EEA AND NORWAY GRANTS:

REVIEW OF ENERGY SAVING AND RENEWABLE ENERGY PROJECTS IN POLAND

FINAL REPORT

OSLO, 8 JANUARY 2009

THE EEA AND NORWAY GRANTS

The EEA Grants and the Norway Grants are the €1.3 billion contribution from Iceland, Liechtenstein and Norway towards reducing social and economic disparities in Europe. Norway's contribution makes up 97 percent of the total support. The beneficiary states are the twelve new EU member states since 2004, as well as Greece, Portugal and Spain. Poland is the largest beneficiary, receiving 43 percent of the net funding.

In the five-year period 2004-2009, grants are awarded to projects within priority sectors such as environment and sustainable development, preservation of cultural heritage, health and childcare, and Schengen and the judiciary. The projects are carried out by public bodies, education and research institutions, civil society organisations and businesses across Central and Southern Europe.

With the EEA and Norway Grants, Iceland, Liechtenstein and Norway aim to contribute towards:

- *solidarity*, by reducing social and economic disparities in the enlarged EEA;
- *opportunity*, by helping new EEA members become fully integrated in the Internal market;and
- *cooperation*, by bringing old and new EEA members together and opening new arenas of political and economic relations.

The Financial Mechanism Office (FMO) in Brussels, which is administratively linked to the EFTA Secretariat, administers the grant schemes.

For more information, visit www.eeagrants.org

Photo: Solar collectors for hot water in the Przeworsk Housing Cooperative.
Paweł Altwęgier (12 Nov 2008)

Contents

Acronyms

BAT	Best Available Technology
CO_2	Carbon Dioxide (GHG emissions)
EEA	European Economic Area
EUR	Euro (currency)
FMO	Financial Mechanism Office
GHG	Green House Gases
GJ	Gigajoule (energy unit)
MJ	Megajoule = 0.001 GJ
MWh	Megawatt hour = 3.6 GJ
NOK	Norwegian Kroner (currency)
PLN	Polish Zloty (currency
TOR	Terms of Reference

energy unit conversion factors

Unit	GJ	MJ	kWh	MWh	koe*
1GJ	1	1000	278	0.278	24
1 MJ	0.001	1	0.278	0.000278	0.024
1 kWh	0.0036	3.6	1	0.001	0.086
1 MWh	3.6	3600	1000	1	86
1 koe*	0.04187	41.87	11.63	0.01163	1

* kilo of oil equivalent

1 Executive Summary

The EEA/Norway Grants provide funding to Poland's priority sector Protection of the Environment, among others. Energy saving in public buildings, the use of renewable energy sources and modernisation of heating systems is an important sub-sector.

On contract for the Financial Mechanism Office in Brussels a review was carried out in October and November 2008 by Scanteam, Oslo, and Proeko, Warsaw. Document study and data collection were done prior to a visit to twelve projects in Poland. The purpose of the review was to collect results data from all projects as a basis to make an assessment of the programme.

1.1 Programme Features

Projects are being implemented in the sub-sector of energy saving and renewable energy promotion. The aim is to reduce air pollution and green house gas emissions, by reducing fossil energy use. From 700 project applications submitted to the Focal Point, about 380 were on the subject of energy saving. Of these, sixty-five made it through the approval process to the implementation stage.

The measures planned and implement are concentrated on the thermo-modernisation of public buildings, and the modernization of heating systems. The use of renewable energy in the latter is marginal.

The common key applied to cost sharing under the programme has been 85% to 15% for the donor grant and beneficiary co-financing respectively. However, due to cost increases over time in Poland's construction industry, the ultimate typical cost-sharing experienced amounts to 60% and 40%. Donor grant funding has been provided for a total of EUR 41.4 million, and on the basis of the resulting cost sharing, total investment amounts to almost EUR 70 million.

1.2 Review Findings

Reporting of the review on results is on expected results as most of the projects are ongoing or only recently completed. A gross building volume of near to 3 million m^3 benefitted from the investments made. 52 of the projects, or about 2.4 million m^3 building volume, fall into the category of schools and similar public buildings, comprising in total 285 buildings. Hospitals and other health-related institutions account for about 350,000 m^3 of building volume in 9 projects comprising 21 buildings, while 4 projects focus on heat supply system modernisation as the main measure, serving the remaining about 200,000 m^3 of building volume, among other for about 2,000 apartments.

In terms of use of EEA/Norway Grants, in the different building categories, schools and similar account for more than EUR 33 million, or 80% of the total. One reason for this is that this building category has often been neglected in the past and there is a great modernisation need. About EUR 5 million has been granted for the category of hospitals and similar facilities, while the remainder of more than EUR 3 million has been used to co-finance heat supply modernisation.

Almost three quarters of the total energy saving target of close to 480,000 GJ (Gigajoule)[1] per year fall to the category of schools and similar buildings. The health-related building category contributes 15%, while heat supply modernisation achieves 11% of the total. Estimated cumulative energy savings amount to almost 20,000 metric tonnes of coal. This will avoid CO_2 amounting to approximately 52,000 tonnes per year[2]. Compared to other measures taken in Poland, this is a visible and significant contribution to the overall goal of environmental improvements.

The review has looked at the results in performance groups: the top ten percent of all projects for each criterion, the core eighty percent, and the bottom ten percent.

In terms of energy saving compared to the situation before the project, the group at the lower end of the spectrum save on average about 27% of energy. The core group, eighty percent of all projects, save on average 54% of energy, while the top performers save on average 76% of previous energy use.

The contribution of the FMO co-funded projects is about 0.2% of the national target. In proportion to the emissions of the sector, which is less than 20%, the contribution is around 1%. This is much higher than what appears possible in the energy sector, according to an official document. Therefore, the review regards the contribution of the programme as a significant achievement.

Assuming an average project life of twenty years, the total accumulated CO_2 reduced in this period amounts to roughly one million tonnes. At an investment cost of EUR 70 million, the cost of CO_2 avoidance is on the order of EUR 70 per tonne on an average, but there is wide variation among the projects in terms of cost of CO_2. This points to widely different project situations, but it is also found that CO_2 calculation done by the projects themselves is often in-transparent and possibly not realistic.

The saving of more than four hundred thousand tonnes of coal over the life time of the projects also results in the reduction of a number of pollutants, in particular sulphur dioxide SO_2, nitrogen-oxygen compounds No_x and dust particles. The quantities of reduced pollutants are considerable, but on a project level the review has not found consistent data. Nonetheless, at the programme level, it is estimated that more than 8,000 tonnes of sulphur dioxide and about 3,000 tonnes of nitrogen oxides, as well as 20,000 tonnes of dust particles are avoided over the technical life time of the projects.

The reduction of pollutant emissions has a positive impact on health of the population, but this cannot be measured in the short term. The room climate and visible exterior appearance of buildings is considerably improved and while mostly pupils and students benefit directly from this, authorities` responsible gain in public image.

In terms of financial viability of the projects the three performance groups show an average payback time of 4.5 years, 11.5 years, and about 26 years respectively, to repay the investment. In general, the top performing group shows a very good performance, while the core eighty percent are very acceptable. The bottom group however, shows an average payback time that is not satisfactory.

[1] To convert to Megawatthours (MWh) divide by 3.6
[2] Emission factors from www.eurima.org have been used

Unit costs per m^3 of building space modernised, range from less than EUR 10 to EUR 87, while the average of the core eighty percent is EUR 27 per m^3. This indicates that widely different situations require substantially different levels of investment, and a higher level of unit costs is not necessarily a measure of poor performance.

1.3 Programme Performance

In general, the reliability of the predictions made hinges on the quality of project design in which the energy audit is a key activity. The reliability of saving projections based on energy audits is variable and the review finds that considering all, a margin of five to ten percent with regard to possible under-performance relative to projections is a safe assumption. The quality of implementation of the measures is the second key parameter, and this is excellent in general, but actually achieved energy savings will need to be measured in the years to come.

The review has developed a project performance assessment framework, with a view to determine the overall quality of the programme. The assessment considered elements such as project design, use of best available technology, effectiveness, cost efficiency and relevance in the overall context.

In summary, programme performance can be assessed as of high and relatively even quality. The key statement is that overall programme performance is of good standard across all six dimensions of assessment used, and that variance in project performance is moderate.

1.4 Conclusion and Recommendations

It is concluded that the programme on energy saving and renewable energy use, as a major part of the projects under the Protection of the Environment priority area, is performing well. The expected results constitute a significant contribution to the national target, when compared to other efforts, and a vast replication potential exists. The cost of avoided CO_2 appears moderate at a level of about EUR 70 on average, but with wide variations. The average cost found compares favourably with the cost level predictions found in relevant literature[3].

