Market analysis of ST-ESCOs

1 Introduction and Background

1.1 Introduction

Between 1975 and 1979 - after the energy crisis - there was a rapid movement towards solar devices. Not only concerns over energy prices, but also grants from the provincial and federal governments were decisive factors for this boom.
Reductions in oil prices, and partially disappointing results from technically unsatisfactory products, plus mistakes in planning and installation, led, in some measure, to the dramatic collapse of the market in 1984.
In recent years, however, further considerable growth has been achieved. The basis for this was an increasing environmental awareness and the return of confidence in solar technology due to the introduction of improved, cheaper systems.
Although there are more favourable sites in Europe in terms of the climate (Spain, Italy, Greece, etc.) Austria leads the per capita solar statistics in Europe with an installed collector area of approximately 360m²/1000 inhabitants (Status: as of end 2004). Austria's equally pioneering role when it comes to technology can be seen from the export share of sun collectors of more than 100% in relation to the volume of own brands in 2004.
The present market report describes activities and framework conditions which have led to success in the field of solar energy in Austria as well as strategies to further extend applications for solar energy.

1.2 Background

The domestic solar heating market

As of the beginning of the 1980's the use of solar energy using thermal collectors has been the subject of constant growth in Austria. At the beginning of this development systems were installed in the main for warm water preparation in private small-scale plants as well as the first larger-scale plastic absorber areas to heat swimming pools.
The production of collectors was performed exclusively by small trading and artisan companies who mostly only offered their products to a regional market. The other components such as the storage tank and control system were bought from other companies and the overall plant was adjusted by the plumbers to suit the customers' requirements.
As of the mid 1990's there was a clear expansion of the applications for solar energy plants. As of this time the first combisystems were installed for partial solar space heating, plants for multi-family homes and hotels as well as solar-supported biomass local heating networks.
The conquest of new applications for thermal solar plants was triggered off and supported by research and promotion programmes from the Federal State and the Provinces. In particular the development of systems for solar space heating triggered off numerous innovations due to the larger collector areas required and new requirements re. the storage tanks. The market share for these combisystems (warm water and space heating) of the collector area installed rose continuously and as of 1998 it has made up for around the half of the collector area installed annually.
The largest plants, with a collector area over 1000 square meters (the largest plant comprises 1,440m²) were installed as support for biomass local heating plants respectively to increase the backflow in district heating networks.
Above all the change from commercial to the industrial production of components and systems towards the end of the 1990's made it possible to change the approach to cover larger markets beyond the borders of Austria. This development was expressed by a significant increase in the export share.

In parallel fashion to the creation of industrial collector productions numerous technological innovations were achieved in close co-operation with research institutes and solar energy companies. These developments range from various product developments (collectors, storage tank concepts, control systems, etc.) to visually attractive solutions to be integrated in buildings (roof and façade integrations) through to special know-how on system-technical solutions in the field of large-scale plants.

In the future it will be necessary to conquer the applications tested in Austria in pilot and demonstration plants for the wide market and in addition to find new applications for solar energy. Apart from the solar supply of a large share of the need for domestic hot water, the solar share of the supply of space heating has to be increased step-by-step. Apart from extending applications in the construction of stories buildings, in tourism companies, in sports centres, in local and district heating networks, in hospitals, etc. the segments of „low temperature heat in industrial companies“ (solar process heat) and „solar cooling“ offer considerable future potential.

Size (from above sources of information or others)
In 1980, 23,000m² of collector area were installed in Austria and in 1995 the 200,000 m^2 level was surpassed for the very first time. At the current moment in time it seems like the market is stabilising at this high level. For example in 2004 191,500m² of collector area were installed. Of this 180,010m² is accounted for by covered flat collectors (95.0%), 1,915m² by vacuum collectors (1.0%) and 9,575m² by non-covered plastic absorbers (4.0%).

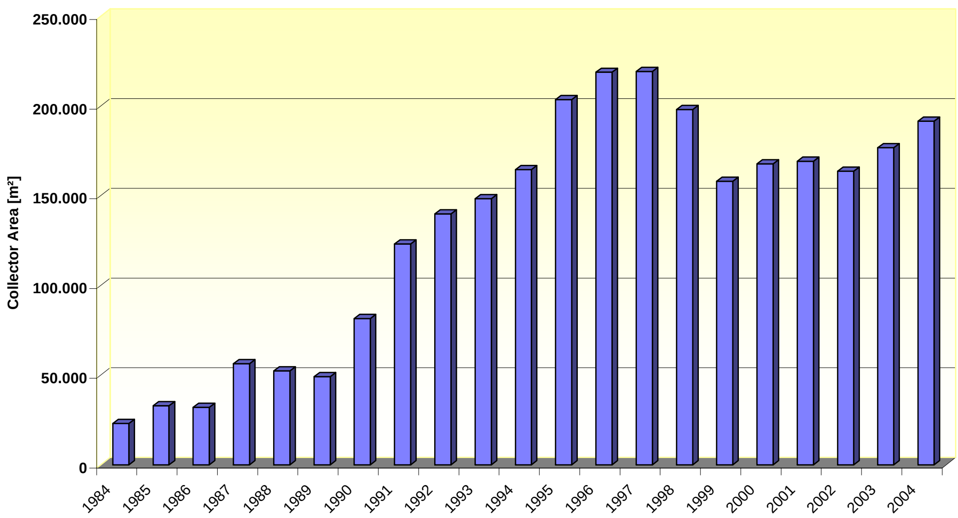
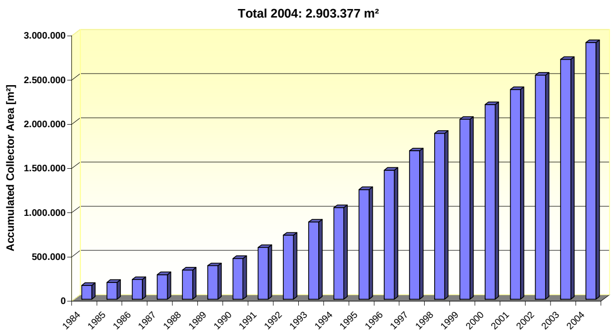


Figure 1: Collector area installed yearly as of 1984 (Faninger, BVS, 2005)

All in all 2,903,377m² of collector area were installed in Austria by the end of 2004t. Of this 2,256,855 m² was accounted for by covered flat collectors (77.73%), 34,124 m² by vacuum collectors (1.18%) and 612,398 m² by uncovered plastic absorbers (21.09%). In this respect flat and vacuum collectors are used in the main for the heating of domestic water and space heating supply and uncovered plastic absorbers mainly to warm private and public swimming pools. When it comes to the installed area of covered flat collectors the trend in the recent past has been a slight rise. With vacuum collectors there is a slight decline and plastic absorbers are declining considerably. This can be explained by the fact that the large share of public outdoor swimming pools already make use of a solar plant to warm the water which that the only potential customers who remain are privately owned swimming pools.



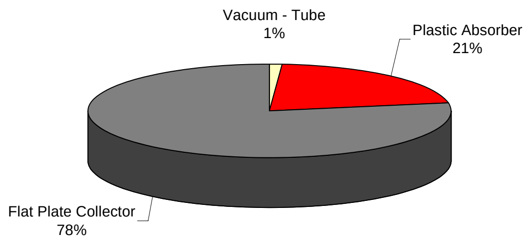


Figure 2:
Accumulated depiction of the overall collector area installed in Austria (1984 to 2004).

Figure 3:
Break-down of overall installed collector area in Austria by the end of 2004 into products.

History: how was this market created?

Market development 1975 to 1979

Between 1975 and 1979 - after the energy crisis - there was a rapid movement towards solar devices. Not only concerns over energy prices, but also grants from the provincial and federal governments were decisive factors for this boom. As early as 1979 this development led to 29.000m² of installed collector area in Austria.

Market development 1979 to 1984

Reductions in oil prices, and partially disappointing results from technically unsatisfactory products, plus mistakes in planning and installation, led, in some measure, to the dramatic collapse of the market in 1984. In this year only 7,500 m² of collector area were installed by a few small solar energy companies.

Market development 1984 to 1995

In recent years, however, further considerable growth has been achieved. The basis for this was an increasing environmental awareness and the return of confidence in solar technology due to the introduction of improved, cheaper systems. One of the many possible ways of achieving the above objectives is through the AEE INTEC (Arbeitsgemeinschaft ERNEUERBARE ENERGIE, INSTITUTE FOR SUSTAINABLE TECHNOLOGIES) which promotes and advises self-build groups on the construction of thermal solar installations. In 1984, at a time when Austrian solar technology had experienced a decline after the first boom of the mid-seventies, the first self-build groups were formed in Styria. The organizers of the first loosely connected self-build groups, founded as a result AEE INTEC, a non-profit organisation, providing advice and assistance on a professional basis. Self-build and assembly procedures were optimized, technical and organisational material prepared, and a chain of advice centres established throughout Austria, with support from Ministry for Environment, Youth and Family Matters. Through the development of an assembly procedure for solar devices, it was possible to reduce the cost by more than 50%, compared with commercially manufactured systems.

One very positive effect was an increase in the PR work which led to a considerable increase in "do-it-yourself systems" as well as greater demand for solar plants installed by plumbing companies. Thus in 1995 more than 200,000 m² of collector area (203.520 m²) were installed for the first time.

Market development 1995 to 2004

Due to the strong demand for solar energy systems an increasing number of companies began to specialise in the production, sale and installation of the former. In 1995 for example the very first distribution networks were established vai wholesalers and individual companies began to offer complete systems (collector-through to storage tank products). These developments led to a considerably reduction in prices which is why the demand for "do-it-yourself systems" declined more and more. All in all between 1984 and 1997 more than 400,000 m^2 of collector area were installed in "do-it-yourself groups".

