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Regional Networks for the development of a Sustainable Market for Bioenergy in Europe



Case study: Reconstruction of the House for children and youth in Brumov-Bylnice, Czech Republic



Acknowledgements

This report has been produced as part of the project BioRegions. The logos of the partners cooperating in this project are shown below and more information about them and the project is available on www.bioregions.eu



The work for this report has been performed by Energy agency of the Zlin region.

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Title of the project

Reconstruction of the House for children and youth in Brumov-Bylnice

Objectives of the project

- Reduction of greenhouse gas emissions
- Improvement of energy efficiency
- Decrease the dependence on fossil fuels
- Decrease operational costs of the House for children and youth in Brumov-Bylnice

The project aims to cut-down energy demand for heating and, consequently, operational cost of beneficial organisation House for children and youth (HCY) in Brumov-Bylnice by improving thermal characteristics of over 60 years old building. In addition to increasing of energy efficiency and replacement of old black coal boiler by biomass boiler will reduce emissions in local environment.

Project Timeline

Preparation of the project including application submission was done in august 2011. Implementation of the project is planned in 2013.

Description of local conditions

Project Operator:

House for children and youth in Brumov-Bylnice is an allowance organization of Brumov-Bylnice municipality. Mission of the organisation is to provide leisure-time activities for children and youth in Brumov-Bylnice and its vicinity. About 60-100 children and youth are daily involved in activities provided by HCY. Growing heating costs burden limited budget of the organisation.

Site selection:

The town of Brumov-Bylnice (5 828 inhabitants) is a centre of the Czech target region of the BioRegions project, which aims to get at least 1/3 of heating and electricity needs from local biomass sources. A district heating system (DHS), utilising local biomass (wood chips) as a main fuel, covers central part of the town. HCY is located in the Bylnice borough without DHS or natural gas connection hence the heating source of this building is an original boiler room for black coal.

Technology analysis

Two-storey building of HCY, over 60 years old, does not meet current requirements for thermal characteristic of building envelope. Walls are constructed of traditional extruded bricks (th. 450, 375 and 300 mm) without heat insulation. Wooden ceilings have insufficient heat insulation. Twin wooden windows are on the limit of their life time.

Old black coal boiler with installed heat output of 120 kW is characterized by low fuel efficiency and high emission rate. Hot water is prepared by two electric boilers. Total annual energy consumption for heating and hot water preparation is 379.4 MWh.

Fuel Supply:

1. Black coal

Average annual fuel costs (without staff and ash handling costs) were around 12 560 EUR in last 3 years. A rise in price of black coal for small customers could be assumed considering uncertainty on Czech coal market for small customers and planned carbon tax implementation for this fossil fuel. Moreover, fossil fuel import causes efflux of capital from rural border region.

2. Biomass

There are two significant sawmills providing biomass for energy purposes in the region and, furthermore, a local biomass market facilitating contracting with smaller local biomass producer is going to start in the frame of the BioRegions project.

Implementation of the project

Growing operational costs and occurring technical complications with obsolete coal boiler persuaded Brumov-Bylnice municipality to ask the Energy agency of the Zlin region (EAKZ) for advice about HCY reconstruction. Energy agency analysed present situation and suggested two variants of solutions for that issue:

1) Complex refurbishment of HCY building

- + cut-down energy demand factor of HCY operation
- the costs of implementation meeting current legislative recommendation

2) Replacement of old coal boiler by new automatic wood pellet boiler

- + increasing of energy efficiency and cut-down of air pollutant emissions
- cost-intensive solution requiring reconstruction of space heating system

A combined variant including complex refurbishment of HCY building and, at the same time, replacement of the heating source was finally chosen. A technical drawing of the chosen option is in Appendix 1. Energy agency coordinated following project stages from current state data collection and elaboration of project technical documentation up to subsidy raise.

System design:

Energy consumption data of HCY along with current lay-out of the building served as source materials for elaboration of an energy audit. The audit has surveyed current state and operation of HCY, suggests and evaluates (investment costs, energy saving end emission reduction) several measures including installation of solar system for hot water preparation, complex refurbishment of the building and heat source replacement. Installation of solar system for hot water preparation is not approved owing to high investment cost and low potential of savings considering operation of the HCY. Calculations has proved that heat output necessary for space heating of HCY would decrease after complex refurbishment (from originally 120 kW to 49 kW) which significantly affects selection of new boiler and reduces investment costs. Measures proposed in the energy audit were afterwards included in project technical documentation:

- Heat insulation of external walls with polystyrene thickness 140 or 160 mm (depending on wall th.)