Performance of the projects is sound in terms of using best available technology in the form of standard rehabilitation measures, although the choice of PVC window frames is a compromise in environmental terms. The broad application of the measures in schools and similar building types appears to be the main success factor. Technologies such as renewable energy and automatic control devices are much less frequently used, and a barrier is limited experience. Energy (- use) management is largely absent in the projects. Awareness of its cost-efficiency seems to be lacking. An area that also leaves room for improvements is a more even standard of energy audit.

Replacement of coal and other fossil fuels for heating of buildings by saving has a large potential in Poland. It appears that in order to utilise this potential, the main requirement is raising the quality standard of designing measures on a broad scale across the country.

[3] Cost-effective Climate Protection in the Building Stock of the new EU Member States, Ecofys-EURIMA, 08/2005

Insufficient processing capacity for project applications, constrained design capabilities and energy audit capacities at the project level and limited awareness of the-state-of-the-art of comprehensive energy saving in the building sector are the main limiting factors in the way of further qualitative and quantitative progress. By contrast, available funding does not appear to constitute a major constraint.

Recommendations

The review recommends to improve and consolidate the standard of energy audits in terms of providing reliable energy saving and pollution reduction indicators.

Further, it is recommended to consider energy-use management as an additional standard measure, as this has a potential in increasing efficient energy savings.

The third recommendation is to consider to a larger extent the inclusion of the sub-category of housing cooperatives or publicly owned apartments, including solar thermal energy for domestic water pre-heating.

The review also recommends adapting the energy audits to include scrutiny of electricity use, in particular for lighting.

2 Introduction

The EEA and Norwegian Financial Mechanisms provide grant funding to Poland's priority sector Protection of the Environment. Energy saving in public buildings, the use of renewable energy sources in heating systems, and modernisation of heating systems are important sub-sectors. It is estimated that more than one third of air pollution and emission of green house gases is caused by heating of buildings with coal-fired heating systems, or the use of other non-renewable fuels for heat energy applications.

2.1 Background

The Financial Mechanism Office in Brussels has initiated the present review in order to determine the impact and potential of contributing to less pollution and climate-relevant measures in the sub-sectors. The review was carried out in October and November 2008 by Ueli Meier of Scanteam, Oslo, and Pawel Altwegier of Proeko CDM, Warsaw. Document study and data collection was carried out prior to a visit to Poland by accessing the FMO data base in Brussels. Field visits were then carried out in the period from 3 to 14 November to a random selection of twelve projects all over Poland. The purpose of the review was to collect results data from all projects, and to verify these and put them in the context of Polish reality through field visits, and discussion of issues with stakeholders.

Under EEA and Norwegian grant financing, at present 65 projects are being implemented or have been completed in the sub-sector of energy saving and renewable energy promotion, with the aim of reducing air pollution and green house gas emissions, by reducing fossil energy use, mostly in coal fired heating systems.

2.2 Structure of the Report

The report has an executive summary and two chapters, of which chapter 3 is substantive. It contains the results found and an assessment of the programme, and it includes conclusions and recommendations.

Annex A gives the full TOR, Annex B an overview of the documents consulted, and Annex C the list of projects and their status. Annex D finally, contains the project data entry and results calculation forms and a data summary sheet in a separate file.

2.3 Acknowledgements and Disclaimer

This review was conducted by Mr. Ueli Meier, of Scanteam/Norway, in collaboration with Mr. Pawel Altwegier of Proeko CDM/Poland. The team received full support from all project staff, government agencies and other stakeholders, in particular the intermediary institution National Environment Fund which provided thematic input and helped determine the scope of the review, and Proeko administration which organised travel logistics and made appointments in an efficient manner. For all this, sincere thanks are given.

Given the complex realities on the ground, this report no doubt contains its fair share of factual mistakes and misunderstandings. But there may also be conclusions and recommendations that actors may be less happy with, and which are not simply attributable to such background errors, but reflect differences of opinion and weighting of factors when carrying out the analysis and reaching conclusions. This report and its findings is therefore the sole responsibility of the consultants, and do not necessarily reflect the views of the client, project staff, government officials or any other actors mentioned in this report.

2.4 Purpose, Scope of Work and Methodology Used

The purpose of the review is to determine the combined impact at the programme level through results at the project level, with a view to assess the efficiency and effectiveness of this type of projects. The aim is to contribute to a sharpening of the focus at the national level, with regard to the promotion of environmental protection measures.

The scope of work consisted of collection of pertinent data from all 65 projects from existing data sources. Initially intended categorisation of projects was only done to a marginal extent. To gain a deeper understanding of the projects implemented, field visits to 12 projects were carried out. The research emphasis was two-fold: a) on the more innovative and complex approaches, and b) on those projects that were not well understood from available documentation but seem important in terms of potential. The review analysed the information collected in terms of results achieved/achievable and in terms of implementation performance.

Specific results that the review has been looking for are:

- Energy units saved in comparison to the baseline value (i.e. the saving in % of the consumption before the project)
- The money saved in operation in terms of reduced energy/fuel costs, and from this the project investment payback period.
- The pollution/CO2 emission reduction resulting from reduced energy use in the specific situation
- Performance indicators that are considered to be used at the project level are:
- The project quality in terms of preparation of the investment (proper assessment and estimation of target and baseline values of indicators, proper management during implementation process, risk management strategy – reduction of need for additional unforeseen works during implementation phase e.g. mould removal).
- The project quality in terms of its design and its merits regarding best available technology and implementation features
- The effectiveness of the project in terms of Energy units saved in comparison to before-project consumption
- The cost efficiency of the project in comparison to other projects e.g. comparison of investment unit costs such as costs of window and door replacement (such comparison can only be made for almost identical investments – regional cost variations, ecological localisation and effect of scale may influence cost of the investment – bigger projects normally have lower unit costs, physical scope of the projects and its localisation shall be comparable (a benchmarking study), and in terms of the calculated payback period of the investment, and in terms of cost of CO_2, SO_2 and NOx.
- The relevance of the project with regard to replicability and publicity value,

In broad terms, the review has also been looking at the projects in relation to a number of other criteria:

- Relevance of the thermo-modernisation measure – (reference to EU energy saving Directives, Kyoto Protocol and climate conventions as well as national strategies);
- Response to the needs – (conditions of public utility building, high competitiveness among applicants, number of application received in comparison with applications received in other measures,);
- Satisfaction of users of thermo modernised buildings (e.g. patients, students, pupils, local population)

In terms of methodology, the review used the following:

- Project document review and data gathering from existing document sources
- Conduct of verification and specific question survey on a limited scale
- Field work, i.e. in depth study of a sample of projects with the aim of building up representative case stories covering different project types.
- Analysis of findings, extrapolation of results to the extent of the totality of projects, and elaboration of impact expected to ultimately be achieved at the programme level, and summary assessment of potential longer-term national level impact for the sector activity.

A simple scoring scale for the indicators has been developed and applied. Both, results and performance indicators are used for assigning the projects to defined performance groups. A form for data entry and results calculation has been developed and used for each project. From this in turn, aggregate data representing programme-level achievements, were generated. This is shown for illustrative purposes below.

Project name		122		**Summary**	
Dzialdowo - Thermo modernisation of an elementary school					
Building volume (m3)	18,354	1 = school or other, 2=hospital or similar, 3=heating system, communal/district heating			
sub-sector	1				
FMO Project Details		**Project measures** (enter 1 for all that apply)		part cost €	area, m2 total
Grant amount €	263,477				
Total project amount €	351,303	Insulation	1	124,418	4,508
Application date	04/09/06	windows/doors	1	31,926	113
Date of implement. agreement	10/12/07	heating system rehab.	1		189 kW
duration (months)	3	fuel switching			
		renewable energy			
Unit investment cost €/m3	24	thermostatic valves	1		230
Implementation status	A	other measures	1		
A=completed, B=in progress, C=not started					
specifiy other measures:		230 radiators, 230 thermostatic valves			
Performance/results indicators		(100 = max performance - 0 = total failure)			
assessed by review:					
1) Project design quality	62	answer cells contain formulae, do not overwrite but enter data on detail page to the right			
2) Best available technology	58				
3) cost per tonne of CO2 avoided		202			
4) Effectiveness	71				
5) Cost efficiency	25				
6) Relevance	41				
7) Subjective gains	70	based on subjective perception of users			
Composite indicator	**54**	value calculated automatic			
measured/calculated values:	saved energy	baseline		after project	
Operating cost per year, (€/yr)	9,502	19,820		10,318	
Energy consumption (GJ/yr)	1,234	2,574		1,340	target
Specify replaced energy type(s)	1	1=coal, 2=oil, 3=gas			
Specify new energy source(s)		A=wood, B=biogas, C=solar thermal, D=gas, E=coal, oil			
GHG avoided (tonnes CO2 equiv.)	116.08	reported	159	83	76
Pollution reduced (tonnes/yr.)	1.18	dust reduction			
specify reduced pollutants	CO 0.216 t/y, SO2 1.213 t/y, Nox 0.407 t/y, dust 1.185 t/y				

