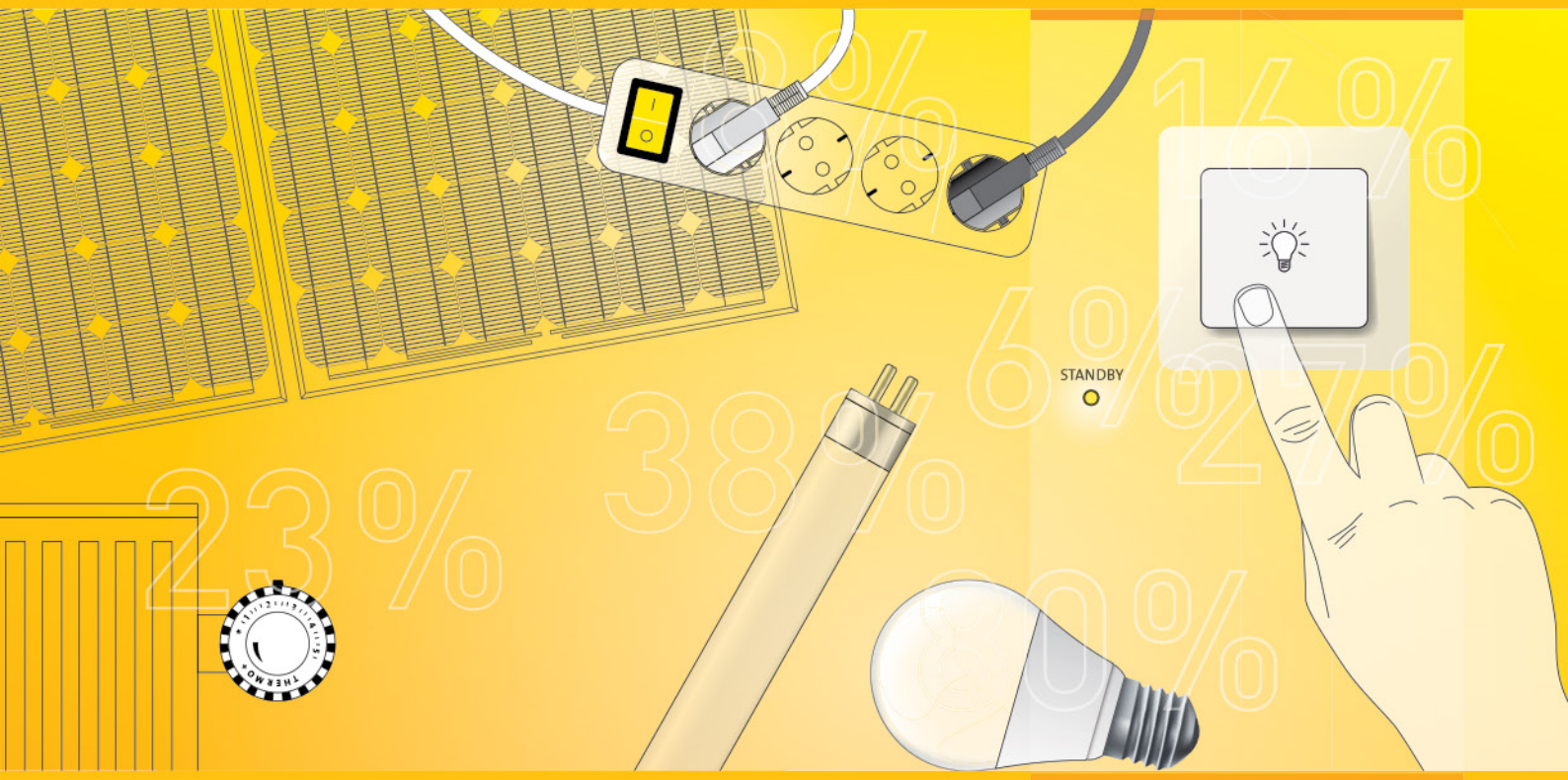
Negawatt power plants in schools – how citizens and climate can benefit

Kurt Berlo and Dieter Seifried



with a foreword by Peter Hennicke (Club of Rome)

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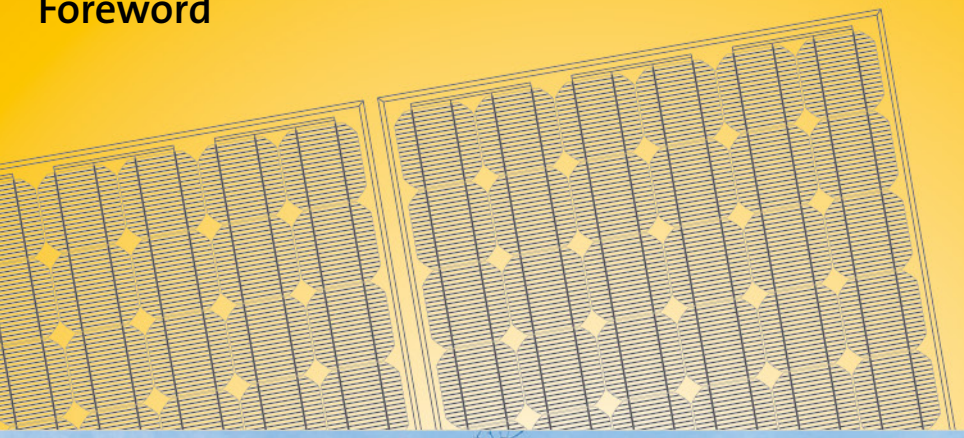
Content

Foreword

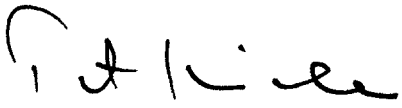


Making climate engagement visible:
PV plant on the roof of
Willibrord Gymnasium in Emmerich

This brochure belongs on the desk of all mayors as well as heads of schools and building authorities in Germany. Indeed, few solar and energy-saving projects can show such a convincing and proven track record as the sample schools presented here, whose results are, in principle, transferable everywhere! The combined "Solar&Spar" (Solar&Save) school projects in Engelskirchen, Emmerich, Gelsenkirchen and Cologne show amazing results: over the contracts' terms (20 years each), they will allow total energy savings of approx. 32 million kWh of electricity and 56 million kWh of heat, thus avoiding the emission of 40 300 tons of CO_2. In addition to an attractive return on the citizen's invested capital (5-6%), the four schools and the four cities will participate in the success and receive around € 700 000 and € 600 000 respectively. And this is not all: students, teachers and parents learn, through the example of their own school, how smartly combined energy saving and solar technologies, along with a rational energy saving behaviour, contribute to climate protection while being incredibly profitable. This is environmental education as no textbook allows! Anyone who doesn't believe this should read this carefully researched documentation. And it would be even better if many stakeholders set out to implement the project concept „Solar&Spar" on a large scale.
The idea behind it is as simple as it is ingenious: find suitable schools, finance their partial energy renovation thanks to public energy performance contracting and invest in state-of-the-art solar and efficiency technology. In other words: PV on the roof, energy saving lighting in all rooms, optimization of the heating system and, where possible, installation of a combined heat and power (CHP) plant for highly efficient electricity and heat generation. The refinancing of investments mainly comes from the saved energy costs. Other revenues come from the PV electricity feed-in, in compliance with the German Renewable Energy Act (EEG).

If we transpose the environmental and economic success of the four sample schools presented here to only 10% of the 30 000 general education schools in Germany, a 500 MW brown coal power plant and the emission of about 4 million tons of CO_2 could be avoided thanks to citizen capital that bears an annual interest rate of 5-6%! A real ecological and economical bargain: a savings bond currently barely yields 0.5%!
If such examples can't boost the joint effort for the energy transition, then what could? Far-sighted energy and climate policies, entrepreneurial courage, technical expertise and persuasion efforts towards the municipalities will be necessary in order for these examples to be replicated on a large scale. This not only works for schools, but essentially also for other public buildings, e.g. town halls, swimming pools, retirement homes, hospitals or sports facilities.

It is therefore high time that the idea of „Solar&Spar through citizen contracting" spreads everywhere!



Prof. Dr. Peter Hennicke
Former President of the Wuppertal Institute
Member of the Club of Rome

Climate protection as a financial investment

1

The participation in Solar&Spar was also actively promoted in Emmerich.

Solar&Spar – a future-oriented initiative

The story begins in the year 2000. Under the title „100 000 Watt Solar Initiative for schools in NRW“, the Wuppertal Institute solicits funding from the Land of North Rhine-Westphalia for a project design for the efficient implementation of extensive energy saving measures in schools. Aim of the initiative: install 50 watts of solar power per student at selected North Rhine-Westphalian schools, while saving 50 more watts in lighting. With this combination, 100 watts of conventional electrical power would therefore be saved for each student. In a school with 1000 students, a 100 000 Watt solar initiative could thus be implemented.

Taking the energy transition forward with Negawatt

Saving energy instead of generating it – the idea of the Negawatt power plants came from Amory Lovins, unique precursor in terms of energy efficiency. Lovins already said in the 1990s: „We should get used to the idea that buying a power-saving device is the same as building a tiny power plant in our own home or in our own factory“. According to Lovins, installing a 15-watt low-energy bulb that emits as much light as a 75-watt incandescent bulb is the same as building a small power plant with a power of 60 „negawatts“, i.e. unused watts. As a result, Lovins described the Negawatt power plants as the „most modern power plants in the world „- without chimneys, without cooling towers and without a dangerous reactor for nuclear fission.[1]
With Solar&Spar, we took up this idea of power-saving plants. However, we wanted to take it a step further by combining energy saving with the generation of electricity from photovoltaic plants and decentralized combined heat and power plants. Thus the programmatic project title „Solar&Spar“.

Involving citizens in the financial success

Investments in electricity and heat saving measures in the Solar&Spar schools had to be globally profitable and, concretely, have a return on investment of around 5%.
Our underlying idea was that if we could show that the fight against climate change is also economically profitable, it would become interesting also for citizens to participate actively and cost-effectively in climate protection. This is achieved with combined solar and saving plants that are created in schools thanks to the financial participation of citizens. Our Solar&Spar projects aimed to increase energy efficiency, develop renewable energies and install decentralized cogeneration plants in various schools.
Today, four schools in four cities in North Rhine-Westphalia can rejoice: their energy technology has been renewed by the Solar&Spar company. In addition, they even receive money for now having pleasantly lit classrooms and a perfectly working heating system. On the roofs, photovoltaic installations generate electricity and supplement the energy production of a total of three combined heat and power plants.