- Heat insulation of the roof with at least 220 mm of mineral insulation.
- Replacement of old doors and windows by new ones meeting recommended values from the regulation ČSN EN 730540-2: $U_w = 1.2 \text{ W/m}^2\text{K}$
- New biomass boiler with installed output of 49 kW (new annual heat consumption of 165.97 MWh)

Technology providers:

A pellet boiler supplier and a construction company for complex refurbishment of the HCY building will be selected in a public commission.

Financing of the project:

Investment costs of the project were initially estimated about 240.000 EUR. House for children and youth in Brumov-Bylnice is an allowance organization of Brumov-Bylnice municipality and the project investment costs will be covered by municipality budget. However, the municipality rejected to finance the project in terms of a bank loan. Therefore, two options to cover investment costs based on a full reimbursement by municipality budget and a financial support (grant) were considered. Financial evaluation of those options (with/without subsidy) is given in Appendix 1 of this document. First option (without subsidy) is too capital intensive for municipal budget. Consequently, EAZK evaluated available grants options considering financial capacity of the HCY founder (Brumov-Bylnice municipality):

- Operational Programme for Cross-border Cooperation Slovakia-Czech Republic 2007-2013
In the frame of this Operational Programme, a project called “Development of energy use of biomass and sun in border region” was focused on reconstruction of the DHS boiler plant in Brumov-Bylnice in 2009. This Operational Programme is attractive due to higher percentage support for cross-border environmental projects in social handicapped border region. It was not possible to get support from this Operational Programme regarding requirements of planned calls for proposals of this Operational Programme.
- Operational Programme Environment (OPE)
The Operational Programme's main goal is to protect and improve environmental quality as a base for sustainable development. Between 2007 and 2013, this programme will offer almost 5 billion EUR from the Cohesion Fund and the European Regional Development Fund for projects falling into one of seven supported areas (priority axes). The aim of the HCY reconstruction project response priority axes 2 and 3.
 - Priority axe 2: The Improvement of Air Quality and Reduction of Emissions
In the frame of **subarea of interest 2.1.1. - Decrease of contribution to pollution load by cut-down of emissions from energy systems without DHS connection**, it is possible to raise subsidy for installation of new low-emission boiler up to 5 MW meets requirements of BAT (biomass, coal or natural gas boilers) eventually improving of building thermal characteristics. The project of HCY reconstruction did not meet one criterion of this subarea - replacement maximally 50 % of installed heat output by a renewable energy source (RES).
 - Priority axe 3: The Sustainable Use of Energy Sources
This project matches with its parameters two subareas of interest: **subarea of interest 3.1.1. - Building-up and reconstruction of heat sources utilising**

RES and subarea of interest 3.2.1. - Realisation of energy savings. Subarea 3.1.1. is usable for installation/reconstruction of the heating source and subarea 3.2.1. is applicable for energy savings projects focused on refurbishment (heat insulation) of external walls/roofs and doors/windows replacement by new ones meeting recommended parameters. Call for proposals combining both described subareas of interest was announced during project preparation therefore the project was adapted to technical parameters of those subareas and application for support from OPE was submitted under name „Opatření ke snížení energetické náročnosti objektu DDM v Brumově-Bylnici“ in august 2011. Technical requirements differ slightly in each Call for proposals but the main idea of the programme is to reduce energy consumption and CO₂ emissions. Reduction of energy consumption and emissions are the main parameters and other parameters are based on their declared amount. For instance, acceptable investment costs (base for calculation of grant amount) are divided by saved CO₂ emissions and the outcome is an important factor for comparing proposed project. Therefore, an active collaboration between applicant (EAZK resp. Project operator), auditor and project engineer was necessary to set optimal balance between energy/emission saving, investment costs and legislative requirements. Furthermore, achievable emission reduction target had to be set because it is controlled by OPE after project realisation. The application was successful and the project will be implemented with support from OPE.

Financial evaluation of the project

The following table presents the costs, benefits and main assumptions used as input to the financial model built within the BioRegions project in order to evaluate the financial viability of this case study. Firstly, the capital and annual operation and maintenance costs after the project implementation are presented, whereas the incomes consist by avoided costs for energy as a comparison between before and after the implementation of the project. If a discount rate of 7% is assumed, the project's Net Present Value (NPV) can only get positive after the 65% provided by the OPE programme.

