated plants); insensible for different steam qualities; secure disjunction between steam and oil cycle possible; low personal costs due to automatic and easy operation; low maintenance costs because of easy and robust design; marketable plants available	
Opportunities The removing of the current deficit of information could lead to a enhanced usage of this technology; can be adopted to CCHP quite easy; subsidies and promotions possible; biomass-based CHP-units are not depended on fossil fuel price developments; achieving autarky; RES-fuel changes are possible	**Threats** Low flexibility regarding changing conditions; dependency on fuels (security of supply, price, quality etc.); high demand of fuels could influence sustainability negatively; low know-how and design mistakes; dependency on changing political conditions; falling prices of fossil fuels and electricity; development is to slow for adapting changing conditions

Table 3: SWOT-Analysis of the DH Enlargements for thermally driven chillers

Strengths Local emissions can be reduced (like fine dust); low effort regarding maintenance and operation for the consumers; little know-how of the consumers is necessary; approved and experienced technologies available; high supply-density enables cheap and environmental-friendly heat and cooling-supply; high reliability	**Weaknesses** Pipeline-bounded production necessary; dependency on legislation or consumer behaviours regarding connection; high connection costs for the consumers; new technologies and developments can't be considered easily; low influences and transparency for consumers; heat and cooling consumption will be monitored later -> changing in consumer behaviours are more difficult to achieve
Opportunities Possibility to improve the district heating and cooling delivery; adoption to cold delivery enables future enlargement and new markets; possibility to integrate cheap and environmental-friendly industrial waste heat; opportunity to integrate solar thermal power, other polygeneration technologies, seasonal as well as day-related storage devices to achieve a higher RES-share or to integrate surplus heat; opportunity to integrate New-RES, polygeneration technologies or storage energy sources (e. g. hydrogen)	**Threats** Decreasing heat demand leads to higher losses, costs and competitiveness; mistakes regarding the design (e. g. too low temperature achieved at the consumers); liberalisation could lead to fossil-based plants; new housing standards could be necessary; community versus single advantage; lobbying of "fossil industry"; strong interest to individual solutions.

Concerning the implementation at a certain site

Finally a SWOT analysis was established at a certain site and for a certain technology. In table 4 the SWOT-results of a cooling device are shown at the regional hospital.

Table 4: SWOT analysis of new/old cooling device of the regional hospital

Strengths	**Weaknesses**
It is expected that the new cooling facility will achieve the COP of app. 3.2. Due to this increase of the coefficient of performance significant electrical energy can be yearly saved. The short distance between the cooling unit and the slot of the supply air allows combining them in order to pre-heat the supply air during the cold seasons. All in all this synergetic measure might yield to yearly heat energy savings. The pre-heating of the feeder water for the necessary steam may lead to reductions of yearly fuel oil.	Limited flexibility with the today adjustment setting. With the today adjustment setting of the cooling storage peak loads can't be reduced and the necessary capacity extension of 15 % can't be achieved. Based on available monitoring results the old cooling facility achieves a yearly COP of app. 2.12 at the moment.
Opportunities	**Threats**
The opportunity is to extend the today application in order to tackle the needed capacity increase. Due to the foreseen reconstruction of the cooling facility heating energy with a temperature level of app. 75 °C can be utilised for various purposes of the hospital. The security of supply will be guaranteed via the foreseen additional back-up storage.	As the major part of the implemented gas supply line is in not accessible within the slots and inserted ceilings there are a high risk of costly repairing of leakages. The existing system can't follow the predicted demand of the hospital in terms of peak loads and capacity extension of 15 %.

Summing up the most important SWOT-analysis-results

The high investment-costs are major barriers. Fluctuating fossil fuel prices, changing political conditions and low flexibility to other changing aspects are negative for investment-decisions. Thus the investors ask for long-term investment-conditions.

The current deficit of information about the polygeneration technologies, the potential and the advantages could be turned to a big chance.