1 Hennicke, P./Seifried, D.: Das Einsparkraftwerk, 1996, S. 103

Climate protection is also an attractive capital investment

Shortly after the concept was developed, the first school was on board: as early as May 2002, the first solar and saving plant was completed at the Aggertal-Gymnasium[2] in Engelskirchen. Shortly before, a solar power plant had already been commissioned on the school's roof, incidentally the largest in the region at the time.
The set goals were already achieved for this first project. The school's energy efficiency was significantly improved and a 350 square meters solar power plant was installed. The necessary capital was collected thanks to the participation of citizens, teachers and students of the Aggertal-Gymnasium. A total of € 420 000 was invested in the school's energy renovation.
Three further Solar&Spar projects followed shortly afterwards: at the Willibrord Gymnasium in Emmerich, at the Gesamtschule[3] Berger Feld in Gelsenkirchen and at the Europaschule in Cologne. Total investment sum: € 3.5 million.

In 2003, the project was selected as a best practice example in North Rhine-Westphalia by the then Minister-President Peer Steinbrück and the then Minister of the Environment Bärbel Höhn, in the context of Agenda 21 NRW. The schools, the municipalities and the involved citizens were on the podium. Proof had been made: climate protection is an investment that makes sense, and schools are a great place to economically develop untapped energy efficiency potentials.

Today, 13 years after this tribute, we would like to take stock and document the activities and framework conditions that contributed to this success. This booklet is intended as an incentive to follow these examples. Sure enough, the framework conditions have changed since the beginning of the project. Some things have become easier, others more difficult. However, our credo remains: whoever invests in energy saving strategies in schools can look forward to an interesting return. If, in addition, citizens, schools and municipalities are involved in the financial success, this locally creates a new energy transition momentum.

Inauguration of the Solar&Spar project in Engelskirchen in 2001

[2] In Germany, a Gymnasium is a secondary school with fairly strict entrance requirements, which prepares students for university studies. German students with sufficient academic results go there at the age of 11 and leave with the Abitur, which can be compared to A-level, Matura or the International Baccalaureate Diploma, at the age of 18.

[3] The Gesamtschule (comprehensive school) in Germany is a form of secondary education to which all children can go after primary school (without selection on the basis of academic achievement or aptitude), at least until the 9th or 10th grade (age 15-16). In several Lands, it has become an alternative to the traditional three-tiered school system (Hauptschule, Realschule, Gymnasium).

Schools: huge untapped energy efficiency potentials!

Almost all cities and towns in Germany have their own building stock. In most cases, one thinks of town halls, administrative buildings and municipal offices. However, these are by no means the ones that generate the most electricity and heating costs. Rather, the many school buildings are at the top of the list for energy consumption, as they usually account for 40 to 60 percent of all municipal buildings' energy costs.

This is mainly because they are often in a poor structural and energetic state: the plaster is crumbling from the outer façades, windows are leaking, they can no longer be opened and the air passes through joints and cracks. In addition, the lighting systems are obsolete, their light efficiency is poor. Most of the time motion detectors and automatic shutdowns are missing; often the light remains on until the cleaning service turns it off late at night after their work is completed. Ineffective heating and ventilation systems no longer work properly; oversized heating pumps with poor efficiency are increasing power consumption. The list of defects could be extended almost indefinitely.

To make matters worse, complaints from headmasters, teachers, janitors, as well as parent or student representatives to the competent authorities often remain unanswered. For many municipalities are heavily indebted, they simply lack the financial resources for the necessary modernization measures. And often enough, other municipal challenges seem more important than energy-related sanitation measures. And so schools continue to waste huge amounts of energy, causing energy costs that further undermine the municipal budget. A vicious circle.
Reason enough to think about alternative financing and action possibilities that would allow carrying out the schools' renovation without overburdening the municipal budget. A viable solution is citizen contracting, as the Wuppertal Institute has successfully implemented in the Solar&Spar projects at four North Rhine-Westphalian schools.

There is a lot to be done: just as in these Solar&Spar projects, the energy renovation of many schools across Germany could also be carried out cost-effectively by replacing inefficient boilers, lighting and circulating pumps.

Contracting – the key to success

2

Cogeneration plant in the basement of the Europaschule Cologne

2.1 How does Energy Performance Contracting work in municipalities?

In an energy performance contract, a contractor invests in technical sanitation measures of a municipal building. With the renovation, the building's energy costs are subsequently reduced. The contractor receives the associated cost savings over a contractually agreed period. Once this contract has expired, it is the municipality that benefits from the saved energy costs. This allows municipalities to save energy in their buildings without having to invest themselves.

The principle of compensating the contractor according to the electricity and heat savings actually achieved sounds simple and obvious. In practice, however, it is more complex. Indeed, one must know the energy saving achieved in order to calculate the compensation. However, this cannot be measured. To overcome this problem, what is done in a contracting arrangement is that the consumptions prior to and following the technical installations' refurbishment are compared. The electricity and heat consumption before the implementation of the measures is called „baseline" and is usually calculated from the last three years' average consumption values. The difference between the baseline and the current consumption then gives the value of the achieved savings.

In addition, the measured heat consumption must also be „weather-adjusted". After all, it isn't irrelevant whether the winter for which the heat consumption was determined was „cold or warm". The correction calculation is based on the so-called „degree days". This is, in technical terms, the sum of the differences between the average room temperature of 20° C and the daily average air temperature over all heating days of the local heating season - in short, the adjustment to a statistical weather year.

So far, it is relatively easy. Where it becomes difficult is when changes occur in the usage of a building. If, for example, teaching times are extended, this also generally increases the building's energy consumption and thus reduces energy savings. The changes in electricity and heat consumption must therefore be determined and the baseline adjusted accordingly. In the case of the Solar&Spar projects, a consensual solution with the building owners has always been sought and found.

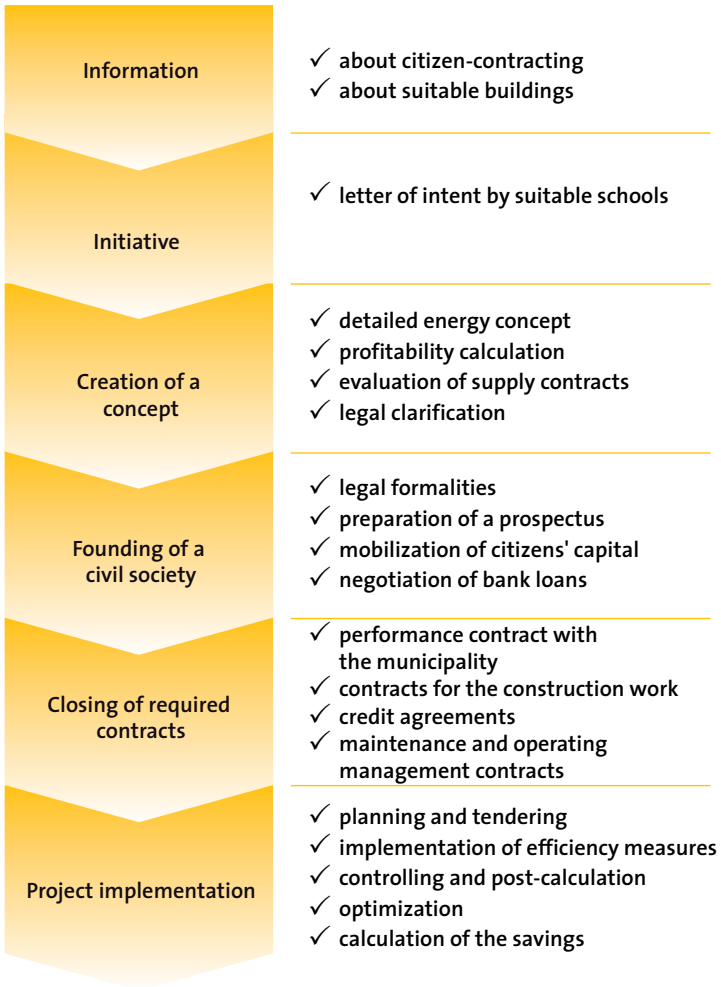


Figure 1:
Key milestones for the implementation of Solar&Spar projects in schools through citizen-contracting

2.2 Citizen-contracting as a model

There are now many contracting companies in Germany who single-handedly plan, implement and finance energy renovation projects. Citizen contracting goes a step further, simply because the citizens themselves finance the energy renovation and also benefit in return from the economic success linked to the induced energy savings. Here, an ad hoc civil society takes on the role of the contractor.

In the case of the Solar&Spar projects, citizens could participate by acquiring share certificates, starting at € 2500. Members of the school community, such as students, parents, teachers, etc., had to be able to invest even more easily. For them, the minimum participation was € 500. The participants annually receive a portion of the saved energy costs, proportionally to the amount of their investment.

Figure 2:
Structure of the Solar&Spar Project Development Companies

Citizen-contracting – Contractual basis

The Solar&Spar projects were implemented by project companies in the legal form of GmbH & Co. KG[4]. These were founded by employees and friends of the Wuppertal Institute. The individual project companies are brought together in a general partner GmbH (Solar&Spar Contract GmbH), which provides the liable equity capital for all four KGs.

The companies and respective cities (as owners of the buildings) are bound by a performance contract which essentially regulates the following points:

- The kWh saved in electricity and heating are valued and paid out according to current energy prices.
- The school and the municipality benefit from the savings.
- The contract term is 20 years (14 years in the case of the Europaschule Cologne)
- The municipality provides access to the school's roof free of charge.
- At the end of the contract period, a free transfer of ownership of the installed Solar&Spar systems is made to the municipality.

[4] A GmbH & Co. KG (Gesellschaft mit beschränkter Haftung & Company Kommanditgesellschaft) is a type of German company. It is a „Kommanditgesellschaft" (limited partnership business entity) with the sole general partner being a limited liability company.