Comments: Yearly saving has been overstated. New information is an energy price of 7.7 EUR/GJ. The project is completed. Have all targeted results been achieved? Reported CO2 avoided is under stated by a factor of 2. I used emission factor from table. Mon

Detail Assessment page		write in colored cells only. Assign a score acc. to scale or instruction		
1) Project design		describe rationale for score below		
- financial viability based, scale 3	0			
- energy audit quality	100			
- budget on basis unit cost (yes=50	35			
- design amendments needed (none=50)	50			
total score	62	calculated automatic		
2) Best available technology				
- modern windows + insulation, scale 1	80	insulation 12 to 18 cm, polystyrene, double gl. PVC windows		
- saving target, scale 2	43			
- radiator thermostats, yes=50	50			
- gas (yes=30) or renew'le energy (yes=50)	0			
total score	58			
3) Project management + implementation				
4) Effectiveness - targets fully achieved	100			
- reduced energy consumption, scale 2	43	47.9%	calculated value	
- cross-cutting issues addressed	70	3 points		
total score	71			
5) Cost efficiency				
- cost per unit compared to other proj. Scale 6	72	€/m3	24	
- simple payback, scale 3	0	payback	37.0	years calculated
- cost per tonne of CO2, scale 5	4	calc. Value	202	
total score	25			
6) Relevance - high publicity/demo value	20			
- contribution to national target, scale 4	88			
- leading example for replication	16			
total score	41			
7) Subjective gains - better comfort				
- less noise, dust, etc.				
- aesthetic improvement				
total score	70	all 3 = 100, two of three = 70, one of three = 30		

Calculate baseline operating cost	
Euro/GJ	7.7
Euro/kWh	0.027698
baseline energy consumption, GJ/y	2,574
baseline operating cost, Euro/y	19,820

Project data entry and calculation form (full details in annex D)

Summary: PL Energy Saving project review

cells are filled automatically from project data sheets

							Measures							Results																	
FMO Proj. Nr.	Sub-sector	Tot bldg volum e (m	Grant €	Estimate Total Cost	Inv. Cost €/m3	Implem. Status	Insulation: walls/roo	windows/doors	heating rehab.	fuel switching	renewable energy	thermostatic valves	other measure	**Composite indicat**	m2 insulation	Best avail. technolo	m2 windows replace	Effectiveness	Cost efficiency	Thermostatic valves	energy cost €/GJ	Money saved, €/yr	Energy saved, GJ/y	Specific energy saving (GJ/m3)	replaced energy typ	GHG reduced t CO2	% energy saved	Payback period, yrs	€ per tonne of CO2	€ per m2 windows	€ per m2 insulation
110	2	30,700	449,347	748,912	24	A	1	1	1	0	0	0	0	**54**	8434	8	1644	67	58	0	6	34,500	5,500	179	1	499	40.6%	15.3	75	0	24
111	2	72,212	638,041	1,063,402	15	B	1	1	1	0	0	0	1	**71**	22168	50	2876	80	80	264	6	81,620	13,854	192	1	1,144	58.0%	9.2	46	0	15
112	2	28,885	485,819	809,698	28	A	1	1	0	0	0	0	0	**60**	7793	19	613	81	55	0	11	41,200	3,870	134	3	364	62.3%	13.9	111	0	28
114	1	16,512	322,472	537,453	33	A	1	1	1	1	0	0	0	**55**	4459	26	0	65	42	0	74	50,085	677	41	1	108	37.6%	7.6	250	0	33
115	1	33,331	425,898	709,830	21	B	1	1	0	0	0	1	1	**65**	7029	59	1740	73	47	397	8	35,776	4,234	127	1	398	48.8%	19.7	89	0	21
120	1	18,150	286,073	476,788	26	A	1	1	1	1	0	0	0	**49**	4217	39	553	64	13	298	23	24,132	1,049	58	1	99	56.0%	13.9	242	0	0
121	3	111789	2,051,750	3,419,583	31	B	0	0	1	1	1	0	1	**68**	0	57	0	83	62	0	6	175,307	31,530	282	1	3,649	6.7%	14.2	47	0	31
122	1	18,354	263,477	439,128	24	A	1	1	1	0	0	1	1	**54**	4508	58	113	71	25	230	8	9,502	1,234	67	1	116	47.9%	37.0	189	0	24
124	1	120,000	1,346,442	2,244,070	19	A	1	1	1	0	0	1	1	**64**	22972	65	3214	78	49	918	8	83,500	10,359	86	1	1,378	57.1%	23.6	81	0	19
125	1	74,404	880,427	1,467,378	20	A	1	1	0	0	0	0	0	**58**	16608	8	3917	65	56	0	9	63,287	7,293	98	0	686	37.0%	16.4	107	0	20
126	2	8,272	349,331	582,218	70	B	1	1	1	1	1	0	1	**72**	4169	60	260	90	53	154	14	63,137	4,620	559	1	494	75.3%	6.5	59	0	70
127	1	19,851	320,938	534,897	27	A	1	1	1	1	0	1	1	**66**	6309	75	52	70	55	296	9	25,350	2,807	141	1	264	53.8%	14.9	101	0	27
128	1	43,073	525,017	875,028	20	B	1	1	1	0	0	1	1	**72**	11557	64	1007	77	74	211	13	89,163	6,605	153		0	55.4%	8.2		0	20
129	1	18,073	425,719	709,532	39	B	1	1	1	0	0	1	0	**60**	5590	63	723	77	28	173	17	36,300	2,130	118	2, 1	180	54.9%	16.1	197	0	39
131	2	107,327	1,354,014	2,256,690	21	B	1	1	1	1	1	1	1	**71**	14351	82	1770	72	61	802	9	113,761	12,371	115	1	1,164	58.0%	14.0	97	0	21
136	1	14,012	278,608	464,347	33	A	1	1	1	0	0	0	1	**76**	5201	73	337	86	71	0	12	66,700	5,493	392	1	328	69.2%	4.9	71	0	33
137	3		259,856	433,093		A	0	0	1	0	0	0	1	**72**	0	83	0	60	81	0	15	61,500	4,100		2	355	40.6%	5.6	61	0	na
138	1	21,476	423,078	705,130	33	A	1	1	1	0	0	1	1	**62**	8925	65	540	78	39	479	10	42,500	4,187	195	1	304	57.4%	16.4	116	0	33
139	1	34,046	322,458	537,430	16	B	1	1	1	0	0	0	1	**68**	10062	53	877	67	81	329	7	44,235	5,960	175	1	561	40.0%	8.6	48	0	16
140	1	9,792	275,015	458,358	47	B	1	1	1	0	1	1	0	**68**	3118	90	651	87	30	24	8	35,000	4,351	444	1	85	70.3%	9.3	270	0	47
142	1	12,943	250,623	417,705	32	B	1	1	1	0	0	0	1	**74**	4664	58	573	90	73	114	9	45,500	4,827	373	1	305	77.3%	7.0	68	0	32
143	1	44,304	591,226	985,377	22	B	1	1	1	0	0	1	1	**59**	9486	52	1757	65	46	318	16	47,000	2,868	65	1	277	38.2%	14.8	178	0	22
144	3,4	50,000	342,284	570,473	11	B	0	0	1	1	0	0	1	**72**	0	42	0	68	95	0	10	140,320	14,032	281	1	1,344	18.9%	4.1	21	0	11
146	1	129,680	1,998,080	3,330,133	26	B	1	1	1	0	0	0	1	**63**	29709	63	5298	76	47	1308	9	169,000	18,468	142	1	2,324	54.8%	17.7	72	0	26
147	1	16,916	354,531	590,885	35	A	1	1	1	0	0	1	1	**75**	4536	80	583	83	67	174	10	51,654	5,198	307	1	489	65.1%	8.1	60	0	35
149	2	27,192	284,106	473,510	17	B	1	1	1	0	0	1	1	**71**	8097	66	576	83	65	491	9	57,600	6,159	227	3	147	63.9%	5.8	161	0	17

Summary project data and results (refer to Annex D for full-scale and complete data)

3 Assessment

The measures planned and implemented to achieve a reduction in energy use are concentrated on the thermo-modernisation of public buildings, and the modernization of heating systems. Thermo-modernisation comprises a number of standard measures such as insulation and building element replacement such as doors and windows, while heating system modernisation addresses most often the user side, and sometimes the heat supply side.