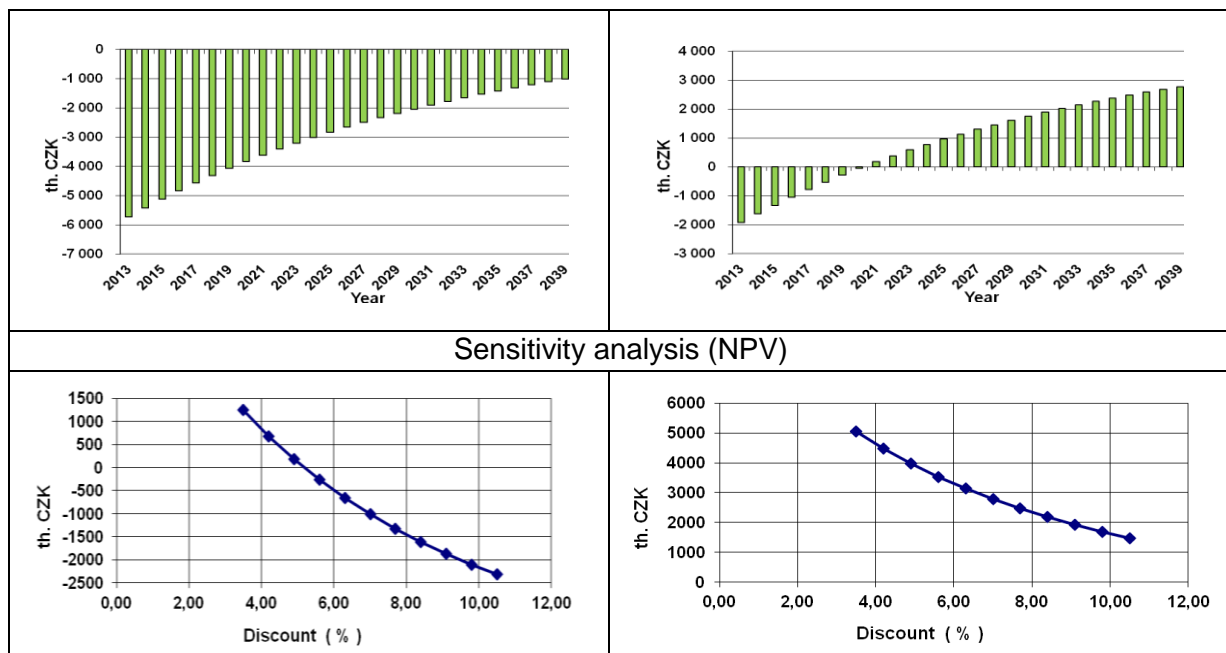
		Without subsidy		With subsidy			
Currency		CZK	EUR	CZK	EUR	25 CZK/EUR	
Capital costs	Investment costs	5 840.00	233.60	5 840.00	233.60	thousand (currency)	
	Assumed subsidy	Amount	0.00	0.00	3 796.00	151.84	thousand (currency)
		Ratio	0.00		65.00		%
	Loan*	Amount	-	-	-	-	thousand (currency)
		Interest	-		-		%
		Payback time	-		-		years
	Own funds	5 840.00	233.60	2 044.00	81.76	thousand (currency)	
Operation &	Annual personnel costs	94.00	3.76	94.00	3.76	thousand (currency)	
	Annual maintenance costs	10.00	0.40	10.00	0.40	thousand (currency)	
	Other annual costs	4.00	0.16	4.00	0.16	thousand (currency)	
	Emission charges**	0.00	0.00	0.00	0.00	thousand (currency)	

