PROJECT RURES

A.T1.3 Minimum template for feasibility studies for implementing EE and RES measures

May, 2018

Project RURES is implemented through the Interreg CENTRAL EUROPE Programme co-financed by the ERDF. This publication reflects the author's views and the Managing Authority and the programme bodies are not liable for any use that may be made of the information contained therein.

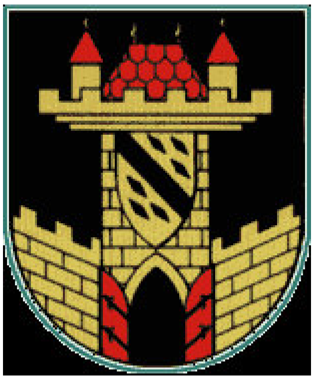
1. Summary in English

The following project is about a sport gym called "Peter-Apian-Turnhalle" in a small city in Saxony called Leisnig. The sport gym is part of a school building complex and is used mainly by the school for teaching purposes. The sport gym has a relatively high heat consumption by now which is caused mainly by an uninsulated building envelop and an outdated heating-system. The aim of the project is to reduce the heat consumption by corresponding measures and through that to improve the energy efficiency of the building and the comfort in the building.

2. Information on the project

The object concerned is located close to the city centre from Leisnig. The gym is part of a high-school building complex and is used mainly for teaching purposes and sport events. The school concerned is the Peter-Apian-School, the only secondary school in the city. The building of the Peter-Apian-Gym was built in 1909. The aim of the project is to increase the energy efficiency of the building and to make the energy supply more environmentally friendly through technical upgrading.

Leisnig itself is a small town located in a rural area. The closer environment consists of small towns similar to Leisnig, f.e. Colditz or Hartha. The whole region is located directly between the three biggest cities in Saxony Dresden, Leipzig, Chemnitz.

Profile Leisnig		
Federal State	*Saxony*	
Rural district	*middle Saxony*	
Inhabitants	*8.407 (according to 01.01.2016)*	
Population density	*106 Inhabitants/km²*	
Local Parts	*in total 40 localities*	
Economy	- *metalworking and ceramic industry* - *fruit growing, handicraft* - *trade and day tourism*	
Local supply	*railway station, library, post office, banks, hospital, schools, nurseries, gastronomy, hotels*	
Transport connection	- *highway A14, railway Station, national Roads (B107, B169, B175)* - *in between the city triangle from Leipzig-Dresden-Chemnitz*	

As many other cities in a rural area Leisnig suffers from the consequences of the urbanisation. More and more people prefer to live in well-developed big cities such as Leipzig or Dresden. Nevertheless, Leisnig has a variety of active sport and cultural associations. Next to the Peter-Apian-School there are two further schools and in total 7 nursery schools. Besides to some small single shops in the city centre there are also commercial areas.

As a local impact the sport gym gives the schools and the associations an opportunity to hold up their sport exercises or to even use them for cultural events. Sport facilities are an important component for a well-functioning society and through that for a well-developed environment. With better and new sport offers the attractiveness of a rural area is expected to rise and to get an important economic factor. It can create jobs and have a big impact on the image of the area. Also, for the touristic infrastructure a well-developed sport program is a significant benefit. Besides an improved sport offer a well-functioning building like a gym can be also host for a big variety of events for the local people.

In the year 2012 an integrated municipal energy and climate protection concept was published for the city of Leisnig. The concept took a look on the energetic infrastructure of Leisnig and focused on the valuation of the energy efficiency and the climate protection of the region. Part of the concept is to identify local used energy sources, to validate the technical equipment of the existing buildings and to evaluate specific local potentials and through that to recommend appropriate measures. The sport gym of the Peter-Apian-School was already a topic in the energy and climate protection concept. Since the energetic condition of the sport gym is improvable, corresponding measures to improve the situation would totally fulfil the recommendations for action of the energy and climate protection concept. Within the framework of the concept the condition of the sport gym already got analysed. The result describes the general condition of the building as outdated and accordingly bad. This causes negative impacts on the energy efficiency and beyond that there are no renewable energy sources used. In the entire building there is no insulation against heat loss built-in and the heating-system does not correspond to the state of the art. As a result of the energetic condition the sport gym has a comparatively high heat consumption. The comparatively high heat consumption can mainly be attributed to the heating system and the non-existent insulation of the building shell against heat loss. Because the heating system has been in operation for 27 years, it is planned to replace it with a gas condensing boiler. In addition, electricity consumption is to be reduced by installing LED lamps and daylight-dependent lighting control.

Beside that the planned measures fulfil totally the planned measures from the former developed energy and climate protection concept, the energetic improvement of the sport gym pursues also the aim of the federal republic of Germany to improve energy efficiency, to increase the use of renewable energy sources and to attenuate the use of energy. The municipalities are in the responsibility to act as the operator in such situations and to take care and support such local improvement. The organisation of the planned project is herewith the responsibility of the municipality. In order to receive support for the planned actions the municipality can obtain subsidies from the federal republic or the federal state. All in all, there is a big variety of possible subsidies but in some matters, it can be more profitable to use a contracting model to plan, finance and execute such projects (→ 4. Financial Analysis). In Terms of environmental fees there will be no difficulties by the energetic renovation of a building.