In 1997 the largest annual collector area of 219,240 m² was installed. Following a decline in 1999 the market has become more stable in the last five years at a high level (between ~167,000 m² in 2000 and ~191,500 m² in 2004).

Table 1: Installed collector area at the end of 2004 and annual solar thermal energy production (Faninger, BVS, 2004)

	Flat plate collectors	**Vacuum collectors**	**Unglazed collectors**	**Total**
Installed collector area in the end of 2004	2.256.855 m²	34.124 m²	612.398 m²	2.371.457²
Annual solar yield in kWh/m²	350 kWh/m²	550 kWh/m²	300 kWh/m²	
Annual solar thermal energy production in 2004	789,9 GWh	18,8 GWh	183,7 GWh	992,4 GWh

main types of products

Domestic hot water production in one- or two family houses
Thermal plants for domestic hot water in one and two-family homes were for a long time the main application for thermal solar energy utilisation which is reflected in the share of collector area installed overall. At the end of 2004 this equalled around 74%. Typical plant sizes are between 5 and 10 m² and these attain solar covering rates of between 50 and 70%. Due to the great demand for solar systems for domestic hot water and as a heating support system in the recent past, the share of purely domestic hot water plants of the collector area installed annually (flat collectors and vacuum collectors) now only makes up for 40%.

Combined systems for domestic hot water production and partial space heating (combisystems) in one ore two family houses
At the beginning of the 1990's the very first solar combisystems were erected in one and two-family homes apart from standard applications for domestic hot water production. As a rule the covering rates of these plants with regard to the heating requirements of the houses equalled between 10 and 50%. Likewise demonstration projects were erected with a 100 % coverage in terms of domestic water and space heating requirements. These applications make totally different demands of the collector areas and of the storage tank and system engineering which led to a host of innovations (large-area collectors, stratification techniques, etc.) supported by national Ministries and provinces. The market share of these combisystems (hot water and space heating) in the collector area installed already equalled 50 % in 1998. It was possible to uphold this high share of solar combisystens in the last few years so that combisystems now make up for 20% of the overall installed collector area (flat collectors and vacuum collectors).
In this field Austria has without a doubt assumed a pioneering role. This development is being pursued, led by Austria, within the framework of Task 26 (solar combisystems), of the Solar Heating and Cooling Programme of the International Energy Agency (IEA).

Large collective solar water heaters
In general this category comprises applications in multiple-storey residential buildings, sports centres, tourism, hospitals, OAP homes, etc.. In the main plants – around 500 to 600 plants – were erected in the field of multiple-storey residential buildings. Compared to the potential available (around 50% of the Austrian population lives in multiple-storey residential buildings), this segment still has a lot to offer. All in all a maximum of 5% of the collector area installed in Austria (flat collectors and vacuum collectors) is accounted for by this applicational segment.

District heating
The largest plants, with collector areas above 1000 square meters, were integrated in district heating networks. Many of these assume the almost 100% preparation of domestic hot water in the summer months and thus eliminate the need to operate the main energy source (frequently biomass) in periods in which the load is low. The largest plant in this category is also the largest plant in Austria and comprises 1,440m² of collector area. This plant erected and operated in „contracting" feeds the district heating network all year round of the City of Graz. The share of district heating plants of the overall collector area installed (flat collectors and vacuum collectors) is below 1%.

Unglazed plastic absorbers
Unglazed plastic absorbers are used in Austria to heat private and public swimming pools. In the last ten years numerous public swimming pools were equipped with unglazed absorber systems which led to saturation in this segment of application. This becomes clear when taking a look at the number of uncovered absorbers installed in 2004. 9,575 m² of installed absorber area mean a decline of around 35% compared to 2000. The share of uncovered absorber systems with absorber areas up to 30 m² makes up for more than 90% in the year 2004 which clearly points to private applications in the main.

New applications
In the recent past the very first solar energy plants were erected in new applicational segments such as for example „solar cooling"and „industrial heat". Further research work and projects will be required in these segments for a wider implementation.
Particularly in the field of solar process heat an extensive potential analysis is currently being carried out within the framework of a national project. There are other efforts to conquer this market segment within the framework of the Solar Heating and Cooling Programmes of the IEA.

Political situation
The energy policy of the Austrian Federal government has enabled the use of solar energy systems in the last ten years since they established constant framework conditions uninfluenced by government bodies. Effort is clearly being undertaken to reach national climate goals by establishing different budgets to promote this cause and pertinent research projects. The most important of these are listed here.

- On behalf of the Federal Ministry for Traffic, Innovations and Technology the programmes were started in the year 2000 entitled „House of the Future", „Factory of the Future" and „Energy Systems of the Future" within the research programme „Austrian technologies for sustainable development". The main points of solar energy research are taken into consideration in these programmes.
- For years the Federal Ministry for Agriculture and Forestries, the Environment and Watermanagement supported companies with the erection of energy-saving measures (as well as solar energy) by awarding them direct grants of up to 30% of the cost of the plants.
- Definition and resolution concerning a national strategy on the climate to satisfy the stipulations of the Kyoto-Resolution in which Austria has agreed to reduce emissions contributing to the greenhouse effect by 13% by the year 2008/2012 (BMLFUW, 2002).
- Instructions from the Federal government to the governments in the provinces, to restructure the funds for housing grants (new constructions and renovation projects) in accordance with the national climate goals (BMLFUW, 2002) with regard to increasing the energy efficiency and the use of renewable sources of energy.
- In 2004 the Federal Ministry for Agriculture and Forestries, the Environment and Watermanagement was started a programme of action entitled the „climate". Solar energy should represent a major point of emphasis of this programme. This Subprogramm is called "solar**wärme**" (www.solarwaerme.at) and managed by the AEE INTEC.
- All of the provinces allow grants for solar plants in the framework of housing grants.
- Many local communities and towns promote the erection of solar plants.

2 The demand side

The main segments of application of solar energy plants (flat and vacuum collectors) in Austria are as follows:

- Domestic hot water production in one and two family houses: 74%
- Combined domestic hot water production and space heating in one and two family houses: 20%
- Collective domestic hot water heaters, district heating applications and others 6%

Potential in the field of one and multiple family houses:

In the year 2000 Austria had around 8.145 million citizens. Of these 57% lived in one and two family homes and 43% in multiple family homes. The number of apartments/houses with the main place of residence (one family homes and multiple family houses) equalled 3.26 million in the year 2000. Of these around 1,312,600 are defined as one and two family homes and 1,947,400 as multiple family homes (Statistics Austria, 2002).

- <u>Domestic hot water production in one and two family houses:</u>

Around 74% of the collector area installed until now was used for the preparation of domestic hot water which means that almost 13% of all one and two family homes possess a thermal solar plant to prepare domestic hot water. Although this area was processed intensely in the past there is still considerable potential waiting to be tapped.

The average size of a solar plant for this application equals:

Collector area:	6m²
Storage volume:	300 l
Solar Fraction:	60-65%
Specific yield:	350 kWh/m²
Collectors integrated in the roof	
System costs incl. installation and VAT:	€ 4.200

- <u>Combined domestic hot water production and space heating in one and two family houses (combisystems)</u>

Around 20% of the collector area installed until now is used for combisystems (domestic hot water preparation and space heating) which means that almost 2% of all one and two family homes have a solar combisystem. The potential still to be tapped in this segment is considerable.

The average size of a solar plant for this application equals:

Collector area:	12m²
Storage volume:	750 l (puffer tank)
Solar Fraction on the total heat demand:	5-15%
Specific yield:	250 kWh/m²
Collectors integrated into the roof	
System costs incl. installation and VAT:	€ 7.500

- Collective domestic hot water heaters, district heating applications and others

The main application in this field is with multiple family houses in the preparation of domestic hot water. As of the end of 1998 around 250 plants were installed in multiple family houses (Fink, Purkarthofer, 1999), which corresponds to a collector area of 15,000 m². At the end of 2001 the plant number is estimated at around 600. This corresponds to a collector area of around 40.000m². If one assumes sizes of around 2m² of collector area for each apartment/house, and if the number of flats/houses in multiple family houses is 1.947 millions as previously mentioned then 1 % of the existing flats/houses in multiple family houses (basically domestic hot water preparation) were reached with solar energy so far. If once strives to achieve higher solar coverage rates resp. a higher integration rate for space heating, then there is still a great deal of potential in this field.

Average assumed dimensions for solar plants in multiple family houses (Fink, Riva, Heimrath, Mach, 2002):

Collector area:	1,5 – 2,5m²per flat
Storage volume:	40 to 80 litres per m² collector area
Solar Fraction on the domestic hot water demand:	20-40%
Specific yield:	350 – 400 kWh/m²
System costs incl. installation and VAT:	€ 340 - € 650

Figure 4 illustrates the specific system costs of flat plate collector systems (mean values out of three offers from solar companies) with increasing collector area. The red line shows the mean value of the blue lines, the upper blue line gives cost numbers with unfavourable boundary conditions and the lower blue line with favourable conditions.