Anteilsschein

ERIKA MUSTERMANN, MUSTERSTADT

IST AM
SOLAR- UND SPARPROJEKT WILLIBRORD-GYMNASIUM EMMERICH AM RHEIN
MIT EINEM ANTEIL VON
2.000 EURO
BETEILIGT. DIESEN BETRAG INVESTIERTE DIE
SOLAR&SPAR CONTRACT GMBH & CO. KG WILLIBRORD-GYMNASIUM EMMERICH IM RAHMEN
DER „100.000 WATT-SOLAR-INITIATIVE FÜR SCHULEN IN NRW – ENERGIESCHULE 2000+"
(LEITPROJEKT DER LANDESINITIATIVE ZUKUNFTSENERGIEN NRW) IN
EINE PHOTOVOLTAIKANLAGE (50 KWP),
EINE BELEUCHTUNGSSANIERUNG UND
WEITERE ÖKOLOGISCHE ENERGIESPARTECHNIKEN.
DER ERTRAG AUS DEM „SOLARKRAFTWERK" UND DIE EINGESPARTEN ENERGIEKOSTEN
WERDEN DER ANTEILSEIGNERIN ALS RENDITE AUSBEZAHLT.

solar+spar contract
Solar&Spar Contract GmbH & Co. KG
Willibrord-Gymnasium Emmerich
(Projektträger)

The plan was to have a return on invested capital of about 5-6%. At the time of printing, however, it is foreseeable that the Solar&Spar projects will exceed the predicted values.
The project planning was carried out by the Wuppertal Institute, Büro Ö-quadrat, Energiebüro Schaumburg and Ingenieurbüro Morhenne GbR.

Within the four civil societies created around the schools, private shareholders have the status of atypical silent partners. They benefit from the company's profits proportionally to the amount of their contribution and have the right to annual information on the year's financial results. However, there is no entry in the commercial register and no annual shareholders' meeting. The administrative burden for the project development companies is thus limited. In addition, the silent partners cannot participate in the company's management, which makes it easier from the managers' point of view.

This same form of company is still possible today, but the conditions imposed by the German Federal Financial Supervisory Authority (BaFin) for the prospectus' drafting have now become very complex and costly. Similar projects can, however, also be carried out on the basis of a different corporate form, e.g. by a cooperative taking over the project's financing and management. (Details in the interview p.26).

Atypical silent partners - advantages of the investment concept:

- The silent partners are not entered in the commercial register (CR); corresponding notary appointments and changes in the CR are completely eliminated;
- private contracts between the silent partners and the GmbH & Co. KG regulate the investment relationship;
- the silent partners are only liable for their contribution;
- the silent partners earn income from commercial transactions;
- annual shareholders' meetings are eliminated and
- the silent partners have a right to information: every year they receive the annual balance sheet, the profit and loss accounts and the management report.

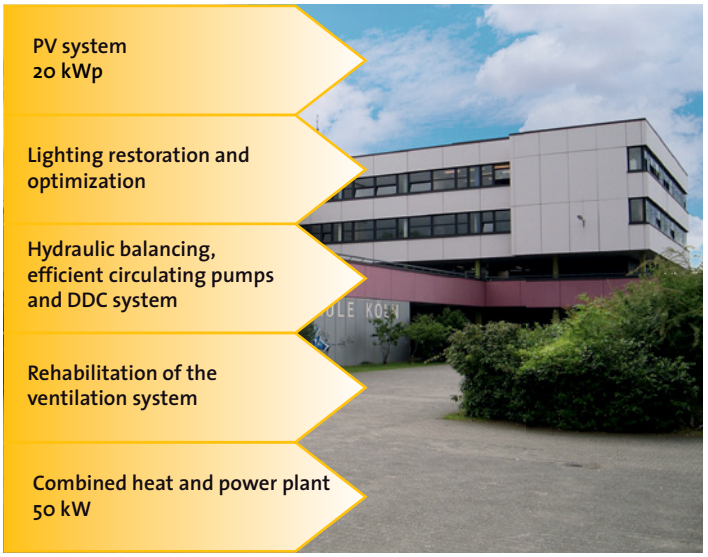


Figure 3:
Solar&Spar measures implemented at the Europaschule Cologne

2.3 Building on the right saving technology

The Solar&Spar school projects invested in very different saving technologies. The focus, however, was on the lighting refurbishment and on the heating systems' renovation and control, whereby heating circuits and circulating pumps have also been optimized. A combined heat and power (CHP) plant has also been installed in three projects, with two CHPs being operated by municipal energy suppliers and one by Solar&Spar Contract GmbH. In parallel, a large solar installation was installed on each school by the respective Solar&Spar company. The smallest installation has a peak power of 20 kW, the largest a power of 50 kW.

Figure 4:
Activities of the Solar&Spar projects and their effects

Measures	Financing	Effects
Photovoltaic plants	Solar&Spar Contract GmbH & Co. KG	Reduction of CO_2 emissions
Lighting renovation	Parents/grandparents Teachers Citizens	Improvement of lighting and learning conditions
Optimization of heating systems and circulation pumps		Rehabilitation of the school without overloading the municipal budget
Rehabilitation of ventilation systems	Renewable Energy Act (EEG)	Less maintenance costs eases the burden on the town treasury
Combined heat and power plant	REN promotion program of NRW*	Students learn to handle energy and water with care
Measures for water saving	Low interest loans from KfW**	Participation in economic responsibility increases sense of identity
Various small measures	Normal bank loans	Positive impulse for the local and regional economy

* REN promotion program of the Land of North Rhine-Westphalia for the rational use of energy and renewable energy sources
** KfW: German Financial Cooperation

2.4 Learning to understand climate protection

An old wisdom from Confucius says: *„Tell me, and I will forget. Show me, and I may remember. Involve me, and I will understand"*. The truth hidden behind this saying has also proven to be accurate within the Solar&Spar projects. The identification with the projects clearly increased with the equity participation of 375 shareholders. This was and is an effect that was absolutely sought and planned. For example, Dagmar Naegele, head of the Europaschule Cologne, is pleased that the widely visible photovoltaic system supports the school's educational identity: „When I speak of climate protection in class, and of the environmentally friendly use of solar energy, I am now more credible thanks to the solar plant on the school's roof" says the teacher. According to her, the Solar&Spar project helps convincing the students of the importance of a rational use of our limited resources.

Anyone who invests in energy saving takes on economic responsibility. The involvement of stakeholders in the project and their accountability is what also fundamentally changes attitudes towards climate protection and energy saving measures specifically. This is why, from the

beginning, the Solar&Spar project was designed to involve as many people as possible from the schools or from their immediate vicinity: students, parents and grandparents, teachers and citizens had to be involved and learn that it is also worthwhile from an economic point of view to invest in the fight against climate change. The energy transition is not something abstract. It is possible here and now.

Students visit the photovoltaic system on the roof of the Europaschule Cologne.

Educational effect: In the Willibrord Gymnasium, the editorial staff of the student magazine „Free Willi“ asked specific questions about the Solar&Spar project.

In designing the energy performance contracts, it was seen to it that as many people as possible from the community could participate. Thus, for all four projects, about half of the total investment comes from shareholders who are residents in the city or region of the respective school. A further aspect for this was that when teachers and students are „confronted“ with modern Solar&Spar and photovoltaic technology on a daily basis, this sharpens their ecological awareness and they handle electricity and heating more sparingly. In addition to the energy savings by means of rational technology, the savings due to changed consumer behaviour are thus added. This will benefit the involved citizens, the schools and the municipalities alike.

The fact that the school also benefits from the annual savings is an additional motivation. For example, the Gesamtschule Berger Feld received a sum of more than € 30 000 for the year of operation 2014, freely disposable. For the long-term headmaster Georg Altenkamp and the temporary headmaster Jochen Herrmann, this money is more than welcome. With it, the school can finance necessary equipment such as cupboards, learning materials and other important purchases (e.g. sports equipment), which will directly benefit the students. „Moreover, the school is experimenting annually how investments in climate protection translate into euros and in cents“ says Jochen Herrmann. According to him, this is a very positive learning effect, which could not be achieved with the school's usual teaching methods. The participation principle has not only resulted in greater savings but also in maximum satisfaction among the shareholders. The Wuppertal Institute conducted a survey among the silent partners in 2009. Already the high response rate of the sent questionnaire of almost 60 percent suggested a very high satisfaction with the Solar&Spar projects. In fact, as a result, 89% of the silent partners would participate in a Solar&Spar project again, based on their experience so far.

The projects' results

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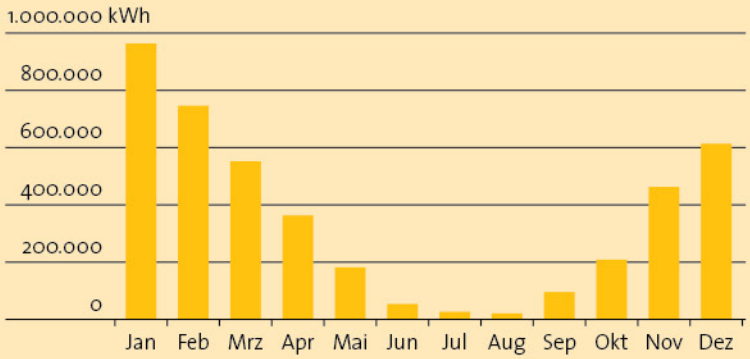
Figure 5: Monthly heating savings at the four Solar&Spar schools in the year of operation 2014



3.1 Heat savings

When it comes to heat savings, many think of thermal insulation. However, in schools, it is not always necessary to improve the insulation to make large heat savings. Indeed, not a single square meter of insulation has been installed in the four Solar&Spar schools - yet nearly 4.3 million kilowatt hours of heat are being saved each year. How did this become possible?

- By replacing the heating systems (in three of four cases)[5],
- by zoning the heating circuits and installing a temperature control device that will adapt the temperature to the heat demand (Direct Digital Control -DDC),
- by hydraulically balancing the heating system,
- by lowering the temperature during nights and weekends,
- by controlling the heating pumps according to the heat demand,
- by (partially) refurbishing the ventilation systems.

As figure 5 shows, the heating savings are systematically higher, the lower the outdoor temperature gets. On the other hand, the electricity savings are dependent on external temperatures only to a small extent (see figure 8 Electricity savings).