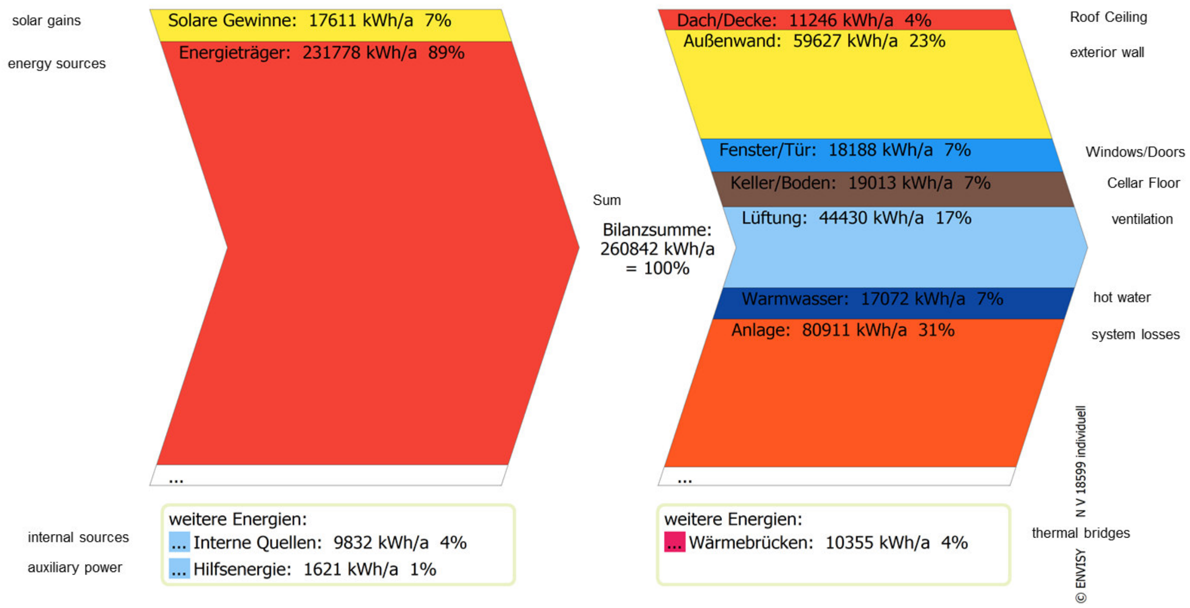
3. Technical and technological analysis

Since the condition of the building isn't the state of the art, in this chapter a more detailed description will be provided. The building was built in 1909. The hole building envelope isn't insulated properly although the windows are double-glazed. The heating and hot water preparation of the building takes place via a low-temperature gas boiler of the company Buderus, year of construction 1992 (nominal heat output 126 kW). The heat transfer in the hall area takes place via ceiling radiant panels. Their functional principle is based on heat radiation. These are considered efficient, as a relatively low flow temperature is necessary for their operation. The following profile gathers some energetic data to the building:

Profile: Sport Gym “Peter-Apian”, Leisnig			
BGF	*441*	$[m^2]$	
Heat consumption	*94*	*[MWh/a]*	
Spec. coefficient heating	*213*	$[kWh/m^2*a]$	
Target value:	*70*	$[kWh/m^2*a]$	
limit value:	*154*	$[kWh/m^2*a]$	
Electric energy consumption	*n.n*	*[MWh/a]*	
Spec. coefficient electric energy	*n.n*	$[kWh/m^2*a]$	
Target value:	*8*	$[kWh/m^2*a]$	
limit value:	*25*	$[kWh/m^2*a]$	

The following data was used as a basis for the analysis of the variants

basic data		
Main use:	Sport Gym	
Building category:	non-residential building	
Year of construction:	1909	
Type of building:	freestanding	
Building location:	inner-city	
Exposure/construction:	compact	
Type of construction:	medium	
Equipment:	medium	
Air tightness:	unaudited	
Average storey height:	5,74	m
usable building area:	441	m^2
Building volume Ve:	2.531	m^3 (Brutto)
Heat-transferring enclosure area A:	1.354	m^2 (Brutto)
A/V ratio:	0,53	m^{-1}
Window areas:	94	m^2
Exterior door areas:	5	m^2
Full storeys:	1	
characteristic width:	8,54	m
characteristic length:	8,54	m
Number of residents/users:	19	
Average room temperature approx.	21,0	°C



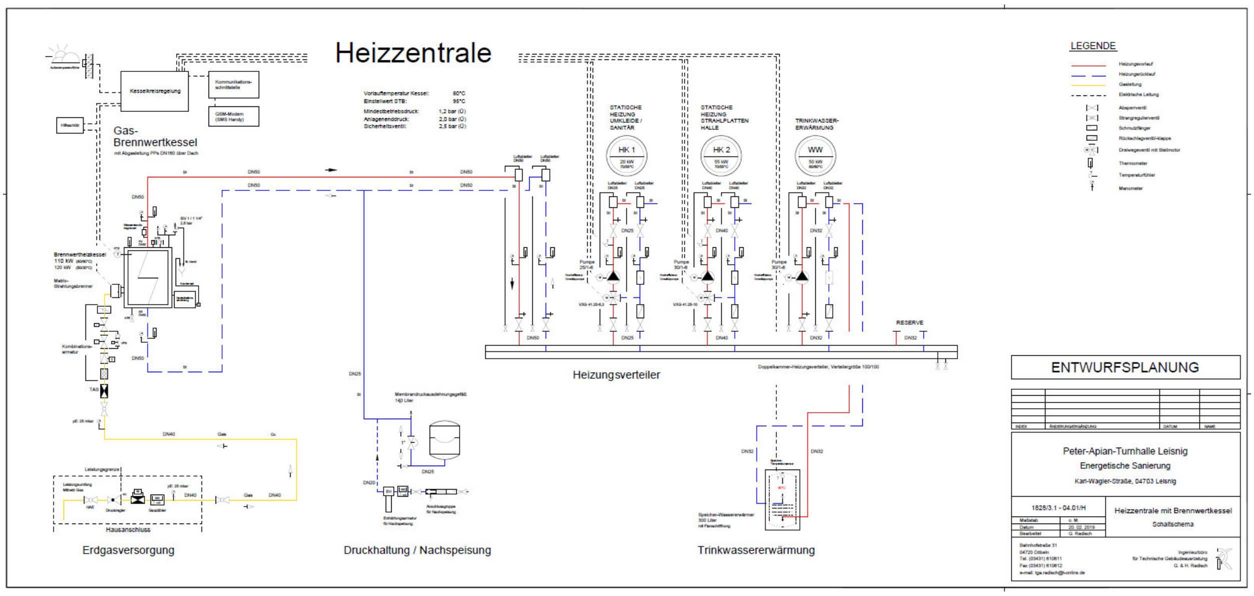
In the energy balance it can be seen that the greatest losses and thus also the greatest savings potentials are to be found in the plant technology. To improve the data shown above the following measures will be set and established:

Heat generation plant:

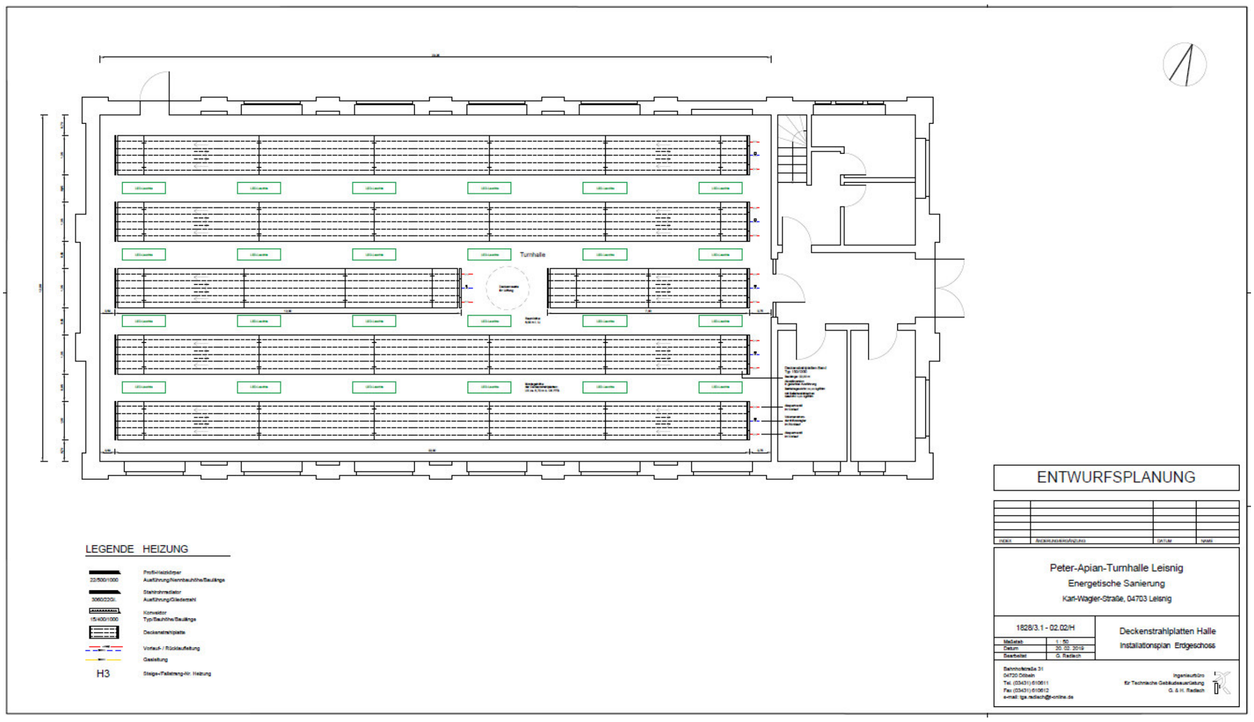
To improve the energetic condition the old low-temperature gas boiler will be dismantled and replaced by a gas condensing boiler with a nominal heating capacity of 110 kW, installed in the central heating unit in the basement. In future, hot water will be produced with the aid of a 300-litre storage water heater for installation directly next to the new boiler. The possible use of a heat pump has been investigated but is not useful for the following reason: the installed heating system, especially the ceiling radiant panel heating in the hall, requires a flow temperature of at least 65...70 °C to achieve the necessary heating power. With this relatively high system temperature, a heat pump system cannot be operated economically. The installation of a thermal solar plant (on the roof or in the outside area) is not possible for reasons of the monument protection.

Heat distribution network:

The heat distribution system in the building consists of a total of three heating circuits, one each for static heating surfaces, for water heating and for the ceiling radiant panels in the sports hall. The described heat distribution system is shown in the following circuit diagram. The circuit diagram is additionally attached to this document, since it is not well representable in this format.



The heating distributor including pumps, fittings and pipes with thermal insulation is worn out and will be replaced. Highly efficient circulation pumps with electronic output control are to be installed to ensure energy-efficient operation of the system. Hydraulic balancing is carried out with the aid of balancing valves and differential pressure regulators. To supply the new ceiling radiant panels with heat, the pipe routing in the sports hall is adapted to suit requirements. Accordingly, heating water supply and return lines must be installed. The installation plan for the new ceiling radiant panels is shown below. Also this document is additionally attached, since it is not well representable in this format.



Room Heating Surfaces

The determination of the necessary room temperatures and the heating load calculation is done according to DIN EN 12831.

Except for the sports hall itself, panel radiators and tubular steel radiators have been installed in the building as room heating surfaces.

The sports hall is currently equipped with a ceiling radiant panel system, which in some cases shows considerable damage caused by everyday mechanical stress (ball throw). For this reason, these ceiling mounted radiant panels are to be replaced by a new, ball-proof model, which also features improved room acoustics and shorter reverberation times.

Five radiant panel bands (4 x 20 m each, 1 x 15 m long) with a width of 1.20 m each will be installed on the ceiling to transfer the required radiant heat to the hall.

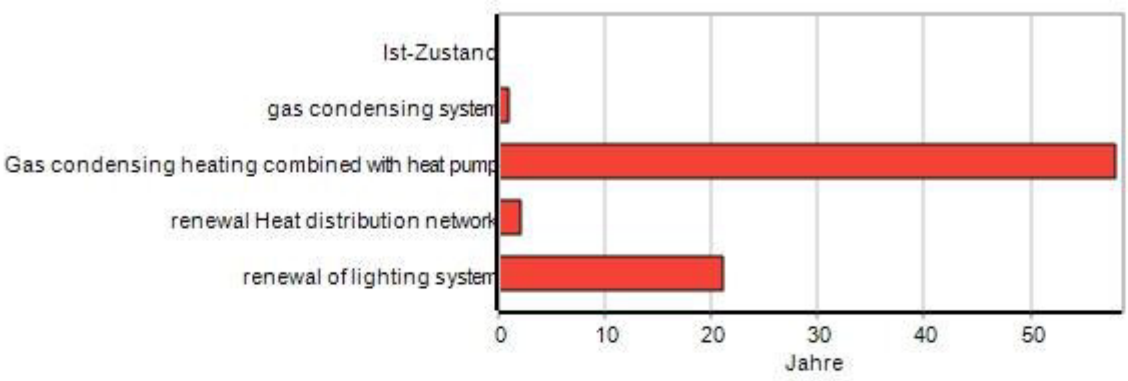
In the following, the variants will be compared with each other from an energetic, ecological and economic point of view.

energetic		Energy requirement[1)]		Energy saving[2)]		Energy saving[23)]
		[kWh/a]	[kWh/m²a]	[kWh/a]	[%/a]	[kWh/30a]
0	actual state	211.151	548,4	./.	./.	./.
1	gas condensing system	188.869	490,6	22.282	10,6	668.459
2	Gas condensing heating combined with heat pump	86.883	225,7	124.268	58,9	3.728.033
3	renewal Heat distribution network	204.249	530,5	6.902	3,3	207.049
4	renewal of lighting system	211.257	548,7	-106	-0,1	-3.179
economical		Investment[4)]	Energy costs	Energy saving	Amortisation[5)]	Net present value[6)]
		[€]	[€/a]	[€/a]	[Jahre]	[€]
0	actual state	./.	15.525	./.	./.	./.
1	gas condensing system	764	14.089	1.436	1	26.163
2	Gas condensing heating combined with heat pump	49.424	14.537	988	58	-35.645
3	renewal Heat distribution network	674	14.996	529	2	8.490
4	renewal of lighting system	30.194	13.970	1.555	21	-15.706
environment (emissions)		SO_2	NO_X	Staub	CO_2	CO_2-savings.
		[g/a]	[g/a]	[g/a]	[kg/a]	[%]
0	actual state	6.470	36.809	1.456	46.148	./.
1	gas condensing system	6.248	33.243	1.345	41.647	9,8
2	Gas condensing heating combined with heat pump	29.033	33.444	3.021	40.139	13,0
3	renewal Heat distribution network	6.210	35.571	1.404	44.600	3,4
4	renewal of lighting system	2.921	34.362	1.131	43.322	6,1