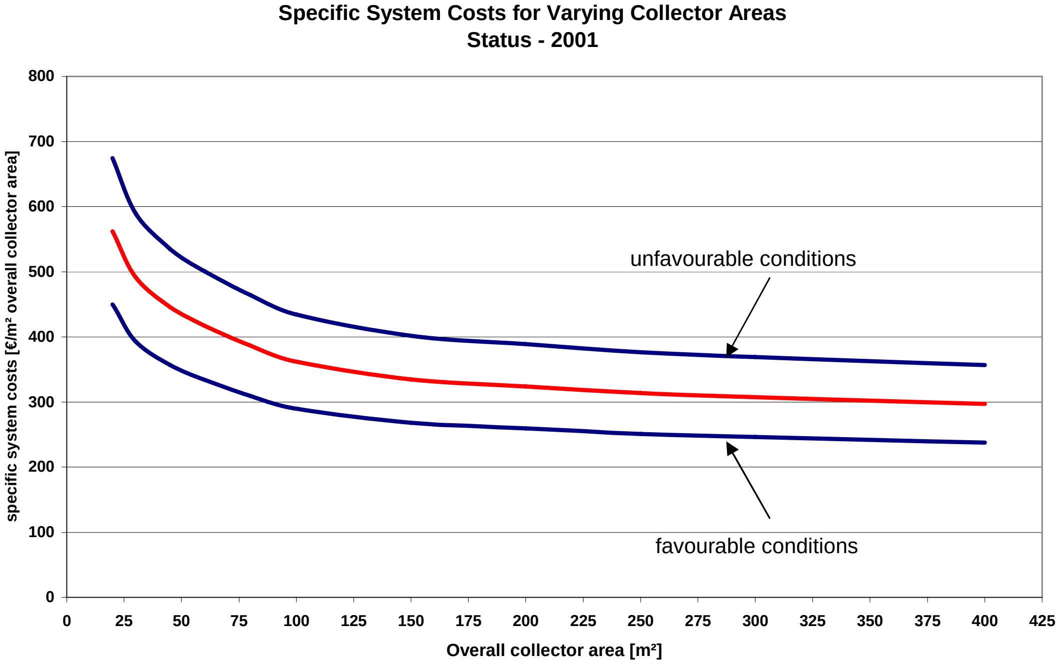


Figure 4: Specific system costs - Austria

Until now some 25 thermal solar plants between 300 and 1440m² have been integrated in Austria in district heating networks. This complies with a collector area of 20.000m². The potential for further inclusions in district heating networks is high. Above all there are a large number of district heating networks fired with biomass. Here solar plants are a good solution to bridge the weaker load periods in the summer without the ecological and economically harmful start-up of the main boiler.

Reasons for these groups / segments to purchase solar, reasons not to purchase solar

<u>One and two family homes:</u>

In the field of one and two family homes the main arguments for the installation of thermal solar systems are as follows:

- independence from fossil energy sources
- increased environmental awareness
- prestige
- convinced about the economic advantages compared to conventional sources of energy
- takes pleasure in technical solutions

Arguments which constantly go against the installation of solar systems:

- uneconomical
- not sufficient grants
- not technically mature and short life cycle
- the building does not look good with the solar energy plant

<u>Multiple family houses, tourism, sports centres, hospitals, etc.</u>

Compared with arguments for and against one and two family homes there are different aspects in this segment of application. The most important difference resides in the fact that economic facts take precedence over emotional arguments in this field. The following favour the use of solar energy:

- prestige (standing out from one's competitors, a positive attitude towards new technologies)
- marketing strategies (to also sell ecological advantages, to sell engineering)
- take advantage of grants

Arguments frequently used against the installation of a solar plant:

- uneconomical
- confidence that the fossil energy prices will continue to be favourable
- technically not perfected and short life cycle (need for research)
- no experts available for the correct implementation

How does each group typically realise a solar heating system (house installer, do-it-yourself, campaigns,)

Solar systems for domestic hot water preparation for one family homes are in the meantime offered by most Austrian as complete systems. In the course of new buildings a large part can thereby be directly reached via the local installation company. Important auxiliary agents to spread the use of solar energy are also the word-of-mouth method, newspaper articles respectively trade fairs and exhibitions. When subsequently equipping solar energy plants combining this with other renovation work (roof renovations, heating renovation work , etc.) which falls within the guidelines for grants proved to be advantageous.

The acquisition and installation of combisystems (domestic hot water and space heating) is performed by correspondingly well-trained solar installation technicians. They are either recommended by word of mouth, contacted at exhibitions and trade fairs respectively lists with experienced solar plant installation are furthered by energy advice organisations.

In the field of multi family homes, sports centres, hospitals etc. the installation company to perform the work is normally contacted following the decision-making phase via a bid for tender. The dimensioning and definition of the system engineering is done by planning offices in co-operation with solar energy companies.

Numerous organisations offer advice and information on solar plants:

- Landesenergievereine
- Local energy agencies (like Graz Energy Agency)
- Austria Solar
- AEE INTEC, (four offices in Gleisdorf, Wiener Neustadt, Villach and Vorarlberg)

Organisations on the demand side (buyers groups, central information sources, central procurement…), reasons for their existence, bottlenecks / opportunities

In individual cases „do-it-yourself“ activities exist but the share of collector area installed per annum (flat collectors and vacuum collectors) is rather small with some 4%g. Likewise the encouragement from potential customers re. activities of this kind is missing almost altogether due to the well developed market.

No centralised procurement, comparable with the activities of the IEA TASK 24 exists in Austria. This has also not yet met with the approval of the solar industry.

Analysis/conclusions: effects of the above on the market, why did they work, why not? Strong /weak points, success/failure factors. What action could be taken to influence these?

With an installed collector area of around 360m² per 1000 inhabitants Austria has the best developed solar energy market in Europe. Apart from applications for domestic hot water preparation in one family homes other applications such as space heating in single family homes, domestic hot water preparation in multiple family houses and district heat connections have been promoted for some time. The large number of installed and properly functioning plants has led to recognition of solar energy amongst potential customers and is frequently met with approval from home-builders building single family homes (new buildings). In addition solar plants have been offered by installation companies almost all over Austria for years (via wholesalers). Do-it-yourself activities, industrial production, compact system packages and tough competition amongst suppliers have means that compares to other European countries the system prices are rather low which has considerably favoured the implementation of solar energy plants.

There are even greater deficits when it comes to existing buildings which make up for the greater part of the energy required in the „apartments/houses“sector. Here it is important to make solar plants interesting both for domestic hot water as for partial space heating in single and multiple family houses via corresponding combinations with grants (roof renovations, exchange of boiler). IN technical terms as well as when it comes

to conducting sales talks, well-trained energy advisors, installation companies and building engineers could provide important impetus. Information campaigns and help for final customers would also appear to be important.
When it comes to the sector of multiple family houses well-trained facility management planners and architects and information campaigns for builders could offer important help. In parallel fashion increased demand for flats/houses erected with due consideration to energy-saving aspects (including the use of solar energy) ,on behalf of those advertising the potential properties, would put pressure on the house building companies and make the decision making „pro solar system" easier (energy pass for buildings). The increase in funds for solar plants respectively the general adaptation of grant models for residential buildings are also absolutely essential.

Also the promotion of Contracting for solar plants is important. Besides general information about solar water heating systems and the advantages for the target groups special information about contracting is significant. Contracting will make it possible to plan large solar plants with out own investment capital. Contracting respectively third party financing is a solution for many barriers, for example financing shortage, lack of know – how, lack off human resources. The energy service companies are planning, financing and carrying out investments of energy efficiency. They guarantee a high comfort and standard of the production, high quality standards of measures a solar yield and a fixed heat price.

3 Supply side

Manufacturers and importers: number, size, products (small, large), special characteristics, % import / export
The collector area produced in Austria (492,700 m² in 2004) surpasses the domestic market volume (169,147 m² in 2001) enormously. The rate of increase in exports compared to the year 2000 equalled 278%. The main part of the collector area exported went to Germany but also included Italy, Switzerland and Spain as important export countries for Austrian industry (Hackstock, 2004).
The numer of imported collectors has been in considerable decline for years and plays no role in the Austrian solar market at 4.800 m² of collector area in 2004.

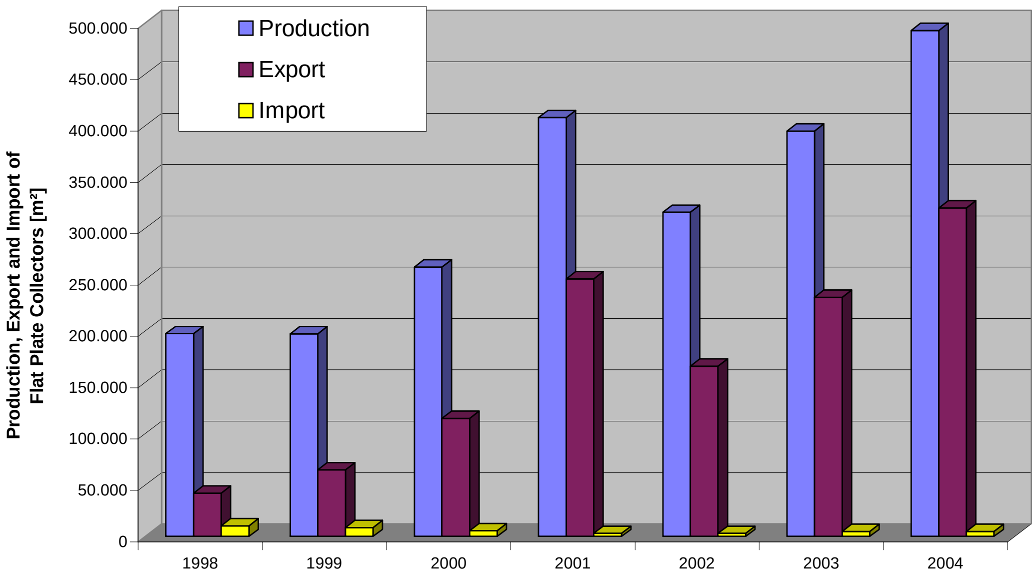


Figure 5: Development of production, export and import figures for thermal solar collectors in the last four years (Faninger, BVS, 2004).

The most important producers in 2004 producing 492,700m² of collector area were as follows:

- GreenONEtec
- Böhm Energietechnik
- Sunmaster
- Doma Solartechnik
- Gasokol
- Riposol
- MEA
- Kalkgruber Solar- & Umwelttechnik
- VIcoM Solarsysteme ProduktionsgmbH
- Ökotech
- Solar Einkaufs GmbH
- Söb & Sun
- GEO-TEC
- SIKO Energiesysteme
- Sun-System
- Teufel & Schwarz
- Prima Sun

As already described in 2.1 flat collectors are mainly used for the preparation of domestic hot water and flat collectors are used in combisystems. These products are of a high technical level and only have slight differences in their efficiency when compared with each other. Most of the flat collectors on offer are based on selectively coated absorbers. Solar coatings represent the minority. The following provides some key figures for a typical Austrian flat collector.