3.2 Electricity savings

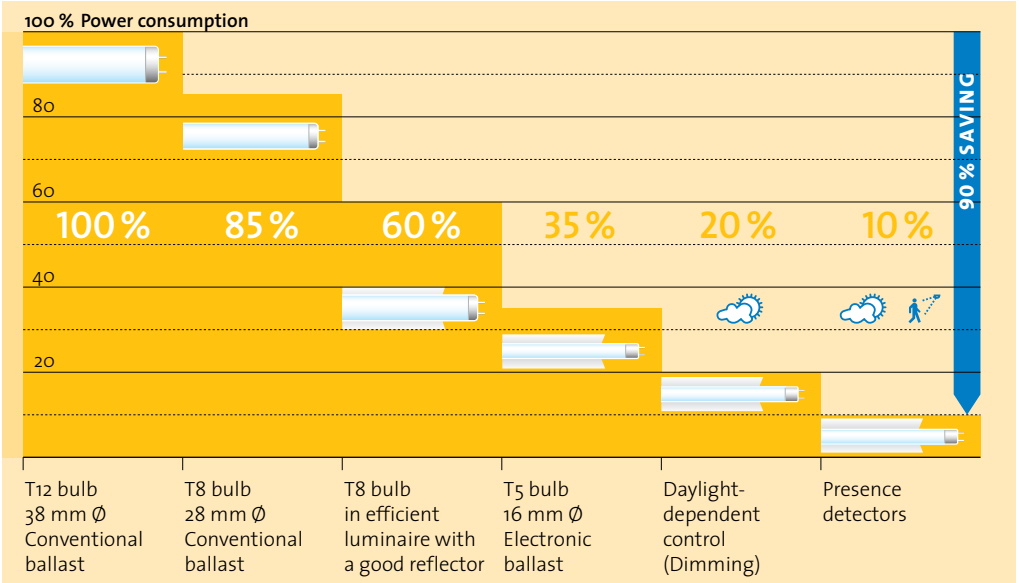
As a general rule, savings in electricity generate interesting results from a profitability point of view. Therefore, the detailed analysis of the electricity savings was also of great interest for the Solar&Spar projects.

The largest electricity consumption in the schools is usually caused by lighting - at least if it is a few decades old. Other large power consumers are usually ventilation systems, heating pumps and, if available, school kitchens. A variety of other small consumers of electricity such as refrigerators, water heaters, media and computers are added to this.

In the Solar&Spar projects, the lighting was replaced throughout the school building and partly also in the gymnasiums. The required number, type and mounting position of the luminaires had previously been determined with specialized computer programs. This resulted in savings both at the investment level and in the subsequent electricity consumption. In addition, there is a positive impact on the functioning of the schools: the lighting renovation also improved the light quality in the classes, in terms of brightness, uniformity and glare-freeness. Old lights were replaced by efficient T5 lamps. As a result, lighting electricity savings of an average of 70 to 80 percent have been achieved. Further savings were achieved by automation of the light circuit, for example with motion detectors and daylight sensors.

[5] The school in Gelsenkirchen is connected to a district heating pipeline.

Figure 6:
Optimized refurbishment of lighting systems: with efficient technology, electricity savings of up to 90 percent can be achieved.



The tube diameter of fluorescent lamps is standardized. The letter „T“ (for tube) is followed by the diameter in eighths of an inch (25.4 mm / 8 = 3.175 mm). Thus, a T5 lamp has a diameter of 5/8 of an inch, i.e. 16 mm. T5 fluorescent lamps are only operated with electronic ballasts and achieve a light output of up to 110 lumens/watt. Therefore, they are as efficient as good LED lamps.

Heating pumps

A lot of electricity can also be saved via the heating pumps. Indeed, these are generally oversized, which makes them pump with too much power - this several thousand hours a year. However, the pump replacement is not sufficient to exploit the saving potential effectively. First, it must be ensured that only the amount of hot water actually needed is pumped through the building. The resistance in the pipe system should therefore be as low as possible. This can be achieved via hydraulic balancing, which minimizes the resistance to flow in the heating circuit. Hydraulic balancing is also a prerequisite for a weekend and night reduction of the heating system and must absolutely be carried out when renovating heating pumps.

Heating control

On weekends, schools are usually not heated, or the room temperature is lowered. This is achieved by pre-setting a lower heating flow temperature on the heating system's control computer. However, the start-up of the heating system on Monday mornings is only satisfactorily completed if the pipe system allows enough hot water to flow through the radiators, and all radiators receive the necessary amount of heat as evenly as possible.

In non-refurbished systems, the heaters closest to the heating plant are supplied with heating water first, while the heating sections with a higher flow resistance initially remain cold. As a result, the heating of the corresponding rooms is delayed.

Thus, the heat-up process takes many hours. The consequence: teachers and students complain, and the janitor reacts by cancelling the lowering of temperature. This can be avoided with hydraulic balancing. Positive secondary effect: volumes of water put into circulation are drastically reduced, which saves further pumping electricity. In addition, the temperature in the return line drops, thereby improving the heating system's condensation efficiency.

Thanks to the several electricity-saving measures, significantly higher than expected electric consumption and power savings could be achieved in all Solar&Spar schools:

- **In total, a power-saving of more than 600 kW was achieved across the four schools.**
- **With approximately 4000 students, this corresponds to a saved electrical power of over 150 watts per capita.**
- **Pro student, the Solar&Spar power plant „produces" 300 kWh or rather negawatt-hours (saved energy) per year.**
- **Overall, the schools' annual electricity purchase has been reduced by more than 1.2 million kilowatt-hours.**[6]

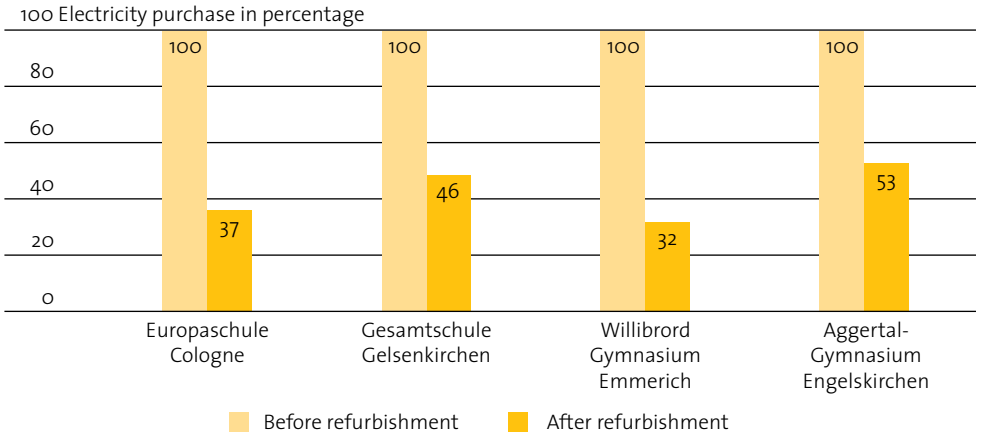


Figure 7:
The electricity purchase at the four Solar&Spar schools was significantly reduced

[6] Part of the reduced electricity purchase results from the power generation of the combined heat and power plants.

3.3 Electricity generation

In addition to energy-saving measures, electricity generation plants were also installed in the Solar&Spar projects:

- Photovoltaic systems with a total output of around 140 kW were installed on the schools' roofs. These currently (2015) produce more than 140 000 kWh of solar energy annually, which is fed into the public grid and remunerated according to EEG rates.
- At the Europaschule in Cologne, Solar&Spar also installed a combined heat and power plant (50 kWel), which generates around 300 000 kWh of electricity per year for the school's own consumption.
- When adding up the results of all measures, the Solar&Spar principle translates into a total electricity saving and generation of around 1.8 million kilowatt hours per year.
- In addition, the schools were able to reduce their electrical power demand[7] by a total of around 600 to 700 kW per month. This power reduction is systematically achieved whenever the demand for electricity on the grid is high, i.e. on working days (when classes are in session in schools) and during the winter months (when the heat demand is high and the combined heat and power plants are in operation). The power saving is only significantly lower during the summer holidays given that naturally, the power demand is correspondingly low at that time. In this respect, the power-saving plants meet the energy-economic requirements perfectly.[3]

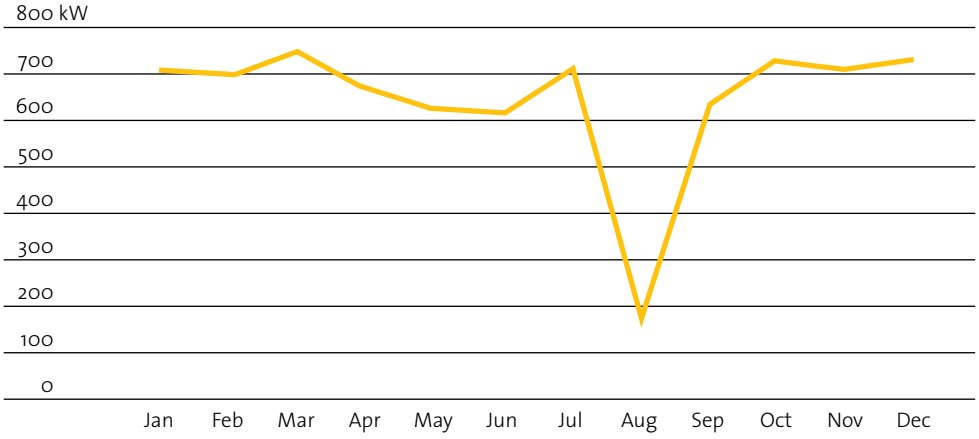


Figure 8: Achieved electrical power savings (sum of saved power) over the four Solar&Spar projects

[7] This power demand is used for electricity billing, which takes into account both power (demand, in kW) and energy (consumption, in kWh). It is based on a maximum average power demand during the month.

3.4 Water savings

The water consumption in schools is determined to a large extent by toilets, showers, sinks and the kitchen consumption. Reducing it should be a part of any savings project in schools. Thus, measures to save water have also been taken in the Solar&Spar projects presented here.

- By installing water-saving shower heads and by shortening the time-setting of the self-closing fittings in the showers of the gymnasium, both water and heat consumption have been reduced.
- n addition, the water pressure on the lower floors of the schools was adjusted by pressure reducers. Thus, flows were reduced in sinks and toilets, where it was possible and sensible to do so.

Overall, around 5 million litters of water are saved in the four schools each year. This not only reduces the cost of purchasing drinking water but also reduces the amount of wastewater and thus saves a similar amount in wastewater costs.