3.1 General Programme Features

From 700 project applications submitted to the Focal Point, about 380 were on the subject of energy saving, and in a competitive process, 78 projects were selected. Of these, 65 made it to the implementation stage. Only a small number of projects are completed as of November 2008, most are still under implementation, and a few have not yet been started. Reporting of the review on results is therefore on expected results, and an assessment of how likely it is that expectations will be met.

Selection of the projects was carried out in a competitive process on the basis of demonstrated project merits. Based on the numbers, two interpretations can be made.

1) The fact that more than 54% of all applications were submitted for energy saving projects indicates that the perceived need in the sub-sector of public buildings is enormous, and outweighs other preferences.

2) According to the National Environmental Foundation (NFOSIGW) acting as a supervising intermediary organisation for the sector, acceptance of only about 21% of the projects points to the finding that many applications have not been found to be of an acceptable standard. The reason for this is seen in the fact that energy saving projects are quite complex in terms of credibly demonstrating costs and benefits, in particular when proposed measures go beyond simple building insulation. In comparison to the magnitude of need, available capabilities in terms of relevant skills and experience are limited.

The EEA/Norway Grants have been used for basically three categories of buildings/ measures, but there has also been some degree of mix of the categories. Measures on buildings have been relatively uniform and consisted of a) wall and roof insulation, b) the renewal of doors and windows, and c) improvement of heating systems on the user side, by replacing radiators to an extent, and installing thermostatic valves to automatically control room temperature. In combination, the measures achieve energy savings of generally more than 50%.

Measures on heating systems on the supply side have been combined with the building rehabilitation measures mentioned above in eight of the projects. In four projects heating system modernisation has been the main objective. Measures implemented are exchange of the heat production facility, most often combined with fuel switching, but also renewal of heating pipes, and modernisation of controls, in a few cases by automation of heating functions.

Energy management as a non-investment measure, is largely absent from the projects. As a rule, energy management understood as a measure addressing the behaviour of users has an excellent cost/benefit ratio as none or very limited investment costs are involved. The level of additional energy savings is about 5 to 10 percent in the experience of the review. Not including it as an explicit measure constitutes a missed opportunity in the programme. The review finds that this is due to a general lack of awareness of the potential of energy management by users.

The programme measures conceived are directed chiefly at the EU Directive 2002/91/EC on Energy Efficiency: Energy performance of buildings. According to the Directive, quote: "*The common calculation methodology should include all the aspects which determine energy efficiency and not just the quality of the building insulation. This integrated approach should take account of aspects such as heating and cooling installations, lighting installations, the position and orientation of the building, heat recovery, etc.*" unquote. It is noted that the measures adopted in the EEA/Norwegian Grants programme do not include lighting installations and other electricity use in buildings, thus not taking a fully integrated approach, as intended by the Directive. A lack of awareness on the part of the applicants regarding the potential saving in lighting use may be the reason.

The scope of the programme comprises a gross building volume of near to 3 million m^3 that benefitted from the investments made. 52 of the projects, or about 2.4 million m^3 building volume, fall into the category of schools and similar public buildings. Hospitals and other health-related institutions account for about 350,000 m^3 of building volume in 9 projects, while 4 projects focus on heat supply system modernisation as the main measure, serving the remaining about 200,000 m^3 of building volume. Two of these projects are for housing cooperatives, providing heat energy more efficiently to several thousand apartments.

The numbers characterising the programme in more detail are presented in the table below.

Category	Number of projects	No. of individual buildings	Total building volume (m3)	Total grant amount (EUR)	Energy saving planned (GJ/yr)	Per-centage
Educational facilities	52	285	2 395 000	33 506 000	353 000	74 %
Health facilities	9	21	345 670	5 114 000	72 000	15 %
Heating systems	4		212 000	2 848 000	54 000	11 %
Housing cooperatives *	2	2 000 flats	100 000	537 000	18 000	4 %

* Note: housing cooperative data are part of heating systems

The category of schools and other public buildings contributes with almost three quarters to the total energy saving target of close to 480,000 GJ (Gigajoule) per year. The health-related building category contributes 15%, while heating supply modernisation achieves 11% of the total.

In terms of use of grants, in the different building categories, schools and similar account for more than EUR 33 million, or 80% of the total. This indicates that the measure of school building rehabilitation is the most preferred. One reason for this is that this building category has often been neglected in the past and there is a great modernisation need. About EUR 5 million has been granted for the category of hospitals and similar facilities, while the remainder of more than EUR 3 million has been used to co-finance heat supply modernisation.

The common key applied to cost sharing under the programme has been 85% to 15% for the donor grant and beneficiary co-financing respectively. However, due to cost increases over time in Poland's construction industry, the ultimate typical cost-sharing experienced amounted to 60% and 40%. The grant therefore is about two thirds of the originally intended level, but it is still considered high. This has meant that many of the project beneficiaries had to take out a loan to finance the cost increase. Donor grant funding has been provided for a total of EUR 41.4 million, and on the basis of the resulting cost sharing, total investment amounts to almost EUR 70 million.

3.2 Energy Saving Results

The review has analysed all projects to the extent possible. In order to arrive at a differentiated picture at the programme level, projects have been assigned to three different performance categories. The top performers (10%), the core group (80%) and the bottom group (10%). Various aspects of energy saving results and different elements of financial results were considered.

In general, with regard to the reliability of the predictions for energy savings made, it hinges on the quality of project design in which the energy audit is a key factor. Energy audit as such is not an "exact science", but rather, it is a diagnosis carried out with a number of assumptions as the basis. Experience and skill of the energy auditor are key to a good audit, and such characteristics of professionals are widely variable. The Polish intermediary institution National Environment Fund (NFOSIGW), responsible for supervising projects falling under the Environment priority area, estimates that the reliability of energy audits varies plus/minus 25%. If true, errors in energy saving projections would level out over a large number of projects. The review finds that some of the energy audits are not entirely transparent by failing to show the causality between specific measures and the expected savings. The quality of implementation of the measures is the second key parameter. Assessing the quality of implementation, the review found good workmanship and work execution throughout. On this basis, a margin of 5 to 10% with regard to possible under-performance of the programme against predictions may be a safe assumption. Actually achieved energy savings will need to be measured in the years to come, but such measurements are not without pitfalls either.

3.2.1 Percentage of Energy Saving

In terms of energy saving compared to the situation before the project, the ten percent of projects at the lower end of the spectrum save on average about 27% of energy. It is noted that this is just above the limit set by Polish law which stipulates that in the event of rehabilitation measures taken, an energy saving of 25% is the minimum requirement for funding eligibility. The core group, eighty percent of all projects, save on average 54% of energy, while the ten percent top performers save on average 76% of previous energy use.

As would be expected from significantly different situations and sizes of projects, energy savings results differ widely. A relatively low level of energy saving as seen in the bottom 10% is often due to previously executed measures, and it is therefore not necessarily an indicator of a "bad" project. On the other hand, it is quite obvious that the largest saving potential is found in situations where the object for modernisation is in a poor state. It is in such situations that savings of 70% and more are often possible. At the same time, buildings in a poor state require frequently rehabilitation measures that are not energy-related, such as for example the repair of leaking roofs. Such measures are then included in the rehabilitation plan, and costs for it are not shown separately. To an extent, this makes it more difficult to compare cost-efficiency of energy measures between the projects.

Extreme values of a low, less than 7% saving, compared to the extreme maximum of more than 78% is surprising nonetheless. It becomes more credible when looking at the cost of CO_2 avoidance in the two cases: In the project with the extremely small energy saving percentage, 1 tonne of CO_2 displacement costs EUR 47, while in the project with the extremely high energy saving percentage it costs EUR 119 to avoid one tonne of CO_2. This explains some of the discrepancy: Reducing energy use a little bears low specific costs, while achieving a high degree of saving costs more per unit to achieve.

3.2.2 Energy Saving per Unit of Building Space

Specific saving results, expressed as the expected saving of energy units per each unit of building space, shows wide variance. The average of the bottom ten percent of projects save less energy by a factor of 9 as compared to the average of the top ten percent performers. A reason could not be identified for such wide differences in what the projects are to achieve. Perhaps it is simply due to extreme project situations characterised by a poor state of the buildings in question and different extents of not energy-related measures, but possibly there is also a problem with the design of some of the bottom-end projects.