Table 2: Energy key figures for flat collectors commonly used in Austria

	Typical flat plate collector
η_0	0,8
K1	3,5 W/m²K
K2	0,019 W/m²K²

The absorber elements are partly made of individual stripe elements and partly of large-scale absorber elements. Particularly in applications in which the visual appearance is of great importance (façade integrations) large-scale absorber elements proved advantageous. The absorber pipe is mainly attached to the absorber sheet metal as a result of welding, soldering or clamping.
For standard collectors produced in Austria between 2 and 12m² elements can be delivered. In the last five years in particular there has been great demand for large-scale collectors with an area of between 6 and 12m² which are laid professionally by truck-mounted cranes. In this way the time for installation can be considerably reduced in addition to energy advantages. Large-scale collectors can be supplied both for erection on roofs or integration in the roof itself.

Quality / durability of products (collectors, other parts), guarantees
The quality of the products installed is basically high. In calculations collectors are given a life cycle of 20 years. According to practical experience and in line with guarantee specifications from collector manufacturers longer product life cycles can be assumed. Austrian producers give guarantees of on average between 5 and 10 years for flat collectors. In legal terms manufacturers in Austria agree to guarantee

conditions of one year. Extensions of this guarantee period are possible by contract. A new general EU regulation foresees a basic two year guarantee for all products.

In Austria installation engineers have to issue a performance guarantee for the system as a whole (Association of the Protection of Consumers, 2002). This warranty enters into force when defects exist when the plant is first started up and these then lead to malfunctions or yield reductions. The period of guarantee expires three years after the first start-up.

Installation / maintenance problems,
The standard systems for domestic hot water preparation in single family houses rarely represent any installation problems due to the wealth of experience of those performing the installation work and the high pre-fabrication rate in many cases. The situation is different when it comes to combisystems respectively large scale solar heating applications. Typical installation errors are as follows:

- insufficient plant deaeration
- admission pressure in expansion vessel does not comply with the filling pressure
- safety devices are installed in the wrong place
- wrong collector hydraulics devices respectively wrong pipework lead can cause problems with the stagnation behaviour
- heat exchangers are wrongly connected
- flow rates are not set
- the temperature sensors for the controller are in the wrong position
- the hydraulic coupling with the auxiliary heat respectively with the heat distribution network was not sufficient

Solar energy companies recommend the yearly maintenance of solar plants respectively they themselves offer maintenance contracts. The following problems occur frequently as a result of a lack of maintenance:

- there is air in the system which can prevent the flow rate and lead to a breakdown in the solar system. As a result of the automatic auxiliary heat source this defect can go unnoticed for a long time.
- the loss of antifreeze mixture as a result of a responsive safety valve or a leak in the system. As a result of the automatic auxiliary heat source the defect can go unnoticed for a long time.
- the concentration of antifreeze mixture should be checked annually to avoid damage from frost
- every five years the pH value of the antifreeze mixture should be checked to ensure sufficient corrosion protection.

In large-scale solar heating applications maintenance contracts must be concluded respectively professional monitoring should be carried out.

4 Market structures and potentials

SWH branch associations: members, role in market process
<u>Austria Solar</u>
Austria Solar is an association which promotes thermal solar energy and has 24 leading solar energy companies as its members. The main focus of Austria Solar is one the one hand information from end customers and decision-makers, independent of companies, and on the other hand the creation of improved framework conditions and the increase in the presence in the media of thermal solar systems.

<u>Guild of gas, water, heating and ventilation installation companies</u>
In Austria this guild of gas, water, heating and ventilation installation companies has around 2,800 members. Their main tasks include representing the interests of this group of professionals as well as offering standard and profound further and vocational training programmes for installation companies.

Analysis/conclusions: effects of the above on the market, why did it work, why not?
Strong /weak points, success/failure factors. What action could be taken to influence these?

There are still a lot of arguments from customers which constantly go against the installation of solar systems:

- uneconomical
- not sufficient grants
- not technically mature and short life cycle
- no experts available for the correct implementation

But Austrian companies produce high quality solar product at favourable prices. This has a positive effect on the domestic market as well as on exports. A lack of quality is generally not an impediment in Austria when it comes to further extending the market volume. Likewise there is no problem with insufficient guarantees since these are in part better, or just as good, when compared with conventional heating products.

The promotion of solar contracting can be a way to reduce other barriers. Contracting respectively third party financing is a solution for many barriers, for example financing shortage, lack of know – how, lack off human resources. The energy service companies are planning, financing and carrying out investments of energy efficiency. They guarantee a high comfort and standard of the production, high quality standards of measures a solar yield and a fixed heat price.

4.1 The solar heating distribution and installation chain

number, size and level of expertise of installers in general and of solar heating installers
The sales strategies of the producers named in 2.3 can basically be divided into two groups:

- companies who sell to the final customer apart from production
- companies who only produce and who sell to the final customer via a two to three-phase distribution network

As of the mid 1990’s wholesalers have existed in Austria who offer collectors and all solar-specific components and package solutions with a high pre-fabrication rate via the installation companies. Apart from some companies who are already named in the category for producers all large heating suppliers are in the meantime part of this. The main companies are listed in the following:

Sonnenkraft
Solution
Austria Email
Hoval
Herz
ÖIAG
Viessmann
Velux
Buderus
Wolf
Elko Klöckner
Bosch Junkers
Stiebl Eltron
Bramac
Eternit

Nowadays standard systems for solar domestic hot water preparation are available from almost every installation company (approximately 2,800 permits for installation companies have been issued). A survey performed by AEE INTEC in 1998 revealed that as early as then more than 120 installation companies considered themselves solar experts and also offer solar combisystems (Purkarthofer, 1998).

Do installers sell one brand or several brands ?
On the one hand there are, as has already been mentioned, numerous producers and wholesalers in Austria of what are basically similar products and product ranges for installation companies. On the other hand the solar

scene is still relatively young compared to the conventional heating scene and installation companies do not yet have sufficient long-term experience with different suppliers and their products. These two facts would seem to be mainly responsible for a large share of the non-product-loyal installation companies at the moment.

Margins on installation and sales

Producer:		40 – 45%
Wholesaler:		30 - 35%
Installer :	Material:	20%
	Work:	40%

Knowledge of installers

Standardised training programmes for installers do not exist in Austria at all. This refers both to the phase in an installer's training as well as the possibility to participate in further training programmes for trained installers. The installers get the basic know-how concerning solar plants from training programmes offered by solar energy suppliers (producers, wholesalers, etc.). In addition in individual cases different institutions (ECONOMIC Chambers, Energy-Saving Associations, Research Institutes, etc.) offer further training at different levels for installers.

It should still be mentioned that serious errors occur only very rarely when installing the standard applications for solar plants (domestic hot water preparation in single family houses).

Courses for installers: which courses are there, subjects, level, % of installers that have followed the course

- Training as a „Solateur"

As of the beginning of the 1990's a training programme has existed to train as a „Solateur". This is organised by the Viennese Solar School and covers solar thermal applications as well as photo-voltaic matters and heat pumps. As of 1998 this training course has been EU- certified and is offered all over Europe in two phases:

Solateur practitioners (245 training units)
Solateur technicians (425 training units)

To date one „Solateur practitioner" course has been held in Austria with five participants (Solarschule Pinkafeld, 2002)

- Training seminar „Solar Space Heating"

In 14 training units participants receive a basic knowledge of solar combisystems. Wihtin the course of the last five years around 80 people took part in this training seminar (WIFI Upper-Austria, 2002).

- Training seminar „Solar multiple family houses"

In five training units participants receive a basic knowledge of solar plants in multiple family houses (Upper-Austrian Energy Saving Association, 2002).

- Vocational School training as a „Solar- and Eco-Energy Technician"

In autumn of 2002 a new training course will commence in Linz to become a „Solar and Eco-Energy Technician". This course aims at giving installation training with the focus on solar and eco-energy techniques. (Vocational School in Linz, 2002)

- Various courses, seminars and symposia

Various courses, seminars and symposia are offered by institutions (Energy Saving Institutes, Research Institutes, Vocational Promotional Institutes, Economic Chambers, etc.) on different solar-specific subjects.

- Certified solar installer and planer training

(within the framework of the klima:aktiv program from the Austrian ministry of life)
In 64 training units participants receive a intensiv knowledge all over different solar theral systems. Including climate protection, components of solar heating systems, characteristics of solar heating systems, selection of the accurate system, dimensioning of solar heating systems, dimensioning of components, installation, putting

into service & maintenance, operation & yield controls, consideration of costs and economic efficiency of solar thermal systems marketing and practice.

- solar practical man

(within the framework of the klima:aktiv program from the Austrian ministry of life)
All over there are 16 training units. In 8 training units the participants receive a knowledge of different solar thermal systems in singular family houses. Including components of solar heating systems, characteristics of solar heating systems, selection of the accurate system and fast dimensioning of solar heating systems. The rest of the training units the parzicipants receive a practical knowledge of installation, putting into service & maintenance, operation & yield controls.

- solar consultant

(within the framework of the klima:aktiv program from the Austrian ministry of life)
In 8 training units participants receive a knowledge all over different solar theral systems. Including climate protection, components of solar heating systems, characteristics of solar heating systems in singular family houses, selection of the accurate system, overall view of solar thermal components, consideration of costs and economic efficiency of solar thermal systems marketing.

Certification schemes for installers
There is no compulsory certification for installers respectively special certification for solar energy. On a voluntary basis installers can for example acquire the "green heat" certificate which stands for special installation competence when using renewable sources of energy and thus also includes solar plants.