	Wood pellets	Price	0.82	0.033	0.82	0.033	currency/kWh
		Annual costs	126.03	5.04	126.03	5.04	thousand (currency)
	Black coal***	Price	-	-	-	-	currency/kWh
		Annual costs	-	-	-	-	thousand (currency)
	Other fuel	Price	-	-	-	-	currency/kWh
		Annual costs	-	-	-	-	thousand (currency)
Incomes	Annual heat sale		0.00	0.00	0.00	0.00	thousand (currency)
	Annual electricity sale		0.00	0.00	0.00	0.00	thousand (currency)
	Other (annual) income		0.00	0.00	0.00	0.00	thousand (currency)
	Annual energy cost savings		182.00	7.28	182.00	7.28	thousand (currency)
Evaluation criteria	Net present value	NPV	- 1 013.06	-40.52	2 782.94	111.32	thousand (currency)
	Internal rate of return	IRR	5.18		18.81		%
	Simple Payback Period	SPB	16		6		years
	Discounted Payback Period	DPB	-		8		years
	Year of implementation		2013				-
	Lifetime (evaluation)		27				years
	Discount		7.00				%
	Potential energy savings		213 583.00				kWh/y
	Potential CO ₂ savings		121.03				t/y
<p>* Brumov-Bylnice municipality rejected bank loan and the project is covered by municipality budget</p> <p>** Emission charges are implemented for middle and large air-pollution sources in the Czech Republic, but the installed boiler falls (after its heat output) into "household" category without emission charges. Ecological tax is included in the fuel prices, but implementation of a new "carbon tax" for small coal consumers is unclear (introduction planned on January 1st 2013 was postponed), therefore, carbon tax is not included.</p> <p>*** Black coal (314.36 thousand CZK/y ≈ 12.57 thousand EUR) will be fully replaced by wood pellets. Annual Personnel+Maintenance+Other costs were 333.78 thousand CZK (13.35 thousand EUR) <u>before project implementation</u>.</p>							

Financial evaluation of the project (CZK)

The cumulative discounted cash flow is shown in the first two graph of following table where it is clearly depicted that the project's benefits exceed costs only in the case of the OPE subsidy and only after the 6th year of implementation. In the last two graphs a sensitivity analysis is conducted in order to decrease uncertainty and check the robustness of the results against the factor that can have the highest impact which is the assumed discount rate.