energetic		Energy requirement[1)]		Energy saving[2)]		Energy saving[23)]
Building envelope (U-value)[7)]		Total	Roof	Wall	Cellar	Window
		[W/m²K]	[W/m²K]	[W/m²K]	[W/m²K]	[W/m²K]
0	actual state	0,94	0,21	1,40	0,93	1,95
1	gas condensing system	0,94	0,21	1,40	0,93	1,95
2	Gas condensing heating combined with heat pump	0,94	0,21	1,40	0,93	1,95
3	renewal Heat distribution network	0,94	0,21	1,40	0,93	1,95
4	renewal of lighting system	0,94	0,21	1,40	0,93	1,95

1) Energy requirement per year or per m² of heated area: This is the energy that must be purchased.
2) Energy savings per year
3) Energy savings over a period of 30 years
4) Investment: This is the energetically motivated investment (net investment), subsidies/KfW interest advantages and repair costs have already been deducted.
5) Amortization: Time in which the net investment has flowed back again. A refurbishment package has amortized if the time is less than the useful life of the refurbished/renewed components.
6) Net present value: Investments and savings are discounted over 30 years with the calculation interest back to the starting date. The greater the capital value, the more profitable the renovation package.
7) U-value: Quality of the building envelope, the lower the value, the less energy is lost via the components.

In the following figure, the amortisation times of the variants are graphically displayed once again. During the amortisation period, maintenance costs of 80% were assumed for the renewal of the heating system with a gas condensing boiler and the renewal of the heat distribution network.



4. Financial analysis

As a source of the investment financing for the described project, there are different contracting models possible. If a municipality aims to realize a planned energy project by using a suitable contracting model it means that a range of tasks and responsibilities will be given away to the contracting partner which would be more familiar with the requested competences. Apart from a contracting model the municipality can finance the planned project through municipal loans or through subsidies from different support programs. Additional information about different local subsidies are already introduced in the RURES Template DT 3.1.1 "Analysis of framework conditions and the general aspects of added Value through RES". Since this information is already provided, this chapter will focus on the different contracting models. Municipal loans require self-directed solutions to build, finance and maintain the project. Compared to the high degree of personal responsibility by financing through municipal loans a contracting model often can be a more profitable and a simpler solution. Additional loans put a strain on the often-burdened asset budget while contracting rates can be handled as lucrative depts. By using a contracting model, a public authority can modernize and optimize their energy plants or implement energy-saving measures without the need to hire trained professionals. The local authority can continue to perform their usual duties while their local facilities get modernized and optimized in an efficient professional way. The responsibility of the public authority to secure the basic supply will be given through that, without major additional expenses for the municipality.

All in all, there is a big variety of possible contracting models, but depending on the systematic approach and the target of the contracting there are two basic types:

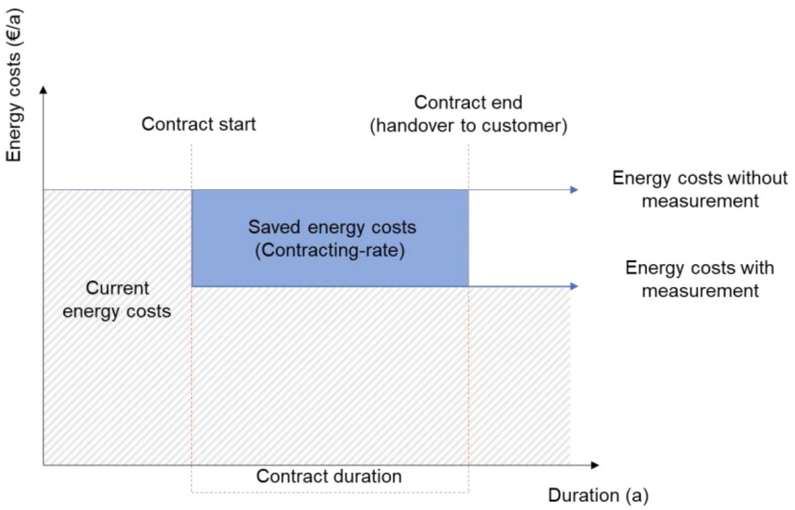
- *The contracting of plants: The contractor is taking care of the planning, financing, implementation, operation and maintenance for the planned energy supply plant. The refinancing for the contractor is secured through fixed usage fees for the demand-oriented energy supply.*
- *The performance contracting: It integrates all kind of energy-saving measures for a specific object. The contractor takes care of the financing, the planning, the implementation and the maintenance for the planned energy supply plant or energy-saving measure. The refinancing for the contractor is regulated through the achieved energy cost savings.*

Apart from these two basic types there are additional possibilities such as an operator contracting, a financing contracting or a facility-management contracting. To find out which contracting model is *suitable for the planned project a detailed examination is needed and must be carried out. The detailed examination must look on the whole project workflow to find out the best solution.*

Since the municipality hands the contractor a wide range of responsibilities over also a wide range of expenses get relocated to the contractor but with benefits for both sides, as shown below:

	Municipality	*Contractor*
Expenses	- *Transaction costs*	- *Transaction costs* - *Capital-linked costs* - *Consumption-based costs* - *Operational costs*
Use	- *relief from administrative expenses* - *discharge of the asset budget*	- *remuneration* - *earned profit* - *customer loyalty*

The financial risk is mostly relocated to the contractor and gets financed by the municipality by paying fixed usage fees or achieving energy cost savings. After the contracting project is completed successfully the energy saving or the energy plant passes into the ownership of the municipality. The average contracting project last between 7 to 20 years, depending to the contract model and the project. The graphic below shows schematically the process and the distribution of costs and profits for a contracting model (Performance contracting).



The basic requirement to decide for a contracting model instead of a self-directed municipal loan is a preceding capital value analysis with a positive outcome for it. All in all, a municipality can choose between a contracting model, municipality loans or corresponding subsidies.