Other market players: Wholesale, property developers, … why they are involved, what they do, from what position, with what effects

Apart from heating and solar energy companies two Austrian tiling producers (BRAMAC and ETERNIT) also now offer the assembly of sun collectors via roofing companies. The supply and assembly scope is restricted exclusively to collectors. This initiative to include a new artisan profession in the dissemination of thermal solar plants has already proved to be successful in Austria and should be promoted more in the future.

Analysis/conclusions: effects of the above on the market, why did it work, why not? Strong /weak points, success/failure factors. What action could be taken to influence these?

10 years ago all the producers of solar products directly supplied the final customer and at the same time solar installers. Another step when establishing a functional distribution and sales network was to establish an intermediate stage in the distribution network – the wholesaler. The interest of the conventional heating branch which already had a very well structured wholesale (practically all the heating installers are supplied via wholesalers) was not yet high enough at the beginning of the 1990's to assume the distribution of solar systems in an aggressive manner. For this reason some companies established wholesale structures specifically for the solar branch. This strategy proved to be extremely successful and has meant that in the past the conventional heating branch has recognised the solar market as an extremely lucrative business field and now also sells solar plants via these distribution structures. This development has meant that today almost all the heating installers also offer thermal solar plants.

Another important step for the rapid dissemination of solar plants is the greater inclusion of other professional groups from the construction trade who have a very good distribution network. The very first success in this field was achieved with the inclusion of roofing companies in the distribution of solar plants.
Due to the great potential of façade-integrated sun collectors professional façade constructors are ideal for the implementation of solar plants. In this respect it is important that the existing distribution networks are made use of and thus the number of potential suppliers of solar plants can be increased relatively simply and quickly as initial experience in Austria has shown.
Façade constructors and roofers integrate the collector areas in the building, installers assembly the rest of the system.

4.2 Sales and marketing

How are solar heating products sold, and by whom? What margin / motivation does each selling party have?
In Austria solar systems are basically sold via two distribution strategies:

- Manufacturer – Grossist – Plumber – Customer
- Manufacturer – Plumber – Customer

Some small producers form an exception in these structures and also sell directly to the final customer. The usual financial margins of the individual groups were already dealt with in 2.4.

Public awareness and perception, knowledge / perception in market segments
In the past the environmental awareness of the Austrian population has increased and thus the interest in renewable sources of energy such as solar plants and biomass heating installations has grown. This development is explained on the one hand by a loss of confidence in the availability respectively price stability of fossil sources of energy and on the other hand by the long-term PR work on behalf of numerous climate protection and energy saving institutions. If solar energy systems are, however, to make a contribution worth mentioning towards achieving the goals of the national climate protection programme (Kyoto goals) additional different and well-planned initiatives will be essential in terms of the motivation of the final consumer.

Ease of access to installers / consultants / manufacturers
Since the solar market is well organised in terms of standard applications (domestic hot water preparation) it should not be a problem for the final consumer to find a corresponding installer.

Availability / ease of access to information
Basically it is easy in Austria to obtain some in-depth information about the possibilities offered by solar applications. Interested customers can for example obtain information resp. advice from:

- Regional institutions which offer energy and solar advice
- Regional installers
- Trade fairs and exhibitions

Increasingly interested parties acquire information themselves via the Internet respectively pertinent journals and publications.

Availability of / information on / access to demonstration projects
In the meantime standard systems for domestic hot water preparation possess a very good dissemination rate and can no longer be called demonstraction projects. Possibilities to view these and exchange experiences with satisfied owners are sufficiently available.
In terms of solar combisystems and large-scale solar heating applications EU projects exist and national demonstration projects in which extensive plant monitoring is carried out. Summaries of the measured results obtain are available for planners, architects, decision-makers, etc., and it is also possible to visit the plants on the site.

Use of financing structures like leasing, guaranteed results, third party financing, solar contracting

In Austria a lot of projects with third party financing have been realised at the moment, but they have still no great influence on the Austrian solar market.
Often diluted forms of guaranteed results are used as the basis for grants in some provinces which means that the grant issuing authority only released the sum to the builder when proof of the agreed solar yields has been furnished (mostly 350 kWh/m²a). Individual builders pass this guarantee obligation on to the installer performing the work and retain the liability amount withholded. (mostly 3% of the investment volume) until proof of the agreed yield is furnished. If the agreed yield cannot be achieved, the liability discount to cover the higher need for auxiliary heat is used, projected for the life cycle of the plant.

4.3 Independent testing / publication of product information

Test centres, testing and certification,

In Austria sun collectors are tested at the Federal Research and Test Centre ARSENAL, Vienna. The Austrian test standard ÖNORM M 7714 was replaced in 2001 by the EU standard EN 12975.

Obligatory / voluntary / needed for incentives
In general there is not legal obligation for producers to have their sun collectors tested. It can, however, be said that a collector test was carried out for almost all the collectors offered in Austria.
In standard applications the performance tests of collectors scarcely influence the decision to purchase and do not represent an absolute must. The situation is different with regard to large-scale solar applications in which the requirements made of the collector efficiency rate are already anchored in the tendering process and proof has to be furnished by the companies taking part in the form of test certificates.

Publication / accessibility of test results
Market reviews of the collector (incl. test results), storage tank and control system types on offer were published in 1996 and 1998 by order of the Federal Ministry for Agriculture and Forestries, the Environment and Watermanagement by AEE INTEC in book form.
A list of currently tested collectors can be obtained from the Federal Research and Test Centre ARSENAL. The performance tests can be directly obtained from the suppliers (producer, wholesaler, installer).

Analysis/conclusions: Effects of the above on the market, why did they work, why not? Strong /weak points, success/failure factors. What action could be taken to influence these?

- Clear improvements in products via collector tests
- Effects above all on producers who compare the tests with each other
- A problem at the moment: test collectors are prototypes. It would be good to get samples from the series via the test institute.

4.4 Policy environment for solar heating industry

Subsidies, tax incentives, loans, rental etc., other government policies
NO direct Federal grants are awarded in Austria for residential buildings. Grants for solar plants are taken care of in the conventional housing grants in the provinces.
Housing grants are, however, a matter for the provinces which means that there are different grant models for solar plants in each of the nine provinces. This is made even more complicated by the fact that one has to differentiate in the grant guidelines between single and multi-family homes respectively between a new building and renovation work.
Direct grants are allocated for solar plants in single family home in all the provinces.
For a solar plant for example with a collector area of 8m² and investment costs of € 4.650 a grant of between 6 and 36% of the investment cost can be made use of depending on the province. The average grant for this example equals approximately 25%.
Direct grants, cost-favourable loans or annual repayment grants exist for solar plants in multiple family homes depending on the province.
In addition to the grants available in the individual provinces towns and communities in individual provinces issue grants for the installation of solar plants.

A special grant arrangement for solar plants exists at federal level for commercial companies. For years the Federal Ministry for Agriculture and Forestries, the Environment and Watermanagement has supported companies with the erection of energy-saving measures such as solar plants by offering them direct grants with a standard grant rate of 30%.

Contacts between industry and authorities
Together Austria Solar (Association of most important Austrian solar energy companies) and regional and national energy and solar institutes try to obtain the best possible grant conditions for solar plants from the Federation and the provinces.

Analysis/conclusions: effects of the above on the market, why did it work, why not? Strong /weak points, success/failure factors. What action could be taken to influence these?

It has been seen that in the field of single family homes grants are important but they do not immediately trigger off the assembly of a solar plant. When it comes to solar plants in multiple family houses the extent of the grant is in contrast the main reason why the builder can or cannot be motivated to install a solar plant.
The grant conditions in Austria for solar energy are not favourable in all of the provinces respectively for all fields of application. Overcoming these deficits and creating optimum framework conditions has to be a common goal of the growing solar lobby. This can only be achieved in close co-operation with the Federal government and the provinces.

4.5 Regulatory framework

Building and other relevant legislation, connection to / benefits for energy performance or similar regulations
Housing grants in Austria, as already mentioned in 2.8, are decided by the provinces. Apart from various solar grants there are also different building codes and energy requirements which arise from this. Buildings which may be built in a province with regard to their energy requirements could not be built in other provinces due to the U value or the surpassing of energy requirements.
In some provinces there are complex housing grants which means that carrying out several defined measures to save energy (for example higher thermal insulation, a ventilation plant with heat recovery or indeed a solar plant) results in a higher grant. The province of Salzburg has for example had experience with a housing grant model of this kind for 10 years. Apart from the permanent reduction in the U values of the components in the past an enormous increase in the solar plants in multiple-storey buildings has been achieved with this combined grant mechanism. In 2001 around 60% of the newly constructed multiple family houses in Salzburg has solar plants.

Planning regulations, relevant standards, certificates
The following standards describe specifications for the planning and design of solar plants in Austria:

ON EN 12975: 2001-02-01
Thermal solar systems and components - Solar collectors –
Part 1: General requirements
Part 2: Test methods (1997-12-01)

ON ENV 12977: 2001 10 01
Thermal solar systems and components - Custom built systems -
Part 1: General requirements
Part 2: Test methods
Part 3: Performance characterisation of stores for solar heating systems

ON M 7701: 1985-09-01
Solar energy installations; approximative calculation method for the dimensioning of flat collectors in domestic hot water systems
Bbl 1 1985-09-01
Solar energy installations; forms for approximative calculation method for the dimensioning of flat collectors in domestic hot water systems
Bbl 2 1985-09-01
Solar energy installations; general characteristics for the calculation of passive solar installations and for flat plate collectors used in domestic hot water systems

ON M 7731
Solar heating systems for heating of water - requirements

ON EN ISO 9488
Solar energy
Vocabulary

ON M 7700: 1991-05-01
Solar energy - Terms with definitions

Insurance / liability aspects,
Planning offices are basically insured against planning errors.
Guarantees and guarantee obligations for installers were already dealt with in chapter 2.3.