A comparison of rehabilitation costs per unit of floor area is also often done in building rehabilitation. However, in the present programme, data of floor area have not been available for all projects.

3.2.3 Absolute Volumes or Energy Saved

The total energy saving amounts to 480,000 MJ of heat consumed. The quantity of fuel saved depends on the efficiency of heat production. Since in general, heating of buildings is largely done with coal fired district heating plants, a total conversion efficiency of 80% is used, as most heating plants are not in best possible condition. Fuel savings of almost 20,000 metric tonnes of coal have been calculated. This will avoid CO_2 amounting to approximately 52,000 tonnes per year[4]. Compared to other measures taken in Poland, this is a visible and significant contribution to the overall goal of environmental improvements, as will be shown in a comparison in the following paragraph (3.2.4).

The absolute quantity of energy saving varies widely in the projects. The top ten percent group saves more than 10 times more than the bottom ten percent, and 3 times more than the core eighty percent group. This indicates that there is a whole range of projects from small to large, and this also reflects the fact that EEA/Norway Grants have been awarded to a good mix of small communes, medium sized groups of beneficiaries and large municipalities.

[4] Emission factors from www.eurima.org have been used

Large and small absolute quantities of energy saved are an indication that there are small and large projects alike; it does not indicate any specific quality aspect, but is an indicator of successful efforts at equitable development. Typically, the small projects are found in small rural communities, while large projects are situated in urban areas and large cities.

On the other hand, the large difference in specific energy saving achieved in the top and bottom groups of projects respectively is of some concern, as the two projects with extreme high and low results differ by a factor of more than 21. It is not possible to determine any specific reason for this within the scope of the review. Further investigation only could reveal if there is a serious problem in the performance of some of the bottom-end projects.

The table below summarises energy saving results, using different criteria.

	Energy Saving Results		
Project Group *	% of previous use	Absolute quantity (GJ/year)	Specific: MJ/m3 of building space
Top 10 %	76	18 220	572
Core 80 %	54,4	6 664	184
Bottom 10 %	27,5	1 601	62
Total average	53.8	7 363	207

* Note: The projects in the three groups are different for each criteria

3.2.4 Contribution to CO2 Avoidance

The CO_2 reduction target of Poland is 6% of the 1988 emission estimate of 400 million tonnes, or 24 million tonnes. Hence, the contribution of the FMO co-funded projects is about 0.2% of the national target. In proportion to the emissions of the sector, which is less than 20%, the contribution is around 1%. In other words, it will require a project volume that is about 100 times larger than the present programme to achieve the proportional contribution of roughly 20% expected from the building sector towards the 24 million tonnes. In other words again: Replacement of coal and other fossil fuels for heating of buildings by energy saving and to some degree by renewable energy use has a large potential in Poland, at a scale of 100 times the volume of FMO supported projects. It appears that in order to utilise this potential, the quality standard of designing and planning measures needs to be raised on a broad scale across the country.

A comparison with GHG reduction efforts in other sectors is relevant but due to scarcity of data difficult to carry out. Some specific information could be obtained. According to an important policy document[5] the energy sector comprising both electricity and heat generation for district heating is the largest contributor to GHG emissions with a share of more than 50% of total emissions. According to the document, despite a number of

[5] National Allocation Plan of CO2 Emission Allowances for 2008-2012 Settlement Period, Poland Ministry of the Environment, 2006

measures to be implemented, it is not possible to reduce emissions from this sector by more than 0.2% per year. The institutional and residential buildings, commercial and agriculture CO_2-source category, which is roughly equivalent to the emissions due to heat use in buildings addressed by the grants programme, is contributing less than 17% to total GHG emissions. The grants programme contributes with more than 1% to the national target of CO_2 reduction in the relevant sector. Hence, the programme reviewed is considerably more effective in proportional contribution to national targets when compared to the envisaged efforts in the energy sector. A comparison of the cost at which this is achieved is not possible, as data from the energy sector are not available.

Average costs of CO_2 avoidance found in the programme with EU marginal costs are of interest for comparison with the programme. This however, meets with difficulties. First, authors of five different studies[6] carried out in the years 1999 to 2001 come up with five different figures, ranging from EUR 20 to 135 per tonne. Second, it is obvious that higher percentage levels of energy saved, and therefore CO_2 avoided, is over-proportionatley more expensive, and the baseline energy use intensity determines to a large extent what level of percentage-wise saving results from a specific measure. In other words, moderate measures on a building in very poor shape energy-wise, are more cost effective in terms of CO_2 avoided than further optimising and maximising energy savings by investing in comprehensive measures in a building that is already in relatively good shape. Third, since the studies done six to eight years ago cost of construction have increased in Poland at an estimated 30 to 60%. As a consequence of all factors, cost comparison does not appear very meaningful. What could be learned is that a wide range of avoidance costs found is not unusual due to different situations and circumstances and that the cost level of CO_2 avoidance in the programme is in good company with the general level of such costs in the EU.

Recent and ongoing policy discourse between the EU and Poland indicates that Poland is concerned that fulfilling all climate-related measures under EU Directives may unduly increase costs of industrial production. The Government, it seems, is reluctant to implement some of the measures. The programme reviewed is different from this. For most projects, the payback period is short enough for the projects to be financially viable. This will be shown in a later paragraph. Also, it appears that there are a good number of funding sources for the type of projects under discussion. Stakeholders have realised that energy saving and improved heating efficiency, belong to the most effective GHG reduction measures that are realistically possible. Last but not least, this is also due to the fact that green house gas reduction is just one of the benefits.

Assuming an average project life of twenty years, which is conservative, the total accumulated CO_2 reduced in this period amounts to a calculated 1.04 million tonnes. At an investment cost of EUR 70 million, the cost of CO_2 avoidance is about EUR 68 per tonne on an average, calculated for all future annual reductions during the project life of 20 years at today`s cost. There is wide variance among the projects in terms of cost of CO_2 avoidance, ranging from an extreme indicative EUR 17 to EUR 225 per tonne. This points to widely different project situations, but it is also found that CO_2 calculation done by the projects

[6] Reference from *ibid*

themselves is often in-transparent and possibly not realistic. It is also noted that in some projects, no CO_2 is replaced as the replaced fuel is biomass, and geothermal energy in one case, which are considered CO_2-neutral.

3.2.5 Reduction of other Pollutants

The saving of roughly one million tonnes of coal also results in the reduction of a number of pollutants, in particular sulphur dioxide SO_2, nitrogen-oxygen compounds No_x and dust particles. The quantities of reduced pollutants are considerable, but on a project level the review has not found consistent data. Nonetheless, at the programme level, it is estimated that almost 8,700 tonnes of sulphur dioxide and 2,800 tonnes of nitrogen oxides, as well as 20,000 tonnes of dust particles are avoided over the technical life time of the projects. The volumes of reduction of pollutants were calculated at the programme level only, using general pollutant emission values[7].

3.2.6 Payback Period and Unit Costs

In terms of financial viability of the projects, the review has used the payback period as a simple and easily understood measure. It determines how many years of energy saving after project completion will be needed to pay back the investment with savings from reduced energy use. The 10% best performing projects have an average payback time of less than 4.5 years. The core 80% of the projects, on the other hand, have a payback time of just under 11.5 years, while the 10% poorest performers need an average of more than 26 years to repay the investment, in all cases assuming that energy prices are stable and as assumed. The reliability of these calculations is not considered as very high, as assumed money saving has often not been transparently presented in project documents. Nonetheless, as a trend indication, the numbers serve well.

Using the different criteria, the range of financial performance for the three defined groups Top, Core and Bottom, is shown in the following table.

	Financial Results		
Project Group *	Unit cost of measures (EUR/m3)	Payback period of investment (years)	Avoidance cost of CO2 (EUR/tonne)
Top 10%	11	4.4	32
Core 80%	27	11.6	72
Bottom 10%	61	26.2	188
Total average	23.70	12.9	68

* Note: The projects in the three groups are different for each criteria

[7] Source: Abfallwirtschaft Taschenlexikon, Weber Rudolf, OLYNTHUS Verlag, 1994

Unit costs per m^3 of building space modernised, range from less than EUR 10 to EUR 87, while the average of the core 80% is 27 EUR per m^3. This indicates that widely different situations require substantially different levels of investment.

3.3 Programme Performance

Overall programme performance is determined by establishing performance categories at different levels: Top, Average and Bottom. This makes it possible to analyse the major trends. The purpose of this is to show performance at the programme level and its variations, without getting distracted by project details.