The existing heating plants could be upgraded to polygeneration units by increasing the district heating and cooling supply that would lead to a higher efficiency. Additionally there are several polygeneration applications already in use in the area. Thus it can be expected that the critical amount could be achieved by adequate incentive-schemes.

Adequate funding/promotion regimes

In order to overcome the given weaknesses the following incentive-schemes for the CONCERTO-region will be carried out as part of a balanced mix:

- Trainings and behavioural-educational measures
- Financial subsidies
- Regional vouchers

- CO_2- certificate system

After intensive discussions about other possibilities, like regulations and prohibitions (e. g. connection obligation) to enhance the polygeneration share, it could have been defined, that these strategies are not suitable for this CONCERTO-region (e. g. because of political reasons). In the following the mentioned incentive-schemes are presented in more detail:

Training and behavioural-educational measures

To promote sustainable consumer behaviour four general dimensions of user behaviour of interest for the SOLUTION-project can be identified [5]:

- Technology acceptance,
- technology handling,
- technology-induced behavioural change and
- technology-independent saving potentials.

To address these dimensions and to increase the limited, but growing body of knowledge on the complex interactions influencing the energy behaviour, especially polygeneration applications, the technical and scientific expertise of the project team should be combined with the local knowledge of the involved actors at community level. Before the training activities have started the local drivers and patterns of energy behaviour changes have been identified by stakeholder consultations in order to develop a general framework which can be applied for a set of measures intended to better understand the consumer perception. In this context participatory workshops were organised in order to verify advisements of the site and to better understand favourable conditions for the implementation of the demonstrating polygeneration technologies. Furthermore stakeholder-analysis were performed in terms of power relations, interests, interdependencies, involvement, effects and interrelationship of stakeholders. Finally public perceptions of, and social and institutional impacts and dynamics induced by polygeneration technology investments were also analysed.

Based on the consultations-results a series of lessons/discussion events is arranged in Austria during the SOLUTION-project to address the following objectives [5]:

- Provide opportunities,
- give useful information,
- break routines and attract attention,
- create a positive attitude towards energy efficiency,
- create a sense of control,
- create the intention to act and
- organize widespread diffusion of the behaviour.

The training and behavioural-educational measures aim at continuously addressing different target groups (end-users, authority, industry, operator etc.). Thus the certain content of the event depends on the addressing participant. The events are free and take place very regularly. There are a lot of short events (duration 2 hours) and additionally some whole day events (saturday-lessons and exhibition), to be repeated once or twice during the project.

Selected topics concerning polygeneration for end-users and operators, are presented below:

- Combined Solar heat/electricity technologies
- Technical and financial implementation of solarthermal energy into district heating systems

- Cooling technologies (thermally driven chillers) based on existing biomass-district heating systems
- Various heating & cooling solutions (incl. energy recovery)
- Innovative biomass polygeneration technologies (e. g. microgas-turbines)
- Biomass for electrical power, heat, cooling and mobility
- Advanced home building technologies for polygeneration (incl. using conventional primary energy sources)
- Innovative polygeneration technologies for the decentralised energy supply (organic rankine cycle, microgas turbines, stirling engines etc.)
- Realisation aspects of polygeneration technologies: Financing and economy of polygeneration technologies, existing legal framework conditions (incl. current city plans and building plans), Grants

Selected topics planned concerning polygeneration for authorities, are presented below:
- Advanced polygeneration techniques vs. technology codes
- Energy strategy, planning in the city and compatibility with polygeneration
- Realisation polygeneration systems
- Concerto experiences

Selected topics planned concerning polygeneration for the industries and energy entrepreneurs, are presented below:
- "Boosting polygeneration solutions for industry and community cases"
- Information-events and consultancies within the event (e. g. for CHP- CCHP-units)
- Advantages of polygeneration (e. g. densification of the supply)
- Concerto experiences

Financial subsidies

The design of financial promotion measures (funding policies) for polygeneration is challenging civil servants and town councillors since the financial possibilities of municipalities are limited and energy policy making is a quite complex process. This matter of facts is very complex and thus adequate financial subsidies should be provided by SOLUTION. This incentive-possibility aims at
- improving the financial framework for potential private investors,
- promoting innovative integration aspects of polygeneration and
- preparing access to finance by implementing local polygeneration innovation ventures.