Education and certification for installers / engineers
The current training possibilities for installers were already dealt with in chapter 2.4.
There are no separate training courses for engineers and technical offices. They do however make use of the various possibilities for further training described in chapter 2.4.

Analysis/conclusions: effects of the above on the market, why did it work, why not? Strong /weak points, success/failure factors. What action could be taken to influence these?
When it comes to the design of housing grant models improvements are planned in numerous provinces in terms of the use of thermal solar plants and the implementation of other energy saving measures. Apart from these funds, which will be allocated to the declining market for new buildings, this will strongly affect the distribution of funds available for the energy renovation of existing buildings. Combinations of solar plants with other energy saving measures have proved their worth to determine the grant ratio. The legal conditions for the safety of installers, planners and final customers would appear to be sufficient and are no impediment to preparing the market.

4.6 Education and dissemination activities

Existing and planned, for installers, sales actors, consumers, other parties.
The existing training possibilities were summarised in chapter 2.4. Seen nation-wide the activities are important but they do not offer and standardised and recognised form of training. For this reason the most important national Solar Players have worked out a suggestion for a standardised training programme for installers and planners. Basically this training programmes should contain three parts:

- Basic module (installers, planners, energy consultants, etc.)
- Planning and practical module (installers, planners, etc.)
- Experts module (basically designed for planners)

Following the training the participants have the choice to apply for a certification process.
The first training course is planned for summer 2003.

Analysis/conclusions: Effects of the above on the market, why did they work, why not? Strong /weak points, success/failure factors. What action could be taken to influence these?
If one wishes to cover a mentionable part of the overall heating requirements with solar energy, then the collector area installed today will have to be multiplied many times in the years to come. Trained experts will be required for this purpose. To reach this goal it is important that as few errors as possible are committed by the solar branch as a whole and no setbacks occur. As little as a poorly functioning solar plant is enough to bring in bad publicity which would be detrimental to the implementation efforts being undertaken. Good training is the basis for high quality work and represents an absolute must.

4.7 Information, marketing and sales campaigns / actions

Inventory and Descriptions of running / planned national / regional / local actions.
Please repeat the following questions for each action:
General information on the action, information/marketing / sales, products sold, target groups, scope / region, time and duration, initiator, other important parties, roles of these parties

Numerous activities and initiatives exist and are planned in Austria to raise the level of acceptance and dissemination of solar plants. The most important initiatives and programmes (this does not claim to be complete) are listed in the following.

National activities

Programme of action re. climate
In 2004 the Federal Ministry for Agriculture and Forestries, the Environment and Watermanagement was started a programme of action entitled the „climate“. Solar energy should represent a major point of emphasis of this programme. This Subprogramm is called “solar**wärme**” (www.solarwaerme.at) and managed by the AEE INTEC.

Activities on behalf of Austria Solar
Austria Solar, the Association of Austrian solar energy companies for the promotion of thermal solar energy, organises well-planned marketing and lobbying activities throughout Austria.

OPTISOL
OPTISOL is a national project from AEE INTEC to disseminate optimised solar-supported heat supply networks for the preparation of domestic hot water and solar heating support in multiple family houses.
Project duration: 2001 to 2004

Monitoring large-scale plants (Q-Sol)
This is a national project from the Test and Research Centre ARSENAL in cooperation with AEE INTEC in specially for multiple family houses. The main field of work is to create a standardized monitoring concept for thermal solarsystems and heating networks in multiple family houses (Test and Research Centre ARSENAL, AEE INTEC, etc.).
Project duration: 2005 to 2006

Mosol-Net
Mosol-Net is a national project from AEE INTEC to carry out efficient solar thermal systems for district heating systems. The project directs the attention to residential buildings which are built in several steps of construction.
Project duration: 2004 to 2006

Parabolrinne
Parabolrinne is a national project from AEE INTEC to develope and optimize a parabolic trough collector for higher temperatures (100 to 200°C) in industrial process heating.
Project duration: 2003 to 2005

SolProBat
SolProBat is a national project from Joanneum Research in cooperation with AEE INTEC and the technical university of Graz to develope and optimize simulation programmes for solar heating in industrial batch-processes.
Project duration: 2004 to 2005

NEGST
NEGST is an european project. The austrian essences are done by AEE INTEC. The aim of the project is to transfer different european experiences in the whole field of solar energy.
Project duration: 2004 to 2005

Regional Activities

Climate protection programme of the City of Vienna
The City of Vienna has set itself the goal of installing 40,000 solar plants by the year 2010 in the City area. Initiatives and measures are being correspondingly taken and supported.

SOLAR-NET

The Test and Research Centre ARSENAL is conducting the technology offensive „Solar Energy-Vienna Hungary“ to promote solar plants in small and large applications. The basis to achieve the climate goal of the City of Vienna will be laid in this project (40,000 solar plants by the year 2010).

Solar League in Upper- Austria
The Energy Saving Association in Upper-Austria motivates and documents Upper-Austrian local communities to record and newly install solar plants within the framework of a competition. The Solar League finds out in what community the largest number of solar plants are installed.

Training programmes in Upper-Austria
As already mentioned in chapter 2.4, the province of Upper-Austria offers numerous training possibilities in the field of solar energy and eco-energy.

Multiple family houses and industrial applications
The Energy Saving Association in Upper-Austria tries to integrate solar plants in the province of Upper-Austria in multiple family houses and in industrial applications via different programmes.
Communal energy concept of the town of Graz
The communal energy concept of the City of Graz foresees an extensive programme to disseminate solar collectors. The goal of this concept is the new assembly of 200,000m² of collector area by the year 2010. The City of Graz has taken the first steps towards achieving this goal by installing a corresponding solar grant and taking other initiatives.

Thermoprofit
Thermoprofit is a project from the Energy Agency in Graz to reduce the energy demand in buildings with the help of the „contracting“implementation model. The increased implementation of solar plant within the realm of third party financing is included in this programme.

Solar sports centres
In the province of Styria AEE INTEC tries to motivate sports centre operators to install solar plants within a special programme.

Solar consultation services in Styria
AEE INTEC conducts numerous activities in Styria (consultation services for final consumers, Telephone Service, exhibitions, the organisation of events, etc.) in the field of solar energy.

Solar campaign Styria 2005
In 2005 the solar campaign Styria make to suit the requirements of the Styrian solar market. Preparatory work and talks in this field have already been started.

Solar campaign Tirol 2005
In 2005 the solar campaign Tirol make to suit the requirements of the solar market in tirol. Preparatory work and talks in this field have already been started.

Solar campaign Vienna 2005
In 2005 the solar campaign Vienna make to suit the requirements of the solar market in Vienna. Preparatory work and talks in this field have already been started.

Solar radiation screen in Tyrol
In the province Tyrol a solar radiation screen (conducted by Energie Tirol) is being carried out. Final customers are given information on irradiation and solar hours for the planning of buildings and solar plants.

Solar Hitparade of communities in Vorarlberg
Within a competition local communities are motivated by the Energieinstitut in Vorarlberg to construct solar plants anew and record those which already exist. The winners are ascertained by drawing up a Solar Ranking.

4.8 Success and failure factors

Bottlenecks on the supply side

Despite the already large number of motivated installers there is still a need to increase the interest of this group of professionals in the utilisation of solar energy and to make use of these energy experts as the first contact in energy questions when it comes to the wide-scale market introduction. The goal must be that installers offer solar plants in an active manner themselves and do not just see this technology as an "alternative". The inclusion of other professional groups (roofing companies, façade constructors, etc.) in the distribution of solar plants would appear to make particularly good sense.

Bottlenecks on the demand side

Despite numerous initiatives to disseminate solar plants there is still a great need for information on the possibilities and advantages of solar plants amongst the population. This deficit has to be recorded as do the deficits in the preparation of segments of application. Basically new applications in single family homes have to be worked on and acquired:

- Multiple family houses
- Tourism companies
- Sports centres
- Hospitals
- Particularly space heating applications have to be striven for in addition to domestic hot water applications in all the areas previously named.
- Solar cooling
- Solar process heat

Innovation

- Standardisation and cost reduction
- Optimised industrial production processes
- Technologies for roof and façade integrations
- Development of large-area collectors
- Products with a high pre-fabricated rate
- Development of kid systems for domestic hot water preparation and space heating
- Development of standardised system techniques in the field of large-scale applications
- Development of heat supply concepts adapted to the special requirements of solar energy utilisation (distribution networks in multiple family houses, low temperature applications, etc.)
- Increase in the operational safety and life cycle (stagnation behaviour, monitoring, etc.)
- Product improvements and the simultaneous reduction in costs

4.9 Lessons learned

By the market in the past

- Communication and co-operation (forming networks) between all players pays off.
- Solar energy needs a lobby
- There are numerous possibilities and strategies to disseminate the technology
- The same initiatives and measures do not lead to the same goal in all regions (different framework conditions and mentality)
- Professional sales and distribution networks play an important role when it comes to disseminating the solar plants.
- As of a certain market size, new and often larger companies (for example heating wholesalers) enter the market aggressively.
- Solar plants can only argue in terms of economic viability to a small extent.
- Grants are important incentives when it comes to installing solar plants
- To make grant models effective they have to be „constant" to a certain extent.
- New models like contracting can reduce a lot of barriers

4.10 Opportunities for new market development initiatives

Based on the above:
What opportunities do you see for campaigns and other market development initiatives?
Compared to other European countries Austria has a functional solar plant market. Yet heat production from the overall collector area installed to date only assumes slightly more than 1% of the overall heating requirements in Austria. Realistic estimates revealed that the collector area installed in Austria to date can be multiplied by the year 2010 given the corresponding framework conditions and activities. Thus in 2010 the solar contribution towards heating requirements in Austria could already equal 4.25% (Weiß, 2001). To achieve this campaigns and initiatives will be necessary as well as suitable framework conditions.