The review has developed and used a simple project performance assessment framework. This has been used to rank and categorise projects, and to determine the overall quality of programme implementation. The assessment considers the following elements of performance:

- Project design, in which the quality of energy audit is the most important indicator
- Best available technology (BAT): Extent of use
- Effectiveness of the measures in terms of the relative energy saving level achieved, and how cross-cutting issues have been addressed.
- Cost efficiency in terms of unit costs of rehabilitation measures, payback time of the investment and cost of avoided CO_2
- Relevance in terms of project contribution to the national targets, replicability and demonstration value
- Subjective gains, other than measurable indicators

The assessment elements and underlying criteria are elaborated in some detail below.

3.3.1 Project Design

The criteria used to determine project design quality were: a) taking into account the payback period, b) the quality of the energy audit, and with a smaller weight c) the consistency of cost budgeting, and d) the degree to which later project modifications were needed.

The result of analysis is that there is room for improvements in the area of project design and energy audit, and in energy production and use management in general. This is understandable, as these subjects are more complex and less well understood in the community of building and construction professionals which are the main group of specialists engaged in the type of projects in question. Moreover, there is a strong tradition of obtaining heating energy from external suppliers such as community and municipal district heating plants, and such stakeholders and their specialists have been involved in the projects at the very margin.

There is also limited experience in using solar energy for hot water and biomass, such as wood chips and pellets, as fuel in heat production. Only eight of the projects, or 12%, use one or the other of these renewable resources. These are of a pilot character, and due to the lack of experience leave room for design improvements.

3.3.2 Use of Best Available Technology

This has been assessed in comparison to state of the art windows, doors, and insulation materials and insulation thicknesses used with a scoring scale developed for this purpose.

A second criterion was the projected degree of energy saving, and whether radiator thermostatic valves and clean fuel (gas) or renewable energy are being used.

The results: Insulation materials used are mostly expanded polystyrene which is an oil-based plastics material that is widely available. Rock-wool and fibre-glass materials are also available, but in application for wall insulation it is more complicated to use. On the other hand, rock wool and fibre glass are inert materials and therefore environmentally superior.

Insulation thicknesses, in general, are at the lower end of what is considered the accepted European standard. Broadly speaking, most projects would benefit from an additional 2 to 3 cm of insulation thickness as compared to the result of the "standard" energy audit, simply because this would anticipate possible future energy price increases. In practice, it means that 15 cm insulation thickness should be preferred to 12 cm, very generally speaking. This hypothesis of the review is supported by the results of other studies. One study[8] indicates that insulation thickness applied in Poland tends to be less than in European countries with comparable climate. Another study[9] shows that an increase in insulation thickness as proposed above increases energy savings proportionately, while the increase in costs is not significant.

The type of windows used is of high standard double-glazed state-of-the-art. Frames are mostly PVC, which is somewhat inferior to wood, but less costly. Hence, there is in general a compromise on environmental advantages in favour of better cost economy. PVC (poly-vinyl-chloride) is oil-based as all plastics. Its disposal at the end of its life is problematic, as it contains the heavy metals cadmium and lead needed as chemical stabilisations, and burning PVC produces dioxins which are a cancerogenous substance. For this reason, the use of PVC materials is not considered quite BAT.

In some projects BAT in the form of solar hot water systems is used. This is particularly useful in housing projects and hospitals where hot water use is on a daily basis in considerable quantity. In the experience of the review, if properly designed and dimensioned, solar hot water systems can be very cost efficient. In at least one project inspected and studied in some detail, the awareness of this fact has existed, and as consequence, a very cost effective concept of pre-heating domestic hot water with five units of solar arrays has been conceived and implemented. This provides a part of the hot water needs for an estimated 950 inhabitants. There is no doubt that the measure is a successful example in the opinion of the review. However, measurements will need to be done in the coming years to establish the extent of fuel saving and resulting cost-efficiency.

3.3.3 Effectiveness of the Measures

The main criteria here is the extent of achieved energy saving as a percentage of previous energy use (as also used above), and other elements are the degree of target achievement, and how far cross-cutting issues have been addressed by the project. Effectiveness also includes aspects of reporting of the beneficiary to the donor.

The result is a relatively even performance across projects, in which the largest variable is the energy saving level. The degree of target achievement could not actually be

8 Eurima Insulation Thickness Survey 2004, http://www.eurima.org/

9 Cost-effective Climate Protection in the Building Stock of the new EU Member States, Ecofys-EURIMA, 08/2005

differentiated from one project to another as all projects cannot yet determine with clarity whether targets were actually achieved, due to projects being in progress or only recent completion.

In terms of reporting, the review finds a lack of uniformity of how baselines and results indicators are to be used in reporting.

3.3.4 Cost Efficiency

Three elements have been considered: a) the unit cost of the measures implemented in terms of cost per m^3 of rehabilitated building volume, b) the payback time for the investment, and c) the cost per tonne of CO_2 avoided, calculated by dividing investment cost by the assumed avoided CO_2 over a life time of 20 years.

Results using the cost efficiency criteria show wide variance. Relative to each other, the cost efficiency score varies from a low 13 points to a high 95 points. It indicates that in some situations cost has not been the overriding criteria. For example, some projects dealing with historically important objects are not free to use whatever measure to achieve energy saving, but have to maintain the original visual appearance of the building. This frequently increases costs, and may reduce the energy saving achieved. Historical facades for instance cannot in all cases be subjected to outside wall insulation.

3.3.5 Relevance

Here, a scoring scale has been applied for the level of CO_2 reduction contributed to the national target and the demonstration value and replication potential of the project has also been considered.

The result across projects is not assessed as widely variable. First of all, the review finds that all projects are relevant in the specific local context. In the national context, one could argue that large projects are more relevant than small projects, because absolute savings and the contribution to pollution reduction are larger. However, for small projects different relevance criteria may apply such as setting an example with new technology, and aiming at equitable regional development by also considering small projects of small rural communities.

At the programme level, another factor is also considered of importance, namely job creation. The measures applied are known to be quite labour intensive in a crucial sector of the economy that is among small and medium enterprises. The review estimates that the programme has provided employment for about 600 persons. Considering that the replication potential is estimated at a factor of 100, this appears as a very relevant contribution to the economy of Poland.

3.3.6 Health Impacts

All projects have subjective gains and in general intangible benefits. These however cannot be easily assessed. Typically, user surveys would be required on a meaningful scale to generate results. The review´s impression from visits is that the level of comfort is improved in the thermo-modernised buildings. Informal information received indicates that some objects have been in a poor state in terms of space heating to an extent that cold winter days necessitated closing the school for example.

Medical research indicates that there is a direct relationship between local pollution levels and the incidence of respiratory disorders. An improved room climate, especially in schools, is perceived as having a positive effect on the building occupants. Combined, a significant positive health impact is expected. Medical research in the medium to long term is required to establish and verify the extent of such impacts.

In terms of visual appearance, it is obvious that the modernised buildings are vastly improved. This, in many communities, boosts the image of the authorities, and the achieved solutions have generated much pride with the proponents.

3.3.7 Sustainable Development

Energy efficiency is one of the requirements of sustainable development. In the building sector, efficient energy use requires well insulated buildings. Therefore, a good insulation standard is a prerequisite for sustainable buildings. Sustainable buildings in turn contribute to sustainable development, and in this context, the programme makes an important and broad-based contribution in Poland. The specific factors in the programme that contribute to sustainable development are: Resource (fuel) conservation, pollution reduction, avoidance of GHG emissions, a positive health impact, job creation, and finally comfort gains for users and image gains for the implementing authorities, quasi social capital gains.

3.3.8 Summary of Project Performance

Another assessment element initially intended to be used is "project management and implementation". However, it was found that in retrospect, it is impossible to assess project management reliably on the basis of project documentation, and as regards implementation standards, no variability was found in the projects visited, and according to the supervising national agency, implementation is even in all other projects also. Hence, a *project management and implementation* assessment element was not used.

The assessment framework, applied to every project, produced a numerical indicator for each assessment element, after values for criteria resulting from various scoring scales were filled in. A composite indicator was then calculated as the arithmetic mean of all six elements. The resulting score provides for ranking the projects on an arbitrary scale from 1 to 100, where a score of 100 would be theoretical perfection. Results are as follows:

- The 10 percent best performing projects score on average 69 points, with the highest at 73 points.
- The 80 percent core projects score on average 57 points, with the lowest at 48 and the highest at 65.
- The bottom 10 percent projects have an average performance score of 45 points, with the lowest at 41 and the highest at 46.
- Taking the average of each group, and the core eighty percent as the standard, performance varies by and large by plus/minus 20%. On this basis, programme performance can be assessed as of high and relatively even quality.