Without subsidy	With subsidy
Cumulative discounted cash flow	



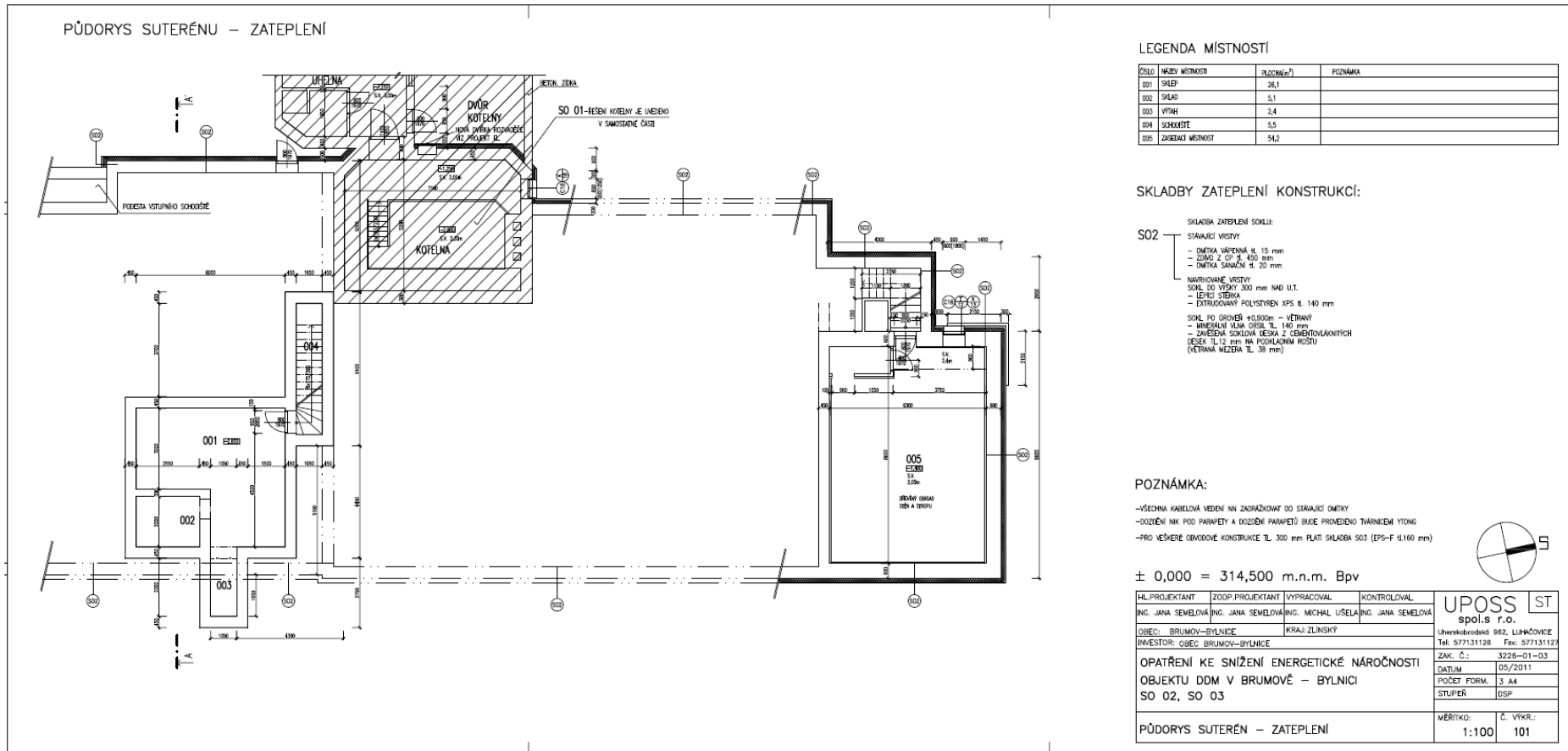
Conclusions

Implementation of the HCY reconstruction project in Brumov-Bylnice is in compliance with approved Biomass action plan designed within the BioRegions project for target region consists of two towns (Brumov-Bylnice and Slavcin) and eleven neighbouring villages. Complex refurbishment of the building will result in energy efficiency increase and simultaneously in decrease of local dependence on imported fossil fuels. Raising utilisation of local biomass strengthens economical and social stability of border region because financial resources stay in the region as well as jobs linked to biofuel supply. Consequently, utilisation of local biomass increases energy self sufficiency and stabilises the heat prices on acceptable level. Finally, local pellet market is supported (i.e. common pellet purchase by public organisations and citizens) and stabilised by guaranteed consumption of new public pellet boilers.

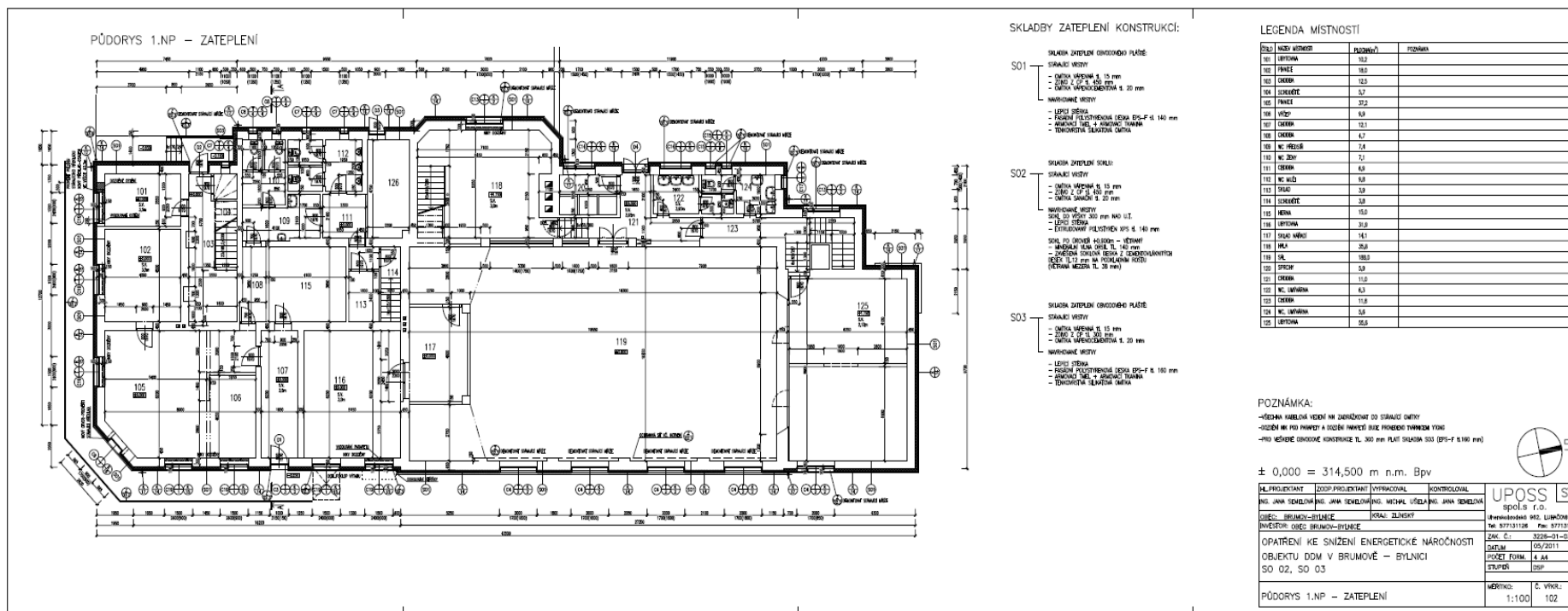
Comprehensive approach is necessary not only for big projects but also for small local projects. Simple replacement of the old coal boiler by new biomass boiler would reduce emissions and fuel costs but high maintenance costs and energy losses caused by poor thermal characteristics of the old building would still increase operational costs of the HCY. On the other hand, a single complex refurbishment dramatically influences energy consumption and operation of the building which invokes new different requirements on heating system in winter season. Comprehensive chosen variant embody synergy effects reducing investment costs (lower heat output of new boiler is required) and operational costs (e.g. personnel, maintenance).