As already mentioned in chapter 2.12, the Federal Ministry for Agriculture, Forestries, the Environment plant and Watermanagement plans to start a programme of action in 2003 entitled the „Climate“ (2003 to 2010). Solar energy is to be a major focus of this programme. This initiative could make a major contribution towards achieving these goals.
Contents and aspects which are to be dealt with in the framework of the subject of solar energy in the climate protection programme:

- Implementation of a target group-oriented marketing concept
- Creation of „favourable“ framework conditions at the Federal and provincial level (e.g. energy tax, rearrangement of housing grants in new buildings and renovation projects; ideas on promotional policies with regard to large-scale plants in multiple-storey buildings, in the field of tourism and industry; etc.,)
- Creation of standardised and recognised training structures
- Creation of a „Solar Energy“ network
- Increase in the plant density in already well processed market segments (e.g.: preparation of domestic hot water in single family homes).
- Increase in solar space heating supply share in single family homes.
- The medium-term conquest of segments of application still unconquered to date (multiple-storey building, tourist companies, sports centres, hospitals etc.). Apart from applications for the preparation of domestic hot water measures should also be dealt with here which aim at the partial covering of space heating requirements.
- Medium-term entrance into new segments of application (solar process heat, solar cooling, etc.)

4.11 Opportunities for governmental support

What opportunities do you see for governmental support?
<u>Grants for final customers and demonstration</u>
Grants for solar plants, with the exception of special grants for commercial companies, are incumbent on the provinces. In most provinces new decrees in relation to housing grants could lead to improvements in the implementation of energy-saving measures. Apart from improving grant guidelines in new buildings, the restructuring of funds in the field of building renovations is particularly promising.
Within the national climate protection programme to achieve the Kyoto goals the Federal government is increasingly putting pressure on the provinces to carry out corresponding changes (in terms of climate protection) in housing grants. Apart from other energy-saving measures solar plants could be taken more into consideration as a result of this. Changes of this kind in the grant guidelines in the “residential building” segment are to be expected in the medium-term.

When it comes to conquering new segments of application which basically cannot be allocated to the field of residential building (solar cooling, industrial heat, etc.) respectively in the implementation of which other framework conditions predominate require corresponding funds (for example for demo. projects and the subsequent market launch).

<u>Legal framework</u>

- introduction of energy tax
- obligatory arrangement of solar energy plants in corresponding fields of application

Research

On behalf of the Federal Ministry for Traffic, Innovations and Technology the programmes „House of the Future“, „Factory of the Future“ and „Energy Systems of the Future“ were started in the year 2000 within the framework research programme „Austrian technologies for sustainable development“. Within these programmes solar energy can be taken into account in the tendering processes in addition to other technologies.

Research tenders explicitly directed at solar energy could provide the necessary innovation impetus into new segments of application (large scale solar systems, solar cooling, industrial heat, etc.).

5 Market prices for ST-ESCOs implementations

The chance of making solar thermal third party financed projects more attractive in the future could be approached by reducing the investment costs. However, different factors have to be considered here:

- **Collectors and substructure**
  About 50-70% of the total investment costs is the price for high-efficiency solar collectors including an appropriate substructure. We could try to work on the technological part to see if costs can be reduced here.
- **Engineering costs**
  The costs for project development, engineering, contracts still represent a very notable cost item. Experience and know how in the work with solar thermal ESCOs, collaboration with experienced partners, utilization of good and efficient tools and – last but not least – the replication of similar plants may represent ways to reduce the overall engineering costs for a solar thermal project.
- **Subsidies**
  On the long term, subsidies must be expected to drop rather than to stay at a high level. This results in an increase of the effective investment costs, and this effect must be attenuated or by other factors. Once a high technological level of solar thermal plants is reached, attention could be paid to linking possible subsidies with a function control of the plants and a guaranteed energy output, rather than taking the m² of installed collector area as a basis!
- **Conventional energy price**
  As the prices for conventional (fossil) energy continue to increase, the price for solar thermal energy is not touched by this trend. Due to this reason, solar thermal becomes more and more attractive as the payback periods become shorter.

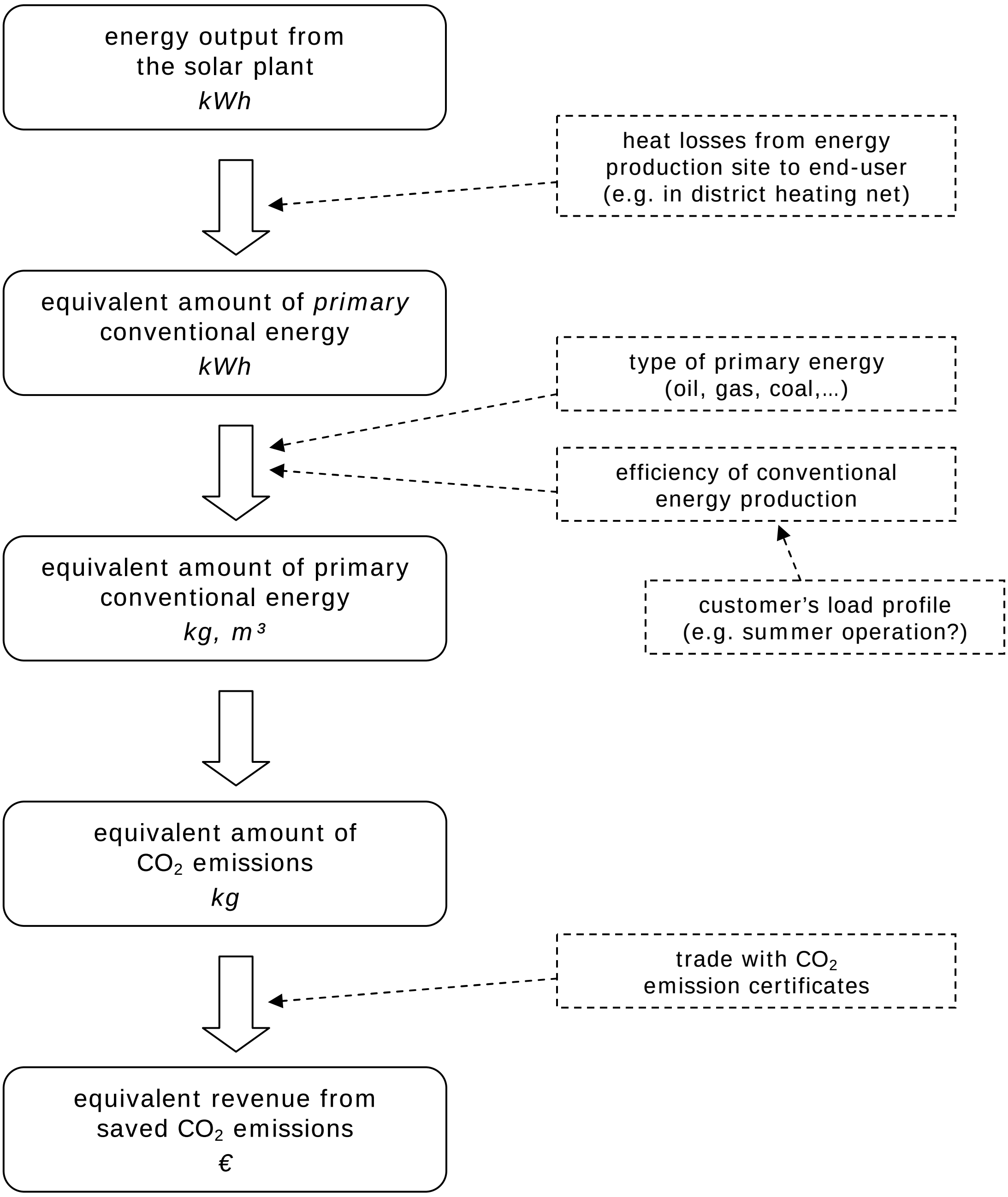
Revenue from reduction of CO_2 emissions

Some development in the economic approach towards solar thermal ESCO projects has to be done in the area of the trade with CO_2 emission certificates. Today (to nahwaerme’s knowledge) there exists no approach suitable for getting economic benefits out of saving CO_2 with solar energy on an easy practicable way. Such a tool is a basic prerequisite for the implementation of a financial recompense for the solar company for its contribution to the reduction of CO_2 emissions.

The idea behind the concept which we should develop is based on the assumption that the customer of the solar thermal plant (e.g. a manufacturing company) is registered to take part in the trade with CO_2 certificates. Then, the installation of the solar plant helps gives the company the possibility to reduce its CO_2 emissions and therefore sell their CO_2 emission certificates. This is an additional financial benefit for the customer stemming from the installation of the solar plant, and it results in a shorter payback time. Alternatively, the income from the trade with CO_2 certificates should be transferred directly to the ESCO, for the simple reason that this amount of money is linked to the solar plant, and the solar plant is the ESCO's property.

However, a practical approach (= a real-world tool) for calculating the financial benefit stemming from the CO_2 reduction from a solar thermal plant has still to be developed. The financial recompense should be the same amount of money that the customer of the solar plant may earn through the trade with CO_2 certificates. This means that the basic tool should include the basic steps shown in the following diagram.

As one can see, the starting point is always the energy output of the solar thermal plant. This is the reason why a solar company (and consequently also the corresponding solar thermal ESCO) must ensure a very energy output of the plant in order to get the maximum benefit from its contribution to the reduction of CO_2 emissions. The step from the solar kWh to conventional primary kWh includes possible distribution losses. At this point, the efficiency of the primary energy supply must be included in some way, and it seems to be important to make realistic assumptions here! E.g., often the efficiency is very low in summertime due to bad partial load behavior, this also applies to some of the new boilers. In this way one gets the amount of primary energy in kg or m^3, and the equivalent amount of CO_2 produced in the combustion can be calculated with available tools. This is the amount of CO_2 really saved by the solar thermal plant, and can be sold via emission certificates by the customer. That way the saved CO_2 emissions are translated into a corresponding sum in €, and this amount (or maybe a certain percentage of it) should be attributed to the solar ESCO.