3.5 Calculation of profits

Whether in terms of electricity, heat or water, the implemented saving technologies have reduced consumption in the four Solar&Spar schools in a sustainable and efficient way. But how are the profits to be calculated? How exactly can shareholders now benefit financially? In the Solar&Spar projects, the following steps are taken:

- Each kilowatt hour and cubic meter of water saved is multiplied by the current reference price that the city, as the building's owner, would otherwise have to pay for energy or water.
- At the beginning of every year, the electricity, heat and water savings of the previous year, in regards to the baseline, are calculated and multiplied by the average price for electricity, heat (gas or local heating) or water. Fixed price components such as base price or meter fees are not taken into account.
- In addition to these calculated profits for heat and electricity savings, the project generates income from solar power generation and from the CHP plant (Europaschule Cologne).

Table:
Total and per student annual energy savings and generation in the four schools. The total number of students is 4080..

	KWh per year	KWh per student and per year
Electricity savings	1,244,000	305
Heat savings	4,301,000	1,054
Electricity generation CHP	300,000	74
Electricity generation Solar	140,000	34

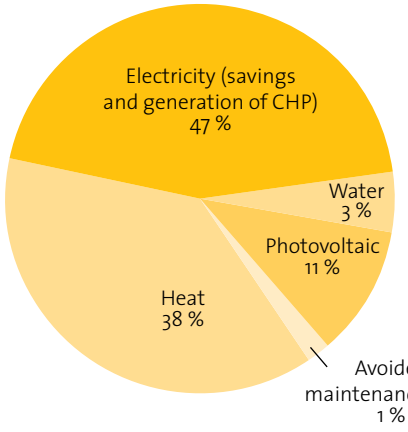


Figure 9:
Total income from all Solar&Spar projects in 2015: 643,000 €

Overall, the result is very satisfactory. For example, in 2015, the four projects combined generated profits of € 632 000. It should be emphasized that nearly half of this is attributable to the electricity sector and a somewhat smaller share to the heat savings. Solar power generation accounts for 11 percent of the revenues achieved by the project, and water resources for around 3 percent.

3.6 Operational experience and environmental impact

At the time of printing, the power-saving plants presented here have been in operation for more than ten years. It is time to take stock:

- So far, the saving targets have been achieved or even exceeded in all four Solar&Spar schools.
- When the contract term comes to an end (the last project ends in 2023), approx. 32 million kWh of electricity and 56 million kWh of heat will have been saved. This corresponds to the annual energy demand of approx. 13 000 energy-efficient homes or approx. 20 000 passive houses.
- In addition, the solar power systems will have generated a total of around 2.2 million kWh of solar power over the contract period.
- The savings in heat and electricity will have prevented the emission of 40 300 tons of CO_2. The larger share - around 68 percent - comes from electricity savings.

3.7 Monitoring and controlling

After the completion of the previously described Solar&Spar measures, the work of the project development companies wasn't yet completed (and still isn't). In the following years and until today, it has been and is still being verified if and to what extent the savings investments truly work, and whether the solar and CHP plants achieve the projected income. It is also constantly monitored whether the annual consumption of electricity and heat differs noticeably from previous years. If this is the case, the causes of this change are explored. If, for example, it is found that the school is being used more intensively or electrical equipment, such as computers, has changed, it may become necessary to correct the baseline accordingly.

In comparison, the monitoring of photovoltaic and CHP plants is relatively easy to carry out. Modern communication technology allows permanent remote monitoring of the systems by means of mobile interfaces. Faults, such as the defect of an inverter, can be registered and repaired in a timely manner. Solar&Spar has concluded appropriate maintenance agreements with experienced companies. This ensures that the solar power plants on the roofs of the schools always provide optimal yields. The CHP unit in the basement of the Europaschule in Cologne is also connected to remote monitoring. There, a 24-hour service was included in the maintenance contract with the company Comuna Metall. Possible faults are eliminated within a very short time. Such a timely service makes sense here, especially since the CHP plant, with approximately 6000 annual operating hours, is in operation most of the year. Unrecognized technical failures would lead to considerable loss of income.

The monitoring of the installed saving technologies in the fields of lighting, ventilation, and heating control and regulation is somewhat more complex. Here, engineers ensure that the equipment remains functional at all times, which is also in the interest of the schools, regardless of energy-saving effects. If necessary, technical equipment is upgraded, changed or repaired.

The following is an example of a number of technical and organizational measures that were subsequently implemented through the monitoring of the Solar&Spar companies:

- Installation of an electricity and water saving industrial dishwasher in the cafeteria of the Gesamtschule Berger Feld
- Installation of a peak load capping device to reduce expensive power peaks
- New programming of the control technology
- Retrofit installation of radiators in the music rooms of the Europaschule Cologne
- Major repairs and power enhancement of the photovoltaic plant at the Aggertal-Gymnasium in Engelskirchen

Since the beginning of the Solar&Spar projects, such monitoring tasks have been carried out, among others, by the technical engineers that we have commissioned: Gerhard Wohlauf, Energiebüro Schaumburg and Dr. Joachim Morhenne. The resulting costs are billed to the respective project development companies. These are „operating costs", which ensure the long term profitability of the Solar&Spar measures.

Experience shows that, in addition to the technical monitoring, regular contact with school janitors is required. This is of great importance and should not be underestimated. Because those responsible for the technology locally know best how the equipment works, and if and where there is a need for technical improvement. At the Solar&Spar Gesamtschule Berger Feld in Gelsenkirchen, for example, the operation of the systems was continually improved, optimized and, if necessary, retrofitted, thanks to regular contact and to the initiative of specialist engineer Gerhard Wohlauf. Thus, record savings could be achieved at this school in the year of operation 2014. That year alone, the school and the town of Gelsenkirchen each benefitted from the project development company's annual results, with more than € 30 000.

Power-saving plants in schools: can they replace a whole power plant?

In Germany there are over 30 000 general education schools. Assuming that at least about 10 percent of these schools are suitable for power-saving plants (financed via citizen contracting), power-saving plants with a reliable power reduction of a total of approx. 500 MW could be installed in these schools. This corresponds to the output of a large coal-fired power plant block. But unlike coal-fired power plants, Negawatt power plants can be built and put into operation within a year and without a long construction permit application process. They could avoid climate-relevant emissions immediately and over a long period of time, as well as relieve the transport and distribution grids.
Moreover, power-saving plants must not be confined to schools: they could also replace other coal-fired power plants in city halls, swimming pools, retirement homes, hospitals and sports facilities.

Everybody benefits

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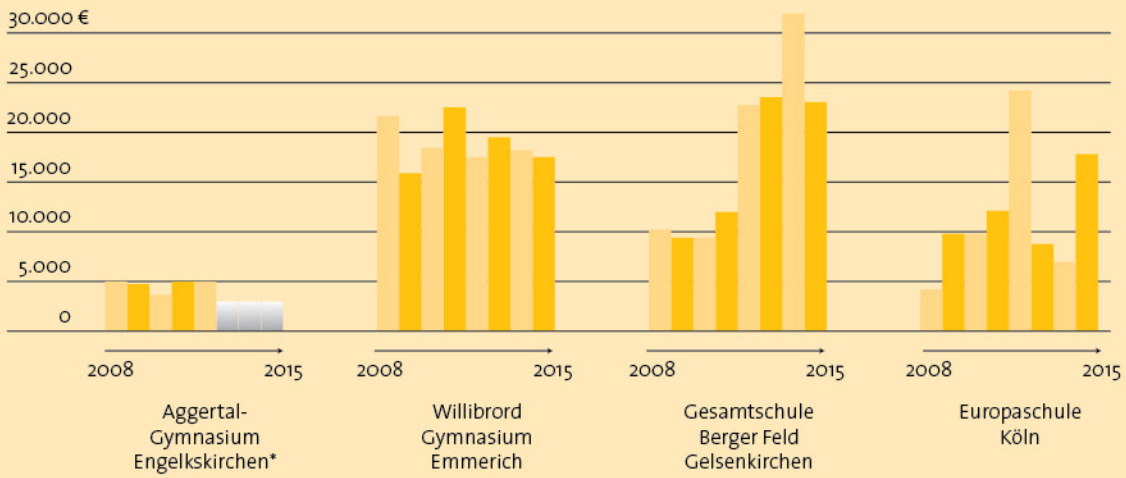


Figure 10: The Solar&Spar Schools receive considerable contributions, at their free disposal.

*The Aggertal-Gymnasium was renovated, so that a success-dependent remuneration of the school was not possible anymore from 2013

4.1 Citizens‘ capital that pays off

A special feature of this project is that the Solar&Spar measures were conceived as „ecological investments“, in which everyone could participate. 375 shares were subscribed. Private and institutional investors participated as silent partners with amounts starting from 500 € (members of the school) or from 2500 € (outsiders).

In all four school projects, teachers, students and parents of the respective school as well as city residents were addressed first for their participation. People who had no connection to the school or city could only subscribe for shares in a second phase.

Assuming that the current level (2016) of natural gas and electricity prices is maintained, the projects will have generated net revenues of around 9 million euros by the end of their contract term. Revenues are used to ensure the citizens an adequate return on their capital, to pay off the loans and to pay for the projects' operation costs as well as taxes and duties. In addition, cities will receive a predictable amount of approximately € 600 000 over the duration of the projects. According to the current state of knowledge, the schools will benefit from the project's success with approximately € 700 000.

In the profit forecast included in the respective prospectus of the school projects, we had announced an interest rate of 5 to 6 percent. Now that all the projects have brought behind them more than half of their contract term, we can already say with relative certainty that the interest rate for the equity investors will exceed the projected values.

4.2 Schools and communities involved in the success

For Solar&Spar, the distribution of income was contractually regulated. According to this, the city, as the building's owner, as well as the school, each receive a quarter of the energy cost savings that exceed the forecasted values. This is to ensure that not only the shareholders benefit from the conservative forecast. Rather, we wanted to make sure that users as well as janitors and the city's administrative staff were all working together to save energy in the schools. The idea is that overall, energy savings will be most effective if all stakeholders profit from the energy saving efforts financially. This way, not only the technical but also the behavioural saving potentials can be fully developed.