5. Summary and recommendations

Concerning to the condition of the sport gym the energetic modernization is necessary. Through the modernization and the exchange of the heating system the climate in the building will be improved distinctively. Due to the age and condition of the heating system and the radiant ceiling panels, the planned maintenance measures are urgently recommended despite the high costs. The installation of a heat pump is currently not economically feasible.

The advantages from these measures will be noticeable on many levels. Especially the local people will benefit from a well-functioning sporty gym to hold up events but also the environment will be unloaded on long-term through the attenuated energy demand. Even on the national level the attenuated greenhouse gas emissions will be an advantage, even if it is only a relatively small measure at the national level. Since the municipalities are self-responsible to improve the local energy infrastructure it is always a win if another module is set and established. Sometimes it can be complicated for a municipality to get involved in such technical and economical questions and it will be a challenge to plan and execute projects like that. But also, on the technical side as well as on the economical side a municipality can set up an environment to succeed in this challenge. National subsidies or contracting models make it possible to involve in such topics and to modernize the local and in total the national energy infrastructure and standard.

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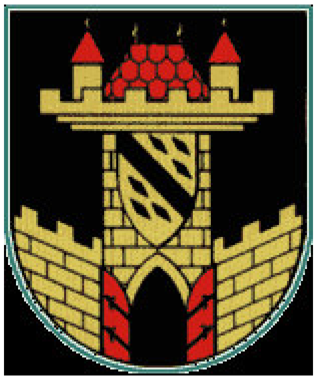
1. Summary in English

The following project is about a nursery school called "Sonnenschein" in a small city in Saxony called Leisnig. The nursery school is in a building which was built in 1900 but got completely renovated in 1996. Since that the envelope of the building is in a comparatively good condition but the heat supply is still not state of the art and should be renewed. Through that the aim of the project is to reduce the heat consumption and to improve the energy efficiency of the building and the comfort in the building.

2. Information on the project

The object concerned is a nursery school located close to the main station from Leisnig. The nursery school is part of a building which was built in 1900. The aim of the project is to improve the energetic condition of the building, to increase the energy efficiency and to make the energy supply more environmentally friendly through technical upgrading.

Leisnig itself is a small town located in a rural area. The closer environment consists of small towns similar to Leisnig, f.e. Colditz or Hartha. The whole region is located directly between the three biggest cities in Saxony Dresden, Leipzig, Chemnitz.

Profile Leisnig		
Federal State	*Saxony*	
Rural district	*middle Saxony*	
Inhabitants	*8.407 (according to 01.01.2016)*	
Population density	*106 Inhabitants/km²*	
Local Parts	*in total 40 localities*	
Economy	- *metalworking and ceramic industry* - *fruit growing, handicraft* - *trade and day tourism*	
Local supply	*railway station, library, post office, banks, hospital, schools, nurseries, gastronomy, hotels*	
Transport connection	- *highway A14, railway Station, national Roads (B107, B169, B175)* - *in between the city triangle from Leipzig-Dresden-Chemnitz*	

As many other cities in a rural area Leisnig suffers from the consequences of the urbanisation. More and more people prefer to live in well-developed big cities such as Leipzig or Dresden. Nevertheless, Leisnig has a variety of active sport and cultural associations as well as there are three schools and in total 7 nursery schools. Beside some small single shops in the city center there are in total 3 commercial areas. As a local impact the nursery school provides the local people an important *pedagogical institution and supports the social infrastructure of the city and the region. To support local integration and social cohesion, a region needs places and rooms where people can meet and get to know each other. Next to public facilities educational facilities are an important factor to succeed with a good coexisting and the integration of everybody. Besides the positive impacts on the society, day nurseries create jobs in the region and require new people to work in.*

In the year 2012 an integrated municipal energy and climate protection concept was published for the city of Leisnig. The concept took a look on the energetic infrastructure of Leisnig and focused on the valuation of the energy efficiency and the climate protection of the region. Part of the concept is to identify local used energy sources, to validate the technical equipment of the existing buildings and to evaluate specific local potentials and through that to recommend appropriate measures. The nursery school "Sonnenschein" was already a topic in the energy and climate protection concept. Since the energetic condition of the nursery school is improvable, corresponding measures to improve the situation would totally fulfil the recommendations for action of the energy and climate protection concept. Within the framework of the concept the condition of the nursery school already got analysed. The building in which the day nursery "Sonnenschein" is located, is generally in a good condition. In the years 1995 and in 1996 it was completely renovated. Measures of the renovation process were to insert windows which got insulating glazing and comprehensive upgrades to the building envelope. Insulation to the exterior/interior walls, cellar ceilings or in the attic was not applied. All in all, the buildings basic substance is in a good condition but there is a high potential to improve it's energy efficiency and through that reduce the energy demand. The Savings potentials can be raised especially by innovations in the field of technical building equipment, by influencing usage behaviour and by gradually replacing conventional light sources. In buildings used for public purposes, general influence should be exerted on usage behaviour.

Beside that the planned measures fulfil totally the planned measures from the former developed energy and climate protection concept, the energetic improvement of the nursery school pursues also the aim of the federal republic of Germany to improve energy efficiency, to increase the use of renewable energy sources and to attenuate the use of energy. The municipalities are in the responsibility to act as the operator in such situations and to take care and support such local improvement. The organisation of the planned project is herewith the responsibility of the municipality. In order to receive support for the planned actions the municipality can obtain subsidies from the federal republic or the federal state. All in all, there is a big variety of possible subsidies but in some matters, it can be more profitable to use a contracting model to plan, finance and execute such projects (→ 4. Financial Analysis). In Terms of environmental fees there will be no difficulties by the energetic renovation of a building.