As shown in the financial evaluation above, despite the important social and economic benefits such a project brings to the local communities, it lacks the required financial viability and, therefore, public financial support is strongly needed for its realisation.

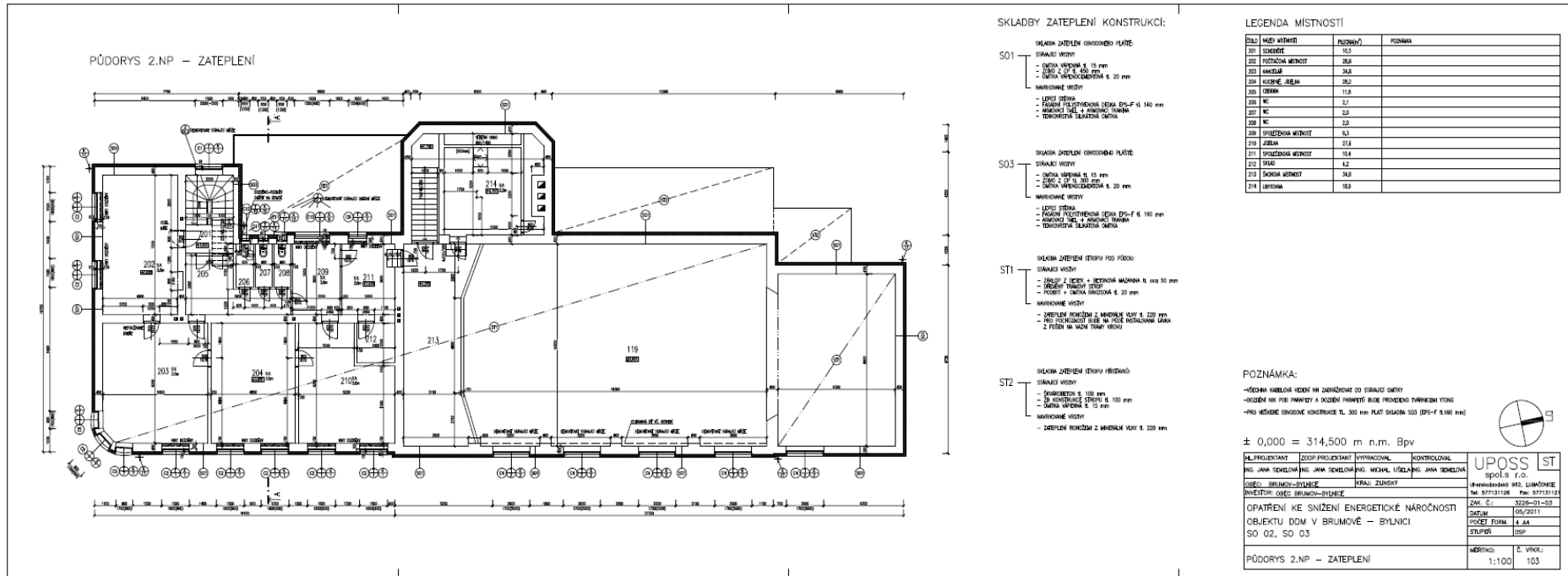
Appendix 1: Technical drawings – Groundplan_Cellar (after refurbishment; boiler room – top of the picture)



Technical drawings – Groundplan_1st floor (after refurbishment)



Technical drawings – Groundplan_2nd floor (after refurbishment)



Technical drawings – Views (after refurbishment)