For the participation of the schools, a minimum remuneration of € 500 or € 1000 per year was fixed contractually. If the savings targets are exceeded, the remuneration increases accordingly. In hindsight it is shown that this is a good incentive for all stakeholders to make more efforts.

As Figure 11 shows, the cities' direct involvement in the financial success of the Solar&Spar projects is high. Further economic advantages result, for example, from the elimination of investment and maintenance costs for components installed by the contractor.

The role model effect of such projects should not be forgotten. Solar&Spar projects can be crystallization points for many more power-saving plants in the municipality, which will in turn inspire private individuals as well as other schools and municipalities in the vicinity.

In the Solar&Spar projects at the four schools in North Rhine-Westphalia, an important positive secondary effect was that the schools not only received state-of-the-art power saving and generation technology, but also improved their learning conditions with the modern lighting system. Students and teachers benefit equally from flicker-free light and a glare-free illumination of the classrooms. Last but not least, students, teachers and parents learn to use energy rationally and economically - and perhaps even continue to do so at home or at their workplaces.

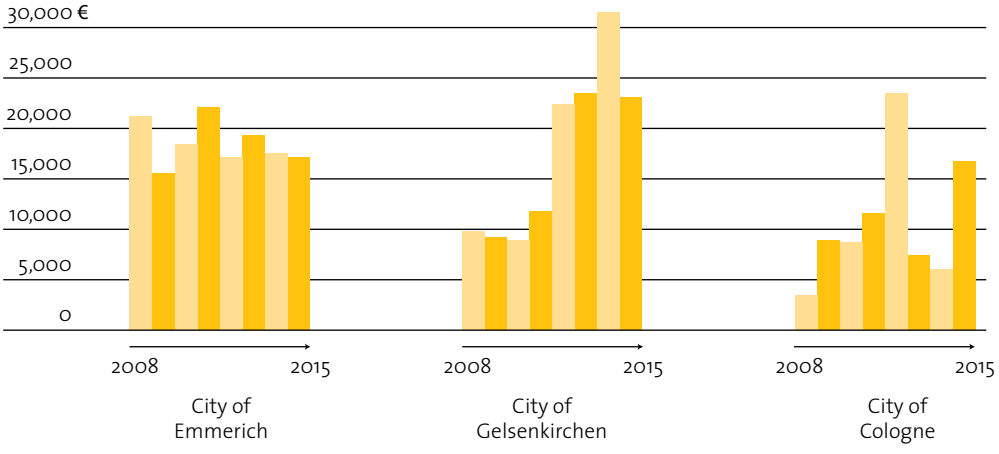
4.3 Promotion of the regional economy

As has already been pointed out, schools' hunger for energy is huge. For example, in large, non-renovated schools, gas procurement costs are of over € 100 000 per year. The majority of this money leaves the region (around 90 percent of the natural gas used in Germany is imported). The situation is similar in terms of electricity supply. In this case, the money may not flow abroad, but it does not stay in the region either.

With savings projects based on citizen contracting, the money flows change: citizens invest locally in the energy saving project. This benefits the local handicraft businesses that carry out the work, and additional direct and indirect jobs are created. The regional economy benefits, the tax revenue in the region increases.

Without any doubt, power-saving plants with citizen participation are important building blocks for the energy transition. Because negawatts, i.e. the avoidance of energy consumption, are the most cost-effective energy supply alternative, they make the energy transition less expensive for society. What is not consumed does not have to be produced, whether with solar energy or conventional energies. Thus, power-saving plants can also contribute significantly to increasing the acceptance of the energy transition within the population.

Figure 11:
The cities, as the buildings' owners, also benefit from the Solar&Spar schools' success in terms of energy savings[8]



[8] At the Aggertal-Gymnasium, the first of the four Solar&Spar projects, the contractual arrangements did not provide for the participation of the city of Engelskirchen. Instead, surpluses over projections were divided into three parts. One third went to the school, one third to the participating citizens and one third to the fully liable partner Solar&Spar Contract GmbH.

4.4 Overcoming obstacles

So far, the experience of the Solar&Spar projects has shown that:

- Citizens are fully willing to invest in the rehabilitation of community-owned property.
- Citizen-contracting is worthwhile, including financially, for all stakeholders.
- In (almost) every school, there is a potential for energy-efficiency.
- The building authorities of municipalities, agglomerations or Lands are encouraged to tap these economically profitable potentials. If they are unable to do so due to lack of money, personnel or any other reason, they can use the model of performance contracting.

Despite the many advantages for municipal budgets and climate, performance contracting is not very popular among municipalities. Often it is because they have had bad experiences in the past, for example with dubious providers. However, in some building authorities, the argument that often arises after the first hesitation is that their own building management "can do it just as well" - even better and more cost-effectively. Often enough, the psychological effect of begrudging the contractors their profits appears. „They only want to make money", then asserts itself as the administration's general opinion.

This is how building authorities then embark on a project adventure, which they often cannot dedicate themselves to professionally, as they lack the time. And the advantage that in contracting projects engineers ensure the proper operation of the installed equipment, over the entire contract period, is forgotten. Yet this is absolutely essential so that the calculated saving potentials not only remain theoretical figures in the energy concept report, but are actually achieved, throughout the years of operation.

There are several reasons why we promote contracting with citizen participation:

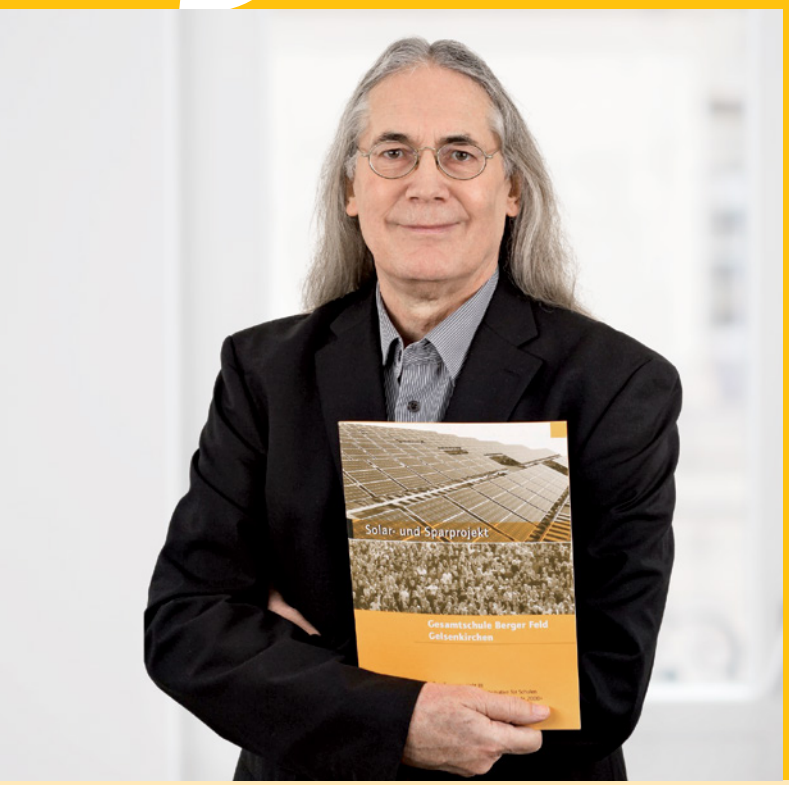
- In projects with citizen participation, students, teachers and the local population are much more involved than in conventional contracting.
- The saving successes can perfectly be communicated in the press because they are no longer company news, but an excellent source of pleasant stories for an interested public.
- If not only the mayor and city administration, but also the schools and citizens are involved in the financial success, then they will all benefit from the image transfer of the energy saving projects.

The four Solar&Spar projects in North Rhine-Westphalia show that cities and municipalities with empty coffers need not remain inactive. Electricity prices are rising continuously, and oil and gas prices on the world market will also rise again. At the same time, more and more people are looking for ethical investment products. The framework conditions for Solar&Spar projects as well as citizen contracting are more favourable and more necessary than ever before.

Further details on the implemented Solar&Spar projects can be found on the project's homepage: www.solarundspar.de

Interview with the project initiators

5



Dr. Kurt Berlo
Project manager at the Wuppertal Institute,
Managing Director of Solar&Spar Contract GmbH

Dieter Seifried
Owner of Büro Ö-quadrat

Mr Berlo, Mr Seifried, what is, according to your experience, the most important factor in the success of a citizen-contracting project?

The fact is that city administrations are generally not enthusiastic about energy performance contracting projects, to put it cautiously. From their perspective, this is quite understandable. Who wants to be given lessons in his area of responsibility? Therefore, persuasive efforts are important at the beginning of the project. Mayors, heads of building departments and city treasurers must be convinced that energy performance contracting is the best solution in certain cases. In particular, if energy-efficient refurbishments do not occur due to a lack of capital or because of too little personnel capacity.[9]

What then is the advantage of a contractor compared to a municipal building department?

First, contractors and some engineering firms are specialists in the field of energy efficiency. They know the most efficient technologies and specialize in the renovation of public buildings. Secondly, they also assume the risks associated with an investment. For example, the risk of higher completion costs, the risk of failure of individual technologies and, above all, the risk that energy cost savings turn out to be significantly lower than expected. What is most important, however, is that contractors subsequently also take on the controlling of the equipment. For example, they assume the equipment's regulation and adjust the settings systematically. The continuous monitoring of the installations throughout the duration of the contract is an essential building block for the project's success. It is not enough to build and install the equipment. Adequate technical controlling is the linchpin for a financially successful contracting project.

For Solar&Spar, your estimates of potential energy savings and financial savings guarantees were deliberately conservative. Was the profit promise enough?

Yes, in all the cases. When we started with the first project in 2001, 5-6% yield promises were not unusual. Today, such projects even work with a lower promise, it's always better than a savings account.
Performance contracting with citizen participation requires a balancing act: the building's owner, in this case the municipality, demands energy cost savings that are guaranteed and as high as possible. The participating citizens, on the other hand, want to bear as small a risk as possible of losing all or even a part of their invested capital. It is therefore important to present the saving potentials not only carefully but also under conservative assumptions. Therefore, our advice is always: deduct a safety margin from the success forecasts. If the forecasts are later exceeded, investors will be all the more pleased.

In other words, you are making the profitability look less attractive than you would expect? Aren't the municipalities disadvantaged by this?