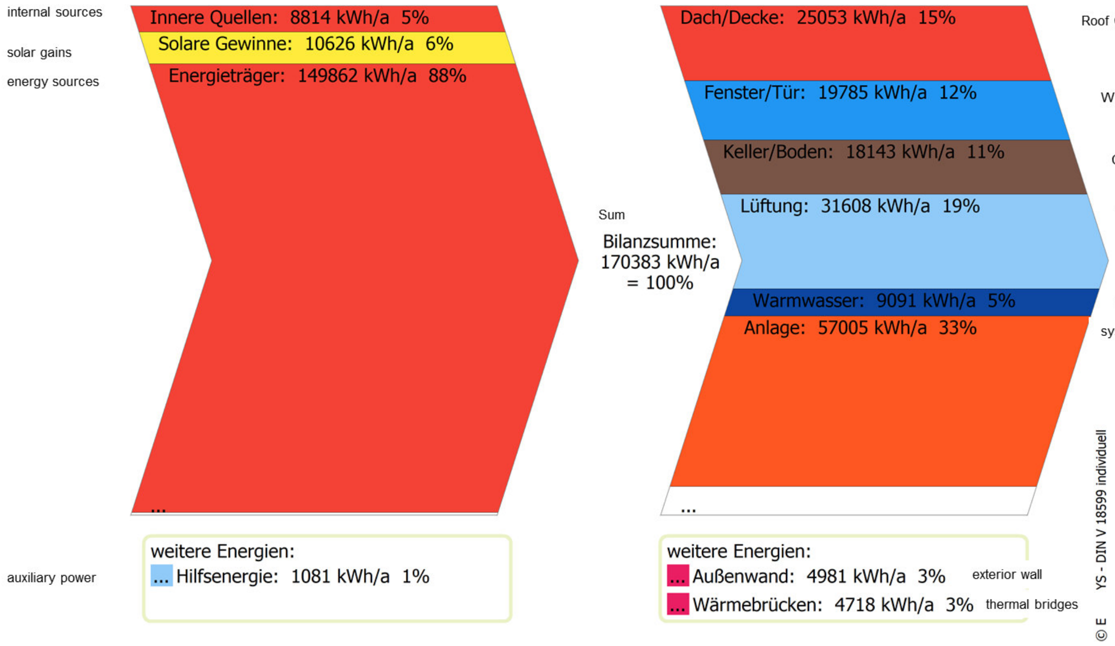
3. Technical and technological analysis

Since the condition of the building isn't the state of the art, in this chapter a more detailed description will be provided. While the whole building is used for the purposes of the nursery school the cellar of the building is used as the caretaker's room and to store technical building equipment. Except for the caretaker's room, the cellar remains completely unheated. The heating and warmth water preparation is carried out via a gas low-temperature boiler of the type Ideal Standard, year of construction 1992 (47 kW nominal heat output). A multi-stage circulating pump circulates the heating water. The hot water storage tank is equipped with 200 litres of storage volume and dates from 1992.
Next to the nursery there is a second building, which is used as an equipment and gym room for the nursery. This building also does not have any insulation and the heating is carried out by current-operated wall convectors. The following profile gathers some energetic data to the building:

Profile: Nursery School "Sonnenschein", Leisnig			
BGF	*385*	*[m^2]*	
Heat consumption	*77*	*[MWh/a]*	
Spec. coefficient heating	*200*	*[kWh/m^2*a]*	
Target value:	*73*	*[kWh/m^2*a]*	
limit value:	*123*	*[kWh/m^2*a]*	
Electric energy consumption	*10*	*[MWh/a]*	
Spec. coefficient electric energy	*26*	*[kWh/m^2*a]*	
Target value:	*10*	*[kWh/m^2*a]*	
limit value:	*18*	*[kWh/m^2*a]*	

The following data was used as a basis for the analysis of the variants

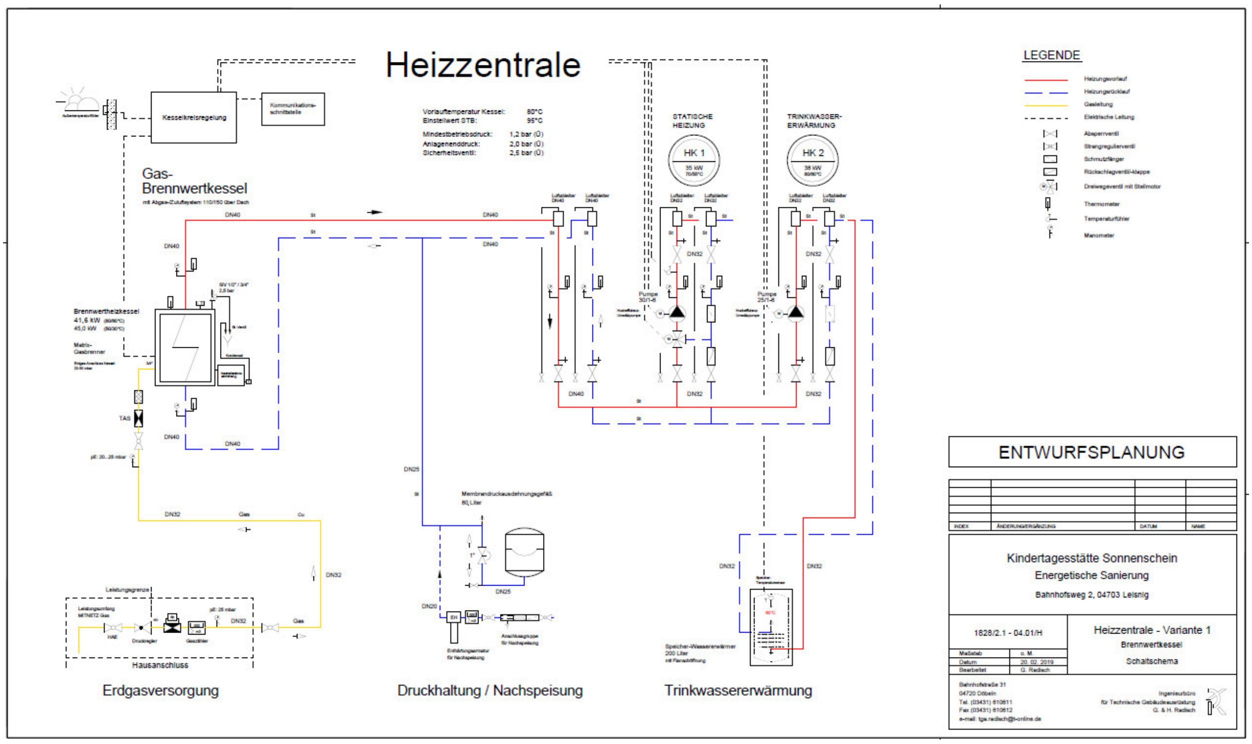
basic data		
Main use:	*Nursery School*	
Building category:	non-residential building	
Year of construction:	1900	
Type of building:	freestanding	
Building location:	inner-city	
Exposure/construction:	compact	
Type of construction:	medium	
Equipment:	medium	
Air tightness:	unaudited	
Average storey height:	3,29	m
usable building area:	385	m²
Building volume Ve:	1.442	m³
Heat-transferring enclosure area A:	545	m
A/V ratio:	0,38	m^{-1}
Window areas:	83	m²
Full storeys:	2	
characteristic width:	8,54	m
characteristic length:	8,54	m
Number of residents/users:	117	
Average room temperature approx.	21,0	°C