Based on a validation and analysis of existing promotion measures, launching a communal energy innovation financial support scheme and in accordance with SOLUTION performance criteria adequate innovative polygeneration integration promotion programmes have been established for the integrating of innovative SMEs and technology providers of the project region in an efficient way. The financial project-incentives were adapted to the regional available subsidies (national, district and municipally grants) to avoid redundancies.

This incentive-scheme enables the financial promotion of different polygeneration technologies and provides safe investments in polygeneration technologies to achieve the critical amount and to decrease possible scepticisms among touched citizens. The financial SOLUTION-subsidies amount 50 %. Following selected polygeneration activities are promoted financially within the SOULUTION-project:
- Innovative photovoltaics/hybrid-facilities

- Expansion of new development as well as upgrading of existing applications towards polygeneration (e. g. for CCHP and CHP-units)
- Thermally driven cooling devices

Regional vouchers

Regional players have the opportunity to use different vouchers for feasibility studies, consulting, preparation work for R&D-projects, planning services etc. in order to raise multiplying effects. These vouchers are used for the payment of the executing organisations / companies. There are 3 different kinds of vouchers available that have to be coordinated with regard to the contents to avoid competitive situations:

1. Vouchers for raising the entrepreneurial energy efficiency [4]: Investigations have shown that depending on the company sector the economically realisable energy-efficiency potentials amount between 20 % and 30 %, whereas polygeneration technologies can contribute a significant share. Within this initiative a structured comprehensive incentive-system is established for SMEs to carry out energy-consultancies in the companies and to identify economically realisable measures. The companies get an extra payment for two different kinds of consultancies (initial consultations and realisation consultations). The grant amounts 90 % of the consultancy costs with a maximum of EUR 675 for each kind of consultation.
2. Innovation-voucher for SMEs [6]: The innovation-voucher is a financial promotion for small and medium enterprises with the aim to enable the access to research- and innovation-activities with a long-term effect. With the innovation-voucher enterprises can pay certain services of research organisations (research institutions within and beyond university walls). The services must contribute to the innovation-activities of the enterprises. The voucher can't be redeemed for non-innovative and simple / conventional consultancy activities. The maximum of financial promotion amounts EUR 5,000.
3. Within SOLUTION a financial grant / voucher of maximum EUR 10,000 can be used for services, that are conform to the regional SOLUTION-objectives and can't be covered by the vouchers listed in (1) and (2), whereas in comparison to the shown vouchers this SOLUTION-grant can also be used by others than SMEs. To guarantee the incentive conditions (avoiding of redundancies, providing of useful undertakings etc.) an investigation will be carried out by the SOLUTION-project team. One of the major focuses of this incentive scheme lies on the identification of potential sites of polygeneration technologies, their planning and realisation. In this context for instance site visits can be carried out and rough concepts of CHP- and CCHP-facilities can be produced with this voucher.

Regional voluntary CO_2-certificate system

A regional voluntary CO_2-certificate-system has been established for companies. By the certificate-system participating companies buy a certain amount of CO_2-certificates that can be used for earmarked / committed zero-emission activities. By the realisation of this measure companies are able to sell their products and services without any CO_2-emmission. Because of the voluntary character the enterprises use this effect for marketing activities. At the moment the generated financial value by the CO_2-system is only used for the building up of humus by the local farmers (humus enables a storage of atmospheric CO_2), but the measure could also be extended to other activities (like the local realisation of polygeneration technologies) as well as other players (like households or municipalities). One ton of avoided CO_2-emmission is sold

with EUR 30 by the farmers. The CO_2-certificates are not tradable to eliminate speculations. After a certain obligation-duration the certificates are worthless.

Communication and implementation strategy

Marketing- and communication-tools as part of the implementation strategy of the incentive schemes can be identified as key for the realisation by providing a target group oriented communication and implementation campaign based on the worked-out schemes. Thus the objective is to draw up an efficient dissemination strategy to pass on the key solutions to the involved players as well as to transfer the model of this project SOLUTION to the potential communities for replication.