That is exactly what must be avoided. At Solar&Spar, we have solved this by granting the city 25 percent of the additional savings, i.e. the part that exceeds the forecast savings. The same goes for the school, which receives another quarter of the unplanned savings for free disposal. The remaining two quarters go to the shareholders and to the fully liable partner, Solar&Spar Contract GmbH. This is a fair distribution, which has proven itself for all actors. If all benefit equally from unforeseen additional savings, everyone will remain committed.

[9] Many cities have had bad experiences with contracting ("cherry picking" in the energy savings, excessive profits, loss of value of the building and equipment due to lack of maintenance), which is partly due to irresponsible suppliers but partly also to the municipalities' inexperience.

Your model strongly relies on the participation of the schools. Isn't that time-consuming?

Good communication is always time-consuming, but in the long term it always pays off. Because the impact of the behaviour of students, teachers and janitors on the school's energy consumption is not to be underestimated. If everyone is actively involved in the concept, everyone is motivated and identifies with the project.
Thus, energy is used more responsibly, lights are turned off when leaving the premises, thermostats are lowered. At the end of the year it pays off in cash; after all, the schools also benefit financially from the savings. A better motivation for behavioural change cannot be imagined.

How important is it to really use state-of-the-art technology?

We consider contracting projects to be truly sustainable for future generations only if the most efficient technology available in terms of energy efficiency is used, and the proportion of renewable energies is as significant as possible. Citizen participation projects are not cash cows, where profit maximization is the main focus. The aim is rather to achieve as much benefit as possible for climate protection while providing an attractive return for investors. For the Solar&Spar projects, the planning engineers were instructed to prioritize energy efficiency and renewable energies. Other objectives were to involve the building's users in the project and to raise awareness of the necessity of climate protection measures both within schools and communities. This is possible through carefully planned and implemented, economically viable efficiency measures and investments in renewable energy sources. The sustainable solution pays off for all parties involved.
Particularly in the case of projects with citizen participation, interest rates should not be driven too high; instead, the benefits for the general public, such as climate protection or better learning conditions in schools, should be highlighted. Longer-term contracts with a thorough renovation make more sense than „cherry picking" with a short contract term and are accepted by the shareholders just as well.

What is the role of funding programs in all this?

Today, there are numerous funding opportunities for efficient technologies and renewable energies that can be used for the renovation of public buildings. These funding opportunities should truly be exploited systematically, not least in order to achieve higher energy cost savings. Funding offers are constantly changing. But it makes sense in any case to check the websites of the funding databases (BMWi[10], Bafa[11], KfW[12] and BMUB[13]) in order not to miss out on any current funding opportunity.

Compared to conventional contracting, the additional task of actively raising capital appears with citizen contracting. Isn't that time-consuming?

First of all, projects funded by citizens must be described in detail in a participation prospectus. This is also important for the credibility of the project provider. In addition to the mandatory information on the opportunities and risks of the equity investment, the prospectus should also

[10] BMWi: Bundesministerium für Wirtschaft und Energie (Federal Ministry for Economic Affairs and Energy)
[11] Bafa: Bundesamt für Wirtschaft und Ausfuhrkontrolle (Federal Office of Economics and Export Control)
[12] KfW: Kreditanstalt für Wiederaufbau (Credit Institution for Reconstruction, a German government-owned development bank)
[13] BMUB: Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety)

present with as much detail the resources and climate protection aspects. Flyers and posters sensibly complement the public relation work. It is also absolutely recommended to publish the prospectus content on a dedicated website. It will later also be used to promptly publish news about the project's development.
When the project was launched, we had good experiences with a public kick-off event. A small press conference can also be held just before. In all cases, it is recommendable to organize the event together with the school and the municipality. Roll-ups, on which the main contents of the project are presented, can later be set up as „silent salespeople" in the town hall, in schools, etc.

Finally, perhaps the most important question of all, which should be of interest to those who would like to follow the example of Solar&Spar: haven't the energy-economic framework conditions changed so fundamentally since the beginning of your projects that such citizen contracting projects could not even be repeated today?

Indeed, since the projects started in 2001, some general conditions have changed. For example, the rules for the tendering of public-sector projects have been tightened. However, there is still the possibility to implement citizen participation projects without carrying out international tendering procedures, for example by implementing them as pilot projects or research projects. From an economic point of view, the situation has even improved, as electricity prices have increased significantly since then, while improved technologies for efficiency measures are available and have also become more cost-effective. This means that for the same amount of money, more savings with higher returns are possible today.
The idea of citizen contracting also benefits from the fact that debt financing is more cost-effective today, due to lower credit rates. The return expectations of equity providers have also become more modest. On the whole, we are of the opinion that the energy-economic framework conditions for power-saving plants are better today than at the beginning of the project's implementation.

Appendix

6


Jetzt mitmachen!
Klimaschutz in Köln
Solar- und Sparprojekt
Europaschule Köln
Investieren Sie in Sonnenenergie und Energiesparen
Klimaschutz durch moderne Energietechnik
Die ökologische Geldanlage!
Jetzt mitmachen!
Klimaschutz in Emmerich a.Rh.
und Sparprojekt
Willibrord-Gymnasium
Sie in Sonnenenergie und Energiesparen
mit Rendite: Die ökologische Geldanlage
Jetzt mitmachen!
Klimaschutz in Gelsenkirchen
nd Sparprojekt
Gesamtschule Berger Feld
e in Sonnenenergie und Energiesparen
rch moderne Energietechnik
Geldanlage!
Landesinitiative Zukunftsenergien N.W.

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- German Energy Agency (dena) http://www.kompetenzzentrum-contracting.de/startseite/
- Berlin Energy Agency (BEA) http://www.berliner-e-agentur.de/themen/energiespar-contracting

Information on citizen energy

- North Rhine-Westphalia Energy Agency http://www.energieagentur.nrw/buergerenergie/
- Alliance BürgerEnergie e.V. https://www.buendnis-buergerenergie.de/aktuelles/news/

Awards

Honorary prize of the BUND Nordrhein-Westfalen

In April 2010, Solar&Spar Contract GmbH was awarded the honorary prize of BUND NRW, the North Rhine-Westphalia regional branch of the BUND (Bund für Umwelt und Naturschutz Deutschland, German Federation for the Environment and Nature Conservation - Friends of the Earth Germany).
Paul Kröfges, BUND's Regional President, awarded this special recognition to Solar& Spar Contract GmbH because their projects „implement the fundamental pillars of the energy transition (energy efficiency and renewable energies) exemplarily".
Every year, the BUND Energy Prize recognizes projects and initiatives that make an exemplary contribution to the environmentally friendly handling of energy.

Best practice projects in the context of Agenda 21 NRW

The Solar&Spar projects in Engelskirchen and Emmerich were honoured as best practice examples in 2003 by the then Minister-President Peer Steinbrück and the then Minister of the Environment of the Land of North-Rhine Westphalia Bärbel Höhn, in the context of Agenda 21 NRW.
Together with other best practice examples, these Solar&Spar projects were presented to the public on their own exhibition stand on November 26th and 27th of 2003 at a Review and Perspectives Conference of the NRW Agenda 21 in Bonn, as well as on a „Best Practice CD-ROM". They were subsequently presented to the general public on the Internet. The selection of best practice examples was made by selection committees composed of representatives from both academia and practice, as well as employees of the competent departments of the NRW Land government. The selection committees were appointed by the State Secretaries Committee for Sustainable Development. State Secretary Christiane Friedrich praised the two Solar&Spar projects in Engelskirchen and Emmerich, which „particularly contribute to the sustainable development and shaping of the future in North Rhine-Westphalia". According to her, these projects can „inspire other potential project initiators" and have also distinguished themselves „by a highly innovative content".

"Solar-Oscar" of the EnergyAgency.NRW

The city of Emmerich am Rhein was awarded the Solar-Oscar 2004 of the Energy Agency of North Rhine-Westphalia for the Solar&Spar project's exemplary installation of its photovoltaic plant.

Appointment as the lead project of the NRW State Initiative on Future Energies:

In the summer of 2003, the Solar&Spar projects were nominated as the lead project of the NRW State Initiative on Future Energies - lead projects were outstanding projects with a special innovative character and special signal effect.


Agenda 21 NRW.
Gemeinsame Ideen mit Zukunft

Das Projekt

Solar- und Sparprojekt Aggertal-Gymnasium Engelskirchen

initiiert und durchgeführt von der

Solar&Spar Contract GmbH&Co. KG

wird hiermit zum offiziellen Agenda 21 NRW-Best Practice Beispiel ernannt.

Düsseldorf im November 2003

Peer Steinbrück
Ministerpräsident des Landes Nordrhein-Westfalen

Bärbel Höhn
Ministerin für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein-Westfalen


Agenda 21 NRW.
Gemeinsame Ideen mit Zukunft

Das Projekt

Solar- und Sparprojekt Willibrord-Gymnasium Emmerich am Rhein

initiiert und durchgeführt von der

Solar&Spar Contract GmbH&Co. KG

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Bärbel Höhn
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ENERGIE–PREIS 2009

Der BUND Landesverband Nordrhein-Westfalen zeichnet die

SolarEtSpar Contract GmbH

mit einem Ehrenpreis aus als besondere Anerkennung für ihre SolarEtSpar-Projekte, die die Grundpfeiler der Energiewende (Energieeffizienz und Erneuerbare Energien) vorbildlich umsetzen.

Düsseldorf, 18. April 2010

Paul Kröfges
Landesvorsitzender

BUND

Media voices (selection):

„The Willibrord Gymnasium in Emmerich shows what the future of energy supply can look like."
zdf.umwelt, 9.5.2004

„Ingenious and exemplary. A project that will definitely make a difference."
Neue Rhein Zeitung, 6.3.2004

„Absolutely exemplary. Considering how quickly the project has been implemented, we can only congratulate all the stakeholders, including the politicians, for their foresight. „
Rheinische Post, 9.12.2003

„An energetic sensation"
Rheinische Post, 9.12.2003

„The project is particularly interesting, as investments of this kind are still rare. Those betting on rising energy prices in the coming years are well served with this investment."
die tageszeitung, 14.7.2003

„The concept is as simple as it is clever."
Frankfurter Rundschau, August 4, 2004

Wo Bürger sich über steigende Preise für Strom und Wärme freuen

In Nordrhein-Westfalen zeigt eine Initiative, dass sich mit dem Energiesparen Geld verdienen lässt / Schulsanierung wird für Privatanleger interessant

Solar & Spar

Nachhilfe für Schulen

Das Willibrord-Gymnasium in Emmerich hat als sichtbares Zeichen seiner Energiewende eine Solaranlage - fast ein Kunstobjekt - erhalten.