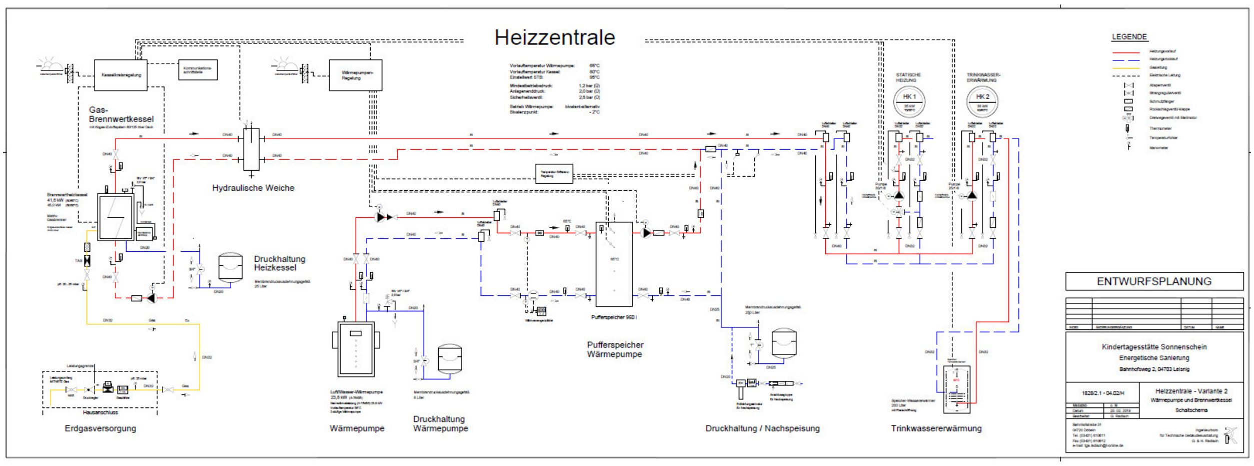
In the energy balance it can be seen that the greatest losses and thus also the greatest savings potentials are to be found in the plant technology. To improve the data shown above the following measures will be set and established:

The Savings potentials can be raised especially by innovations in the field of technical building equipment, by influencing usage behaviour and by gradually replacing conventional light sources. In buildings used for public purposes, general influence should be exerted on usage behaviour. In addition, conventional light sources (mainly T8 fluorescent tubes) should gradually be replaced by energy-efficient T5 fluorescent tubes or energy-saving lamp successes. At the same time, the renewal of technical building equipment should be promoted. The following two variants are being investigated for the replacement of the 27-year-old heating system.

Variant 1: Replacing the old heating system with an efficient gas condensing boiler. How this variant could work and look like is has been already prepared. The following circuit diagram shows the structure of the planned heating system. It consists of two heating circuits, one for the static heating surfaces and one for water heating. The circuit diagram is additionally attached to this document, since it is not well representable in this format.



Variant 2: Replacing the old heating system with a combination of heat pump and efficient gas condensing boiler bivalent operation. In this variant the two heating circuits get supplied by a combination of power-to-heat technology and the gas condensing boiler. Depending on the load curve of the actual demand the two technologies have to balance each other out and are switched on depending on the situation. The following circuit diagram shows the planned heating center and is additionally attached to this document, since it is not well representable in this format.



The existing circulating pump (heating and hot water circuit) could be replaced by a modern high-efficiency pump with a considerably lower energy consumption.

In the following, the variants will be compared with each other from an energetic, ecological and economic point of view.

energetic		Energy requirement[1]		Energy saving[2]		Energy saving[23]
		[kWh/a]	[kWh/m²a]	[kWh/a]	[%/a]	[kWh/30a]
0	actual state	136.588	390,3	./.	./.	./.
1	gas condensing system	100.253	286,4	36.335	26,6	1.090.054
2	Gas condensing heating combined with heat pump	51.612	147,5	84.977	62,2	2.549.302
3	Modernization Lighting LED Retrofit	136.567	390,2	22	0,0	654
economical		Investment[4]	Energy costs	Energy saving	Amortisation[5]	Net present value[6]
		[€]	[€/a]	[€/a]	[Jahre]	[€]
0	actual state	./.	10.115	./.	./.	./.
1	gas condensing system	25.415	7.742	2.373	12	19.698
2	Gas condensing heating combined with heat pump	70.005	9.474	641	126	-60.462
3	Modernization Lighting LED Retrofit	1.200	9.357	658	2	5.746
environment (emissions)		SO_2	NO_X	Staub	CO_2	CO_2-savings.
		[g/a]	[g/a]	[g/a]	[kg/a]	[%]
0	actual state	4.349	23.924	957	29.984	./.
1	gas condensing system	3.916	18.062	769	22.588	24,7
2	Gas condensing heating combined with heat pump	14.491	17.955	1.541	21.634	27,8
3	Modernization Lighting LED Retrofit	2.629	22.727	799	28.600	4,6
Building envelope (U-value)[7]		Total	Roof	Wall	Cellar	Window
		[W/m²K]	[W/m²K]	[W/m²K]	[W/m²K]	[W/m²K]

energetic		Energy requirement[1]		Energy saving[2]		Energy saving[23]
0	actual state	1,32	1,06	1,40	1,20	2,28
1	gas condensing system	1,32	1,06	1,40	1,20	2,28
2	Gas condensing heating combined with heat pump	1,32	1,06	1,40	1,20	2,28
3	Modernization Lighting LED Retrofit	1,32	1,06	1,40	1,20	2,28

1) Energy requirement per year or per m^2 of heated area: This is the energy that must be purchased.

2) Energy savings per year

3) Energy savings over a period of 30 years

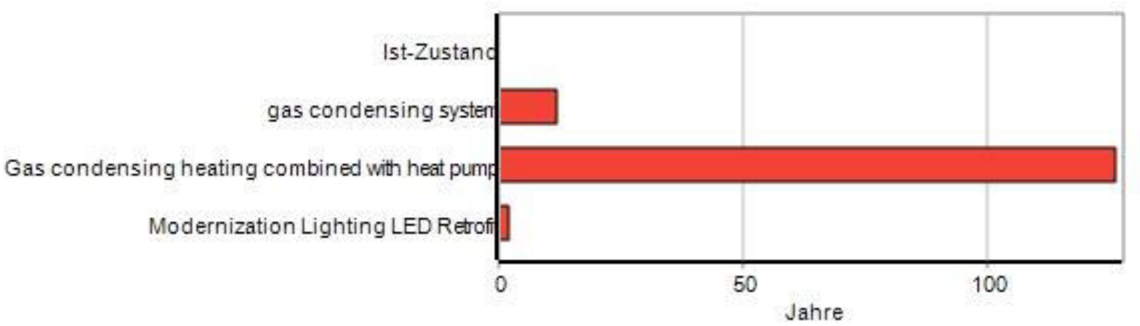
4) Investment: This is the energetically motivated investment (net investment), subsidies/KfW interest advantages and repair costs have already been deducted.