By providing a target group oriented communication and implementation campaign based on the worked-out schemes the players (investors, population, authority) of the CONCERTO zone might be animated to switch to polygeneration technologies. This work facilitates a coherent and significant flow of information on the activities of SOLUTION towards carefully identified and selected targeted audiences, which includes:

- general energy consumers and service providers,
- actors in the communities involved (inhabitants, politics, industries),
- potential investors and
- politics at all levels (national, regional,…).

Conclusions

In order to overcome the given weaknesses such as: “The available support schemes do not have the expected sustainable impact on the market as there is a lack of reconciliations among the communal, regional and national institutions as well as no security regarding pay back time periods for willing investors. Due to frequent amendments of federal incentives the local promotion schemes need to be adapted accordingly as well.” …the following conclusions are drawn.

Irrespectively of the technology-maturity and the economy of polygeneration technologies a critical amount of realised technologies in the region is necessary. To achieve this amount adequate incentive-schemes are essential, that fit to the characteristics of the region, provide a balanced mix and are accompanied by a comprehensive marketing- und communication-strategy.

The goal of the implemented incentive schemes is to discover consumers groups that may be motivated to sustainable (polygeneration) technologies and consumption to address the group-specific motives and preferences as well as to implement strategies to “market” sustainable consumption to different target groups.

Based on the regional conditions investors ask for long-term investment-conditions. The opportunity is to co-ordinate and to promote initiatives (from local to European) for filling gaps as well as to make available existing know-how and expertise in the region. Co-ordinated actions may allow the acquisition of new business areas und customers as well as more efficient dealings with necessary investments.

The participation of social actors is envisaged as a key component of the implementation of polygeneration technologies. The incentive schemes of the project will be conveyed to them in order to enhance better understanding of effects related to energy-use patterns, consumer perceptions, behaviour, economic and legal aspects as well as various attitudes towards polygeneration technologies. Taking this into consideration, it might be able to offer products and services that meet the existing needs within the project objectives. Other stakeholders affected may become attracted and involved in the pursuit of economic, social, environmental, cultural sustainable and technologically viable alternatives, facilitating the adoption of innovative polygeneration solutions, and of institutional conditions in favour of new energy services.

Nomenclature

a	year
app.	approximately
CHP	combined heating and power
CCHP	combined cooling, heating and power
CO_2	Carbondioxide
DH	district heating
e. g.	exempli gratia
EUR	Euro
i. e.	id est
km²	square-kilometres
kW_{el}	kilowatt, electrical
RES	renewable energy sources
RTD	Research Technology & Development
R&D	research & development
SMEs	small and medium enterprises
SWOT	strengths, weaknesses, opportunities, threats
°C	degree Celsius
%	percentage

References

[1] German Federal Ministry of Economy and Technology, 2008: ”E-Energy ICT-based Energysystem of the Future“. Berlin, Germany.
[2] Elbe, S., 2007: ”The conditions of successfull regulations through integraded approaches based on incentive schemes – investigations at the modellarea AKTIV“. Doctoral Thesis. Dortmund, Germany.
[3] Austrian Federal Ministry of Transport, Innovation and Technology, 2010: ”Smart Grids D-A-CH-Workshop“. Proceedings of SMART GRIDSWEEK SALZBURG 2010. June 22, 2010. Salzburg, Austria.
[4] Climate and energy fund of the Austrian federal government: “SME-initiative for increasing the energy-efficiency”. http://www.kmu-scheck.at/ (2011-02-22; 9:35)
[5] Fischer, C., 2007: “Efficient use of efficient technologies: strategies to promote sustainable consumer behaviour”. Freie Universitaet Berlin, Germany.
[6] Austrian Research Promotion Organisation, 2010: “Innovation-voucher for SME”. http://www.ffg.at/innovationsscheck-fuer-kmu (2011-02-22; 15:29)