Manchmal gibt es nur Gewinner

Energie sparen, Sonnenstrom erzeugen und dabei Geld verdienen? Ein Schulprojekt zeigt, wie es geht.

VON ELKE BIESEL

MAGAZIN

Klimaschutz rechnet sich

Am Aggertal-Gymnasium in Engelskirchen belegen Solar- und Sparmaßnahmen, die im Rahmen eines Contracting-Vertrages finanziert werden, dass die Kohlendioxyd-Reduktion von rund 70 % nicht nur der Umwelt, sondern auch den Anlegern nützt.

Das BHKW-Modul, installiert im Keller des Gymnasiums, hat eine elektrische Leistung von

Rendite durch Einsparung

Bereits mit 2.500 Euro kann sich jeder Interessent am neuesten Einsparprojekt des Wuppertal Instituts in Köln beteiligen. Mit den Investitionen werden öffentliche Gebäude energetisch saniert

VON BERNWARD JANZING

Project fact sheets

Aggertal-Gymnasium Engelskirchen

Building owner	Municipality of Engelskirchen
Year of construction	1965
Usable floor area	7844 m^2
Number of students	700
Operating hours	8-10 hours / day 5-6 days / week
Project duration	2001-2021
Project costs	€ 420,000
CO2 savings / year	**200,000 kg**

Savings in energy and water consumption

	Before	After	Savings in kWh	in %
Electricity consumption / year	122,000 kWh	65,000 kWh	57,000 kWh	47 %
Heat consumption / year	1,340,000 kWh	960,000 kWh	380,000 kWh	28 %
Water consumption / year	742 m^3	625 m^3	117 m^3	16 %

Willibrord-Gymnasium Emmerich am Rhein

Building owner	Municipality of Emmerich
Year of construction	1975
Number of students	700
Operating hours	8-10 hours / day 5-6 days / week
Project duration	2003-2023
Project costs	€ 641,000
CO2 savings / year	**472,000 kg**

Savings in energy and water consumption

	Before	After	Savings in kWh	in %
Electricity consumption / year	434,000 kWh	140,000 kWh	294,000 kWh	68 %
Heat consumption / year	1,865,000 kWh	645,000 kWh	1,221,000 kWh	65 %
Water consumption / year	1,254 m^3	1,068 m^3	186 m^3	15 %

Gesamtschule Berger Feld Gelsenkirchen

Building owner	Municipality of Gelsenkirchen
Year of construction	1973-1974
Usable floor area	28,300 ^{m2}
Number of students	1,500
Operating hours	8-10 hours / day 5-6 days / week
Project duration	2005-2024
Project costs	€ 935,000
CO2 savings / year	**750,000 kg**

Savings in energy and water consumption

	Before	After	Savings in kWh	in %
Electricity consumption / year	1011,000 kWh	469,000 kWh	542,000 kWh	54 %
Heat consumption / year	4,650,000 kWh	3,096,000 kWh	1,554,000 kWh	33 %
Water consumption / year	6,953 m^3	4,786 m^3	2.,177 m^3	31 %

Europaschule Cologne

Building owner	Building management department of the City of Cologne
Year of construction	1975
Number of students	approx. 1,100
Operating hours	8-10 hours / day 5-6 days / week
Project duration	2005-2018
Project costs	€ 935„000
CO2 savings / year	**750,000 kg**

Savings in energy and water consumption

	Before	After	Savings in kWh	in %
Electricity consumption / year	1,580,000 kWh	582,000 kWh	998,000 kWh	63 %
Heat consumption / year	3.,600,000 kWh	2,263,000 kWh	1,337,000 kWh	37 %
Water consumption / year	7,778 m^3	5,872 m^3	1,906 m^3	25 %

The team

Solar&Spar Contract GmbH Associates (from left to right):
Dieter Seifried, Dr. Kurt Berlo, Oliver Wagner,
Dr. Claus Barthel, Gerhard Wohlauf,
Prof. Dr. Peter Hennicke and Friedrich-Wilhelm Schäfer

Thank you!

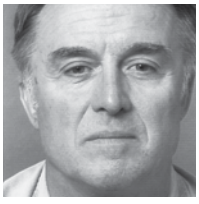
Since the beginning, the technical and commercial implementation and follow-up of the Solar&Spar projects has always been a team work. That is to say that the projects would not have been possible without the participation and support of such a team.

Many thanks also to the responsible staff in the municipal administrations of Engelskirchen, Emmerich, Gelsenkirchen and Cologne.

In addition, we would like to thank the tax consultants responsible for the Solar&Spar projects: Martin Meyer & Dr. Udo Meyer, Engelskirchen, Ingrid Schieck, Emmerich, Heinz-Rudolf Heering, Emmerich.

For their helpful support and for taking on many technical tasks (related to the different aspects of our Solar&Spar projects), we would like to thank the following persons, as well as Dr. Joachim Morhenne, very much:

Detmar Schaumburg
Owner of Energiebüro Schaumburg, Marienheide



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Accounting and shareholder support, Wuppertal

Eckard Köppel
Specialist engineer, technical support for the Solar&Spar projects, Aachen

Checklist: Citizen contracting in schools

7

Please check the statements that apply to the school in your community.
The more „right“ boxes you check, the more worthwhile it would be to consider the possibility of an energy renovation of the school via citizen energy performance contracting.

Lighting	**right**	**wrong**
The school's lighting systems are old.	☐	☐
The classrooms, the teacher’s rooms or study rooms are poorly lit.	☐	☐
Lighting often stays on outside teaching (or other use) hours.	☐	☐
There are no motion detectors or automatic shut-off timers.	☐	☐
Heating and ventilation		
The heating system is over 10 years old.	☐	☐
The heating circulation pumps are over 10 years old.	☐	☐
The ventilation system is over 15 years old.	☐	☐
Heating and ventilation are no longer working properly; there are frequent complaints because of too low / too high room temperatures.	☐	☐
Although the school has more than 500 students, there is no cogeneration plant for combined heat and power generation.	☐	☐
In the case of a renovation of the heating system, additional public buildings nearby could be supplied by a local heating network.	☐	☐

Renewable energies	**right**	**wrong**
There is enough room available on the school's roof for a solar power plant.	☐	☐
Because it is used by clubs in the evenings, weekends and during the holidays, the school's gym would have large enough heat demand to install a solar thermal water heating system.	☐	☐
Structural condition of the building		
The windows of the school building are leaking.	☐	☐
There are draughts in the classrooms: students and/ or teachers complain.	☐	☐
The roof is not insulated.	☐	☐
School action		
Complaints about the school's energetic state by principals, teachers, janitors, parents' or students' representatives to the municipal administration have so far been in vain.	☐	☐
There is no commitment or pedagogical approach on the part of the school towards energy-saving behaviour.	☐	☐
There are no student initiatives that are rewarded by the school.	☐	☐
Municipal action		
To date, the financial resources to carry out the necessary repairs and modernizations have always been lacking.	☐	☐
The municipality is indebted. A further borrowing is not possible, even for the financing of profitable saving measures.	☐	☐
The town's building authority lacks the time for a strategic energy renovation of the school. Other municipal challenges always take precedence.	☐	☐

Impressum

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Dr. Kurt Berlo is a trained businessman and has been working as a project manager at the Wuppertal Institute since 1993. Since 2000, he is the managing director of Solar&Spar Contract GmbH. In addition, he is concerned above all with municipal strategies for energy transition and with aspects of the remunicipalisation of energy supply. He has previously worked on these issues at the Institute for Research on Urban and Regional Development of the Land of North Rhine-Westphalia (ILS) for some ten years. For over 40 years he has been living in the city of Dortmund without a car. Since 1980, he is a strong advocate of the energy transition, both professionally and privately.

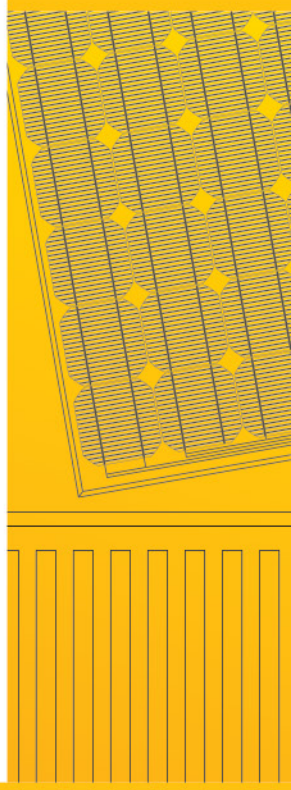
Dieter Seifried, Engineer and Economist
Dieter Seifried studied energy and power plant engineering at the Technical University of Munich as well as economics at the University of Freiburg. From 1983 to 1999, he was project manager and coordinator at the Öko-Institut in Freiburg. As Managing Director of ECO-Watt GmbH, he carried out his first energy performance contracting project with citizen participation at a school in Freiburg in 1998. Since 1999, he has been head of the Büro Ö-quadrat (office for ecological and economic concepts), where he mainly works on concepts that aim to reconcile ecology and economy.

solar+spar contract

Since 2001, Solar&Spar GmbH has launched four unique energy saving projects at schools in Engelskirchen, Emmerich, Gelsenkirchen and Cologne. Through energy performance contracting, citizens of these municipalities are still benefitting today from the economic success of the implemented electricity and heat saving measures as well as from the solar power generation.

A return on capital of more than 5 percent in addition to revenues of € 700 000 for the schools and a further € 600 000 for the municipalities concerned are just some of the many advantages of these four successful projects, which consistently rely on the participation of citizens, city administrations and school members.

In this brochure, for the first time, the general conditions for the success of these citizen contracting projects are described in detail and recommendations are made for interested municipalities, schools and citizens' initiatives that would like to follow these examples.



"This brochure belongs on the desk of all mayors as well as heads of schools and building authorities in Germany."

Prof. Dr. Peter Hennicke, Member of the Club of Rome
Former President of the Wuppertal Institute

solar+spar contract

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