Source: nahwaerme.at

Some market analysis data

This section deals with the following items:

- Price of solar thermal kWh
- Usual terms for bank loans

The price for the solar thermal kWh coming from a solar thermal ESCO can vary in a rather broad range. This amount depends on a lot of factors, but the main influence stems from the competitive source of conventional energy that the solar thermal plant must deal with. If the alternative to the solar thermal plant would be a very modern, large scale gas boiler with condensing boiler technology (with very good efficiencies over a broad range of operating conditions) and with a good load profile (reflected again in low consumption values), then the price of the solar thermal MWh might be limited by some 25 € per MWh.

On the other hand, if the energy source we compare the solar plant with, is direct electric hot water preparation (such as is the case in many multi-family-houses), then the conventional energy source is rather expensive, and the investment of changing is rather high for, the price for solar thermal energy might be as high as 70 € per MWh.

So, it is very hard to give a useful and precise answer to the question of the price of solar thermal energy, as the spectrum of variation is very broad. It depends not only on the conventional energy form, but also on the use of the solar energy (feeding into a district heating net, family houses, industry applications, solar cooling), and last but not least on the load profile.

The same discussion applies to the question on the usual terms of bank loans. No standardized answer can be given to this question: Up to now, the experience of nahwaerme with terms of bank loans has shown that the terms and conditions for the bank loans have to be agreed upon separately in every single project. Of course, they also depend on the key interest rate (or Euribor) and on the type of bank (be it a small, regional bank with good contacts to the upper management between bank and ESCO, or be it a large over-regional bank with quite fix conditions and few margin left). The main variation comes from individual negotiations with the banks in question, and again it helps if we succeed in convincing the personal contact in the bank about the project and about solar thermal energy as a mature technology in general. Thus, the usual bank loans vary somewhere between 3 and 6%.

Comparison of the effect of different economic terms

The following tables compare the effects of different possibilities of economic measures to the result of a solar ESCO. These effects include:

- Different price of a solar thermal system depending on the system size
- Different price paid per kWh solar thermal energy.
- Different percentage of subsidy to the investment costs.
- Different system costs for small or large plants.
- Reduction of investment costs due to reduction of engineering costs and / or collector costs, or due to possible trans-associational agreements and joint projects.

Additionally, there are two possibilities of charging up two different amounts of money to the solar thermal kWh price:

- The energy tax that conventional district heating operators are required to pay if they burn fossil fuels. This amount may total up to 4 € per MWh.

- The revenues from the trade with CO_2 emission certificates: every kWh of solar energy makes the emission of CO_2 from fossil fuels unnecessary; the trade with the corresponding certificates may work as described above.

The price paid by the customer depends on various factors, but is mainly oriented at the fossil fuel price it has to compete with. I.e., if the fossil fuel prices tend to rise, there is a much higher range in which the solar thermal energy price may vary, thus it may rise as well (although not directly linked to any fossil fuel price). This is simply the effect of the competence (conventional energy solutions) becoming weaker over the years, since they become more expensive!

Low loan rates have very little influence to the economic results of a solar thermal ESCO. The current bank loan rates are already very low, so the loan rates could only be reduced very slightly. However, in the long run, a slight reduction of the loan rates is a very ineffective measure when compared with the possibility of considering e.g. the benefit of saving the energy tax and charging this money up to the solar thermal kWh. This corresponds to a higher price paid per kWh of solar thermal energy. Revenues from the trade with CO_2 certificates should also be directly charged up to the solar thermal kWh, and so every kg of CO_2 not emitted because of the use of a solar plant must directly correspond to a higher price per kWh of solar energy!

The quintessence is, that the price increases of competitive conventional energy forms, the money from the (fossil fuel) energy tax and the revenues from the trade with CO_2 emission certificates have most influence on the economic terms of a solar thermal ESCO. The effect of loan subsidies by the state is minimal, but direct subsidies to the investment costs are a rather important figure.

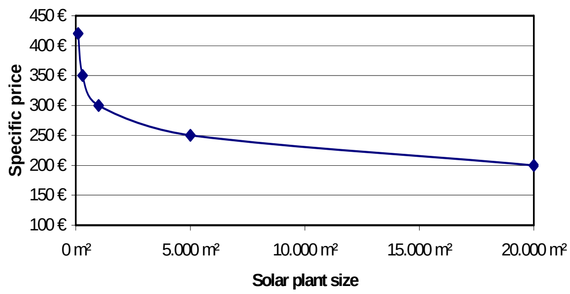
Specific system costs LSP

Specific solar thermal plant prices (in € per m²), depedant from solar plant size

1 Roof-integrated systems

Solar plant size	Price per m² collector area
20.000 m²	200 €
5.000 m²	250 €
1.000 m²	300 €
300 m²	350 €
100 m²	420 €

Prices are to be interpreted as approximate numbers!



2 Roof-mounted systems

Specific system costs are higher due to longer and more complex pipework and substructure for collector mounting.

Pipework	0.2 … 1 running meter per m² collector area 10 … 50 € per running meter
Substructure	30 … 70 € per m² collector area

Source: nahwaerme.at

See the tables below (two tables for two different system sizes), including different assumptions on energy prices and subsidies, for a numerical reflection of the above explanations (source: nahwaerme.at).

Comparison of the effect of different economic terms – part 1: small system (250 m²)

Small plant (250 m²), two price scenarios: 40 €/MWh or 50 €/MWh
The two scenarios might reflect the consideration of the energy tax saved by the solar thermal plant, the revenues from trade with CO_2 emission certificates or simply a better price for the solar energy due to the increase in the fossil fuel prices.

Solar plant size	m²	250
Yearly yield of solar plant	MWh/a	100
Price per m²	€/m²	360
Total plant price (investment cost)	€	90,000

Price per MWh of solar thermal energy	€/MWh	40	50
Yearly revenue	€/a	4,000	5,000
Expenses for service and maintenance	€/a	800	800
Net yearly revenue (= annuity paid to ESCO)	€/a	3,200	4,200
Approx. estimated investment cost that may be covered by the yearly plant revenue	€	32,000	42,000
Amount of investment cost that needs to be covered by subsidies	€	58,000	48,000
Percentage of subsidy	%	64	53
Maximum investment costs allowed to reach the same effect caused by the price increase (from 40 to 50 € per MWh)	€	68,570	
	%	76.2	
Necessary reduction of investment costs	%	**23.8**	

Same plant characteristics as above (250 m²), two price scenarios: 25 €/MWh or 35 €/MWh

Price per MWh of solar thermal energy	€/MWh	25	35
Yearly revenue	€/a	2,500	3,500
Expenses for service and maintenance	€/a	800	800
Net yearly revenue (= annuity paid by ESCO)	€/a	1,700	2,700
Approx. estimated investment cost that may be covered by the yearly plant revenue	€	17,000	27,000
Amount of investment cost that needs to be covered by subsidies	€	73,000	63,000
Percentage of subsidy	%	81	70
Maximum investment costs allowed to reach the same effect caused by the price increase (from 40 to 50 € per MWh)	€	56,670	
	%	63.0	
Necessary reduction of investment costs	%	**37.0**	

Comparison of the effect of different economic terms – part 2: large system (5,000 m²)

Small plant (5,000 m²), two price scenarios: 40 €/MWh or 50 €/MWh
The two scenarios might reflect the consideration of the energy tax saved by the solar thermal plant, the revenues from trade with CO_2 emission certificates or simply a better price for the solar energy due to the increase in the fossil fuel prices.

Solar plant size	m²	5,000
Yearly yield of solar plant	MWh/a	2,000
Price per m²	€/m²	250
Total plant price (investment cost)	€	1,250,000

Price per MWh of solar thermal energy	€/MWh	40	50
Yearly revenue	€/a	80,000	100,000
Expenses for service and maintenance	€/a	3,000	3,000
Net yearly revenue (= annuity paid by ESCO)	€/a	77,000	97,000
Approx. estimated investment cost that may be covered by the yearly plant revenue	€	770,000	970,000
Amount of investment cost that needs to be covered by subsidies	€	480,000	280,000
Percentage of subsidy	%	38	22
Maximum investment costs allowed to reach the same effect caused by the price increase (from 40 to 50 € per MWh)	€	992,270	
	%	79.4	
Necessary reduction of investment costs	%	**20.6**	

Same plant characteristics as above (250 m²), two price scenarios: 25 €/MWh or 35 €/MWh

Price per MWh of solar thermal energy	€/MWh	25	35
Yearly revenue	€/a	50,000	70,000
Expenses for service and maintenance	€/a	3,000	3,000
Net yearly revenue (= annuity paid by ESCO)	€/a	47,000	67,000
Approx. estimated investment cost that may be covered by the yearly plant revenue	€	470,000	670,000
Amount of investment cost that needs to be covered by subsidies	€	780,000	580,000
Percentage of subsidy	%	62	46
Maximum investment costs allowed to reach the same effect caused by the price increase (from 40 to 50 € per MWh)	€	876,870	
	%	70.1	
Necessary reduction of investment costs	%	**29.9**	

One may see that the main effect in the possibilities for a reduction of the necessary subsidies comes from a direct price increase of the solar thermal energy price. The rate of change of the price for the kWh solar thermal energy is much higher than the rate of decrease in price of the investment costs. So, it has taken about 10 years for the investment costs to decrease by some 25 %, but the increase in the price for the solar thermal energy may change in a very much quicker range of time, as it is linked to the fossil fuel price which is known to vary quite heavily, with a strong increase over the past years. As stated above, the consideration of the energy tax saved by the solar thermal plant and the revenues from trade with CO_2 emission certificates have exactly the same effect. This shows that the consideration of these last two quoted items is a very important measure to help reduce the percentage of subsidies needed in order to make a solar thermal ESCO solution economically feasible.

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