The review finds that the main success factor is a certain uniformity of the implementation measures and choice of building category. Almost 75% of all projects are addressing the category "schools and similar communal buildings", and all but three projects are implementing the energy saving measures "wall and roof insulation" as well as "windows and doors replacement". The standard of design and conception of such measures is satisfactory, and the standard of workmanship and supervision in implementation is high.

The challenges are in the area of project design and energy audit beyond mere building insulation, and in energy production and use management in general. This is understandable, as these subjects are more complex and less well understood in the community of building and construction professionals which are the main group of specialists engaged in the type of projects in question. Moreover, there is a strong tradition of obtaining heating energy from external suppliers such as community and municipal district heating plants, and such stakeholders and their specialists have been involved in the projects at the very margin.

There is also limited experience in using solar energy for hot water and biomass, such as wood chips and pellets, as fuel in heat production. Only eight of the projects, or 12%, use one or the other of these renewable resources. These are of a pilot character, and due to the lack of experience, leave room for design improvements.

3.4 Conclusion and Recommendations

The programme on energy saving and renewable energy use, as a major part of the projects under the Protection of the Environment priority area, is performing well. Projects are of high and relatively even quality. The expected results constitute a significant contribution to national targets, and there is a vast replication potential. The cost of avoided CO_2 appears moderate and realistic at a level of EUR 70 per tonne on an average.

Wide variation exists in terms of financial results of the projects, such as unit cost of measures, payback period, and CO_2 avoidance cost. The reasons for such wide variance lies in vastly different situations encountered, but also in the different scope of measures employed.

The key statement is that overall programme performance is of good standard across six dimensions, and that variance in project performance is moderate.

Performance of the projects is sound in terms of using best available technology: Insulation materials used and window design and quality are state of the art and of acceptable cost efficiency, and most projects apply effective thermostatic valves in heating system improvement. The broad application of these standard measures in schools and similar building types appears to be the main success factor. On the other hand, the potential for saving of energy use management appears not to be well understood and applied.

Technologies of higher sophistication such as renewable energy and automation and control devices are much less frequently used, and a barrier is limited experience. Energy (use) management, as an effective non-investment saving measure, is largely absent in the projects, due to an apparent lack of awareness of its importance and potential.

One area that leaves room for improvements is a more even standard of energy audit, energy auditors improved appreciation and consideration of rising energy costs, and the improved linking of energy savings to the fuel replaced, and related GHG emission and pollution reduction. Also, the inclusion of lighting energy use in energy audit and the measures implemented would be beneficial.

It appears that the capacity for the processing (screening) of project applications, constrained design capabilities and energy audit capacities and to an extent limited awareness of the-state-of-the-art of comprehensive energy saving in the building sector, are the main limiting factors in the way of further improvements and a larger scale of activities.

By contrast, the review has the impression that available funding sources do not constitute a major constraint.

Recommendations

Energy saving measures in the sub-sector reviewed are well established in Poland and much has been achieved with the assistance of EEA/Norway Grants. Further improvements to the programme and at the project level appear feasible to an extent of an additional 10 to 20% saving at a marginal increase of cost. With a view to this, the review makes some recommendations.

- The key recommendation of the review is to consolidate the standard of energy audits in terms of providing reliable energy saving and pollution reduction indicators. It appears that this would require an overhaul of the energy audit procedures, but also further training of energy auditors on a broad scale.
- The second recommendation is to consider energy use management as an additional standard project measure, as this does as a rule not increase investment costs, but it has a potential in increasing energy savings.
- The third recommendation is to consider to a larger extent the inclusion of the sub-category of housing cooperatives or government owned apartment blocks because this has a huge saving potential. In addition to standard measures such as thermo-modernisation and heating system improvement, an effective measure is seen in hot water supply modernisation. Solar thermal energy is an effective and economic measure here, if applied diligently for water pre-heating.
- Fourth, in addition to measures in the heating area, it could be very beneficial to engage in measures for electricity saving at all levels. The review recommends adapting the energy audits to include electricity use and to include potential saving measures in the target sub sector.
- Further, project applications screening and processing capacity under various available funding mechanisms needs to be increased to make scaling up of energy saving efforts in the sector possible.

Annex A: Terms of Reference

Introduction

Energy saving in public buildings (2.1.3 – 61 projects), the use of renewable energy sources in heating systems (2.1.4 – only one project can be considered - PL0121), modernisation of heating systems including energy sources in order to make them more efficient, ecological and energy-saving (2.1.2 – only two projects can be considered - PL0144 and PL0163) are important sub-sectors in the priority sector of the PROTECTION OF THE ENVIRONMENT. It is estimated that more than one third of air pollution and emission of green house gases is caused by heating of buildings with coal-fired heating systems, or the use of other non-renewable fuels for heat energy applications.

Under EEA and Norwegian grant financing, about 64 projects are being implemented in the sub-sector of energy saving and renewable energy promotion, with the aim of reducing air pollution by reducing fossil energy use, mostly in coal fired heating systems.

The measures planned and implemented to achieve a reduction in energy use are broadly concentrated on public buildings, where insulation of walls, ceilings and roofs, the renewal of windows and doors, and the modernization of heating systems are intended.

The use of renewable energy is not very wide spread in Poland. A number of projects are therefore undertaken as pilot projects, where non-renewable energy sources such as coal and oil are replaced by biomass fuel or solar energy. A typical application is the use of solar collectors for hot water, and the use of wood chips in central heating boilers to replace coal. These projects are intended for gaining relevant experience

Purpose

The purpose of the review is to determine the combined impact at the national level, of results at the project level, with a view to assess the efficiency and effectiveness of this type of projects. This may assist in gaining a deeper understanding of the type of measures that are the most promising, in terms of the replication potential at a larger scale. The aim is to contribute to a sharpening of the focus at the national level, with regard to the promotion of environmental protection measures.

It is intended to produce a report that presents summary findings of project implementation performance and expected impact, and how this contributes to overall Polish goals of GHG reduction and air pollution reduction.

Scope of Work

The review shall collect pertinent data from all (about 64) projects from existing data sources. It is then planned to categorize the projects broadly and to compile project and results data for each category.

Project owners will be asked by email to provide or verify specific information not available in existing documents. It is estimated that this may be necessary for about half the projects. A comprehensive questionnaire with total coverage is not intended to be used.

To gain a deeper understanding of the projects implemented, and in order to be able to present some case studies in the review report, field visits to about 8 projects are intended, reflecting a fair sample of the various categories. Here, emphasis will be two-fold: a) on the more innovative and complex approaches and b) on those projects that are not well understood from available documentation, but seem important in terms of potential.

The review shall analyze the information collected in terms results achieved/achievable and in terms of implementation performance. Results of such analyses shall be presented and compared to best practice and the contribution to national goals, as far as such is defined.

The review will be looking for suitability of the selected energy measures:

- Relevance of the thermo modernisation measure – (reference to EU energy saving Directives, Kyoto Protocol and climate conventions as well as national strategies);
- Response to the needs – (conditions of public utility building, high competitiveness among applicants, number of application received in comparison with applications received in other measures,);
- Satisfaction of users of thermo modernised buildings (e.g. patients, students, pupils, local population)

Specific results that the review will be looking for are:

- Energy units saved in comparison to the baseline value (i.e. the consumption before the project)
- The money saved in operation in terms of reduced energy/fuel costs, and from this the project investment payback period.
- The pollution/CO2 emission reduction resulting from reduced energy use in the specific situation

Performance indicators that are considered to be used at the project level are:

- The project quality in terms of preparation of the investment (proper assessment and estimation of target and baseline values of indicators, proper management during implementation process, risk management strategy – reduction of need for additional unforeseen works during implementation phase e.g. mould removal).
- The project quality in terms of its design and its merits regarding best available technology and implementation features
- The effectiveness of the project in terms of Energy units saved in comparison to before-project consumption
- The cost efficiency of the project in comparison to other projects e.g. comparison of investment unit costs such as costs of window and door replacement (such comparison can only be made for almost identical investments – regional cost variations, ecological localisation and effect of scale may influence cost of the investment – bigger projects normally have lower unit costs, physical scope of the projects and its localisation shall be comparable (a benchmarking study), and in terms of the calculated payback period of the investment, and in terms of cost of reduction cost 1 tonne of CO2, SO2 and NOx.
- The relevance of the project with regard to replicability and publicity value,
- Sustainability of the projects - (e.g. fund established to maintain results of the project for the agreed period 5 or 10 years)
- Additional environmental dimension - (e.g. positive examples on how beneficiaries fulfill the condition saying that all waste generated during thermo modernisation

process will be utilized in any extracted material from the construction and renovation must be reused, recycled treated or deposed in environmental sound manner).