5) Amortization: Time in which the net investment has flowed back again. A refurbishment package has amortized if the time is less than the useful life of the refurbished/renewed components.

6) Net present value: Investments and savings are discounted over 30 years with the calculation interest back to the starting date. The greater the capital value, the more profitable the renovation package.

7) U-value: Quality of the building envelope, the lower the value, the less energy is lost via the components.

In the following figure, the amortisation times of the variants are graphically displayed once again.



4. Financial analysis

As a source of the investment financing for the described project, there are different contracting models possible. If a municipality aims to realize a planned energy project by using a suitable contracting model it means that a range of tasks and responsibilities will be given away to the contracting partner which would be more familiar with the requested competences. Apart from a contracting model the municipality can finance the planned project through municipal loans or through subsidies from different support programs. Additional information about different local subsidies are already introduced in the RURES Template DT 3.1.1 "Analysis of framework conditions and the general aspects of added Value through RES". Since this information is already provided, this chapter will focus on the different contracting models. Municipal loans or subsidies require a much more self-directed planning and preparation than a contracting model. Compared to the high degree of personal responsibility by financing through municipal loans a contracting model often can be a more profitable and a simpler solution. Additional loans put a strain on the often-burdened asset budget while contracting rates can be handled as lucrative depts. By using a contracting model, a public authority can modernize and optimize their energy plants or implement energy-saving measures without the need to hire trained professionals. The local authority can continue to perform their usual duties while their local facilities get modernized and optimized in an efficient professional way. The responsibility of the public authority to secure the basic supply will be given through that, without major additional expenses for the municipality.

All in all, there is a big variety of possible contracting models, but depending on the systematic approach and the target of the contracting there are two basic types:

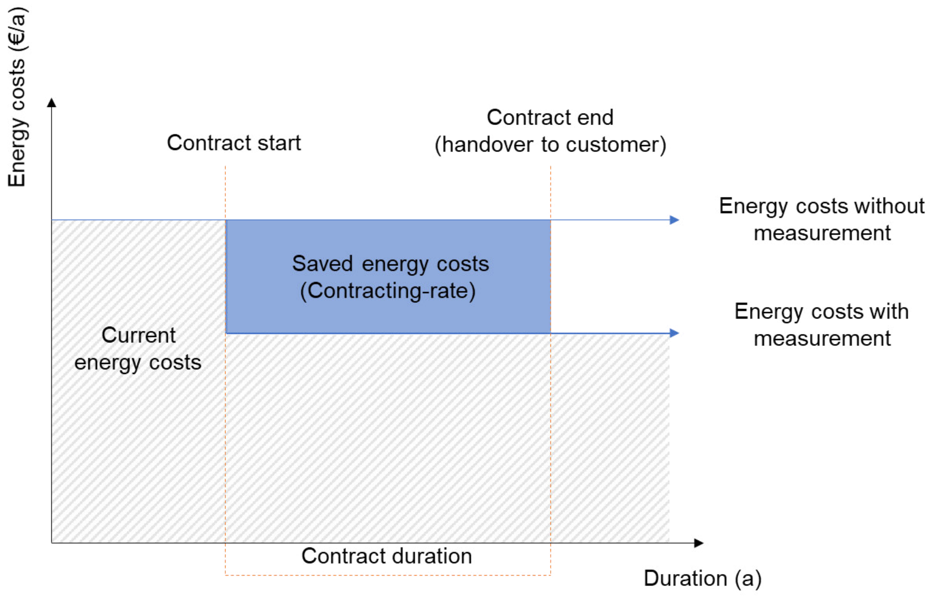
- *The contracting of plants: The contractor is taking care of the planning, financing, implementation, operation and maintenance for the planned energy supply plant. The refinancing for the contractor is secured through fixed usage fees for the demand-oriented energy supply.*
- *The performance contracting: It integrates all kind of energy-saving measures for a specific object. The contractor takes care of the financing, the planning, the implementation and the maintenance for the planned energy supply plant or energy-saving measure. The refinancing for the contractor is regulated through the achieved energy cost savings.*

Apart from these two basic types there are additional possibilities such as an operator contracting, a financing contracting or a facility-management contracting. To find out which contracting model is suitable for the planned project a detailed examination is needed and must be carried out. The detailed examination must look on the whole project workflow to find out the best solution.

Since the municipality hands the contractor a wide range of responsibilities over also a wide range of expenses get relocated to the contractor but with benefits for both sides, as shown below:

	Municipality	*Contractor*
Expenses	- *Transaction costs*	- *Transaction costs* - *Capital-linked costs* - *Consumption-based costs* - *Operational costs*
Use	- *relief from administrative expenses* - *discharge of the asset budget*	- *remuneration* - *earned profit* - *customer loyalty*

The financial risk is mostly relocated to the contractor and gets financed by the municipality by paying fixed usage fees or achieving energy cost savings. After the contracting project is completed successfully the energy saving or the energy plant passes into the ownership of the municipality. The average contracting project last between 7 to 20 years, depending to the contract model and the project. The graphic below shows schematically the process and the distribution of costs and profits for a contracting model (Performance contracting).



The basic requirement to decide for a contracting model instead of a self-directed municipal loan is a preceding capital value analysis with a positive outcome for it. All in all a municipality can choose between a contracting model, municipality loans or corresponding subsidies.

5. Summary and recommendations

Concerning to the condition of the nursery school the energetic modernization is necessary. Through the modernization and the exchange of the heating system the climate in the building will be improved distinctively.

A comparison of the measures clearly shows that the variant with a heat pump is currently not economically feasible. In contrast, replacing the existing boiler with a new gas condensing boiler is economical. Above all the exchange of the lightning makes a saving possible of 50% in the lighting range and amortizes already after 2 years. The advantages from these measures will be noticeable on many levels. Especially the local people will benefit from a well-functioning sporty gym to hold up events but also the environment will be unloaded on long-term through the attenuated energy demand. Even on the national level the attenuated greenhouse gas emissions will be an advantage, even if it is only a relatively small measure at the national level. Since the municipalities are self-responsible to improve the local energy infrastructure it is always a win if another module is set and established. Sometimes it can be complicated for a municipality to get involved in such technical and economical questions and it will be a challenge to plan and execute projects like that. But also, on the technical side as well as on the economical side a municipality can set up an environment to succeed in this challenge. National subsidies or contracting models make it possible to involve in such topics and to modernize the local and in total the national energy infrastructure and standard.