A simple scoring scale for the indicators shall be developed and applied. Both, results and performance indicators will be used for assigning the projects to the defined performance groups.

Methodology

In brief, the review is to follow and use the following methodology:

- Project document review and data gathering from existing document sources
- Conduct of verification and specific question survey on a limited scale
- Field work, i.e. in depth study of a sample of projects with the aim of building up representative case stories covering different project types.
- Analysis of findings, extrapolation of results to the extent of the totality of projects, and elaboration of impact expected to ultimately be achieved, and summary assessment of potential longer-term national level impact for the sector activity.

Implementation of the Review

Implementation of the review shall be in 4 phases which partly overlap.

1. The consultant will review project information available from FMO, with a view to extract specific information as to type, volume and status of projects, as well as specific projected and expected to be achieved results and performance. Available background information on Polish policies and strategy in the target areas will be studied to determine the national goals and focus areas. This task shall be carried out by the designated international consultant at the home base with a tentative two day visit to Brussels for the consultation of additional documents not reviewed.
2. Hand in hand with the desk study and later field work, complementary (lacking/clarifying) information will be sought from project proponents through email, and where appropriate personal contact. A Polish consultant is to collaborate in this effort, as well as in field work, with translation and interpretation assistance.
3. During a visit to Poland, roughly ten percent of the projects shall be visited by the international and the Polish consultant in order to get a first hand impression of project activities carried out. Through project site visits and interviews of stakeholders, the purpose shall be to substantiate and verify results, and the performance parameters assessed. If appropriate, the field work shall be concluded with visits to the focal point and intermediary institutions to discuss and assess the impacts, achieved, expected and potential, at the national level.
4. Writing of draft and final report versions shall conclude the assignment.

It is expected that a written endorsement issued by the focal point may be needed to identify the consultants as legitimized to carry out the activity vis-à-vis the project proponents and other stakeholders.

Reporting

The review shall produce a report, which is to contain the following:

1. An executive summary, containing the summary results and recommendations of the review
2. A brief introduction, background description and the review was carried out.
3. A chapter presenting the scope of works of the implemented measures in various categories, i.e. the methods and technologies used, and how these were implemented.
4. An assessment chapter:
   a. Performance of projects in the various categories
   b. Results achieved in the categories, summarised in a results matrix. The aim is to show the expected impact in each category, in terms of energy saved, and GHG reduced, and to relate this to costs, thus arriving at Euro/tonne CO2, for example.
   c. A category and group matrix may be presented in the following, or a similarly informative, manner:

Category	Performance Groups		
	Top	Average (core)	Bottom
Building/project category	Values for best 20	Values for in between performers	Values for bottom 20
Schools and general public buildings	EUR/tonne CO2, Euro saved per year, other pollutants avoided, in each category and group		
Hospital and similar facilities			
Communal heating system rehabilitation			
Renewable Energy pilot project	Type of project, potential, etc. for each group		

Work Volume and Time Frame

The review is estimated to require a total of 27 work days for an international consultant and 17 work days for a national consultant. It shall be carried out during October and November 2008. A draft review report is due in the middle of November, and upon receiving comments from stakeholders the aim is to complete the work and produce a final report by the end of November 2008.

The field work in Poland is planned to be carried out end of October, first week of November 2008. This will be preceded by the desk study.

Projects considered for site visits

Measure: 2.1.3: PL0112, PL0176, PL0155, PL0142, PL0149, PL0122, PL0111, Pl0146, PL0156

Measure: 2.1.2: PL0144, PL0163

Measure: 2.1.4: PL0121 – OZE

Annex B: Documents consulted

Documentation for the projects funded with EEA/Norway Grants are largely standardised by the FMO with templates that are provided to applicants. A number of these documents have been relevant for the review. For each project, at least the following documents were consulted:

#	**FMO Document name**
1	Project Application (form PAF)
2	Project Detailed Appraisal Report (form DAR)
3	Grant Decision Document (form GDD)
4	Applicant's Energy Audit Summary Report
5	Applicant's Economic and Financial Analysis of the project
6	Project Intermediate and Completion Report (forms PIR and PCR)
7	Focal point's communication of grant agreement concluded with applicant

<u>External documents</u>

- Cost-effective Climate Protection in the Building Stock of the new EU Member States, Ecofys-EURIMA, 08/2005
- National Allocation Plan of CO_2 Emission Allowances for 2008-2012 Settlement Period, Poland Ministry of the Environment, 2006
- Eurima Insulation Thickness Survey 2004, http://www.eurima.org/
- Abfallwirtschaft Taschenlexikon, Weber Rudolf, OLYNTHUS Verlag, 1994
- EU Directive 2002/91/EC on Energy Efficiency: Energy performance of buildings

Annex C: List of Projects

Object categories: 1=schools and similar, 1=hospitals and similar, 3=heating system renewal, 4=housing cooperatives

Implementation status: A=completed, B= under implementation, C=not started

FMO No.	Project Name	Grant amount (EUR)	Object category	Implementation status	visited by review
PL-0 110	Czluchow - Thermo modernisation of a primary school and a municipal kindergarten	449 347	2	A	No
PL-0 111	Kolobrzeg - Thermal modernisation of public utility complexes	638 041	2	B	Yes
PL-0 112	Tarnów - Thermal modernisation of Specialist Hospital	485 819	2	A	Yes
PL-0 114	Gora - Thermo modernisation of school complex facilities	322 472	1	A	No
PL-0 115	Prudnik - Thermal insulation of schools	425 898	1	B	No
PL-0 120	Glubczyce - Thermo modernisation of school	286 073	1	A	No
PL-0 121	Bartoszyce District - Modernisation of Heating Management	2051 750	3	B	Yes
PL-0 122	Dzialdowo - Thermo modernisation of an elementary school	263 477	1	A	Yes
PL-0 124	Lodz - Thermo modernization of the buildings of the Lodz Technical University	1346 442	1	A	Yes
PL-0 125	Przemysl - Thermo modernisation of education facilities	880 427	1	A	No
PL-0 126	Szprotawa - Thermo meodernisation of school and education centre	349 331	2	B	No
PL-0 127	Konskowola - Thermo modernisation of public buildings	320 938	1	A	No
PL-0 128	Zakopane - Thermo modernisation of schools	525 017	1	B	No
PL-0 129	Wadroze Wielkie - Thermo modernisation of public buildings	425 719	1	B	No
PL-0 131	Sosnowiec - Thermo modernisation of hospital	1354 014	2	B	No
PL-0 136	Radzilow - Thermal insulation of public utility buildings	278 608	1	A	No
PL-0 137	Orzysz - The construction and modernisation of the heating network	259 856	3	A	No
PL-0 138	Zabludow - Thermo modernisation of public utility buildings	423 078	1	A	No
PL-0 139	Kreszyce - Thermo modernisation of the commune school	322 458	1	B	No
PL-0 140	Smetowo Graniczne - Thermo modernisation of an education complex	275 015	1	B	No
PL-0 142	Pakosc - Thermo modernization of a middle school	250 623	1	B	No
PL-0 143	Torun - Thermo modernisation of educational buildings	591 226	1	B	No
PL-0 144	Ozarow - Modernization of boiler room	342 284	3,4	B	Yes
PL-0 146	Gdynia - Thermal insulation of educational institutions	1998 080	1	B	Yes
PL-0 147	Kamiena Gora - Thermo modernization of public buildings	354 531	1	A	No
PL-0 149	Dzierzgon - Improvement of energy conservation in public service entities	284 106	2	B	Yes
PL-0 150	Konstantynow Lodzki - Thermo modernisation of public buildings	761 867	1	B	No
PL-0 151	Wejherowo - Thermal modernisation of the buildings of the educational centre no. 2 of the Deaf	382 740	1	B	No
PL-0 155	Busko district - Thermo modernisation of educational institutions	1 885 056	1	B	Yes
PL-0156	Swidwin - Thermo modernisation of public utility buildings	822 786	1,2	A	Yes
PL-0158	Wierzbica - Thermo modernisation of public utility buildings	334 138	1	B	No

Object categories: 1=schools and similar, 1=hospitals and similar, 3=heating system renewal, 4=housing cooperatives

Implementation status: A=completed, B= under implementation, C=not started

FMO No.	Project Name	Grant amount (EUR)	Object category	Implementation status	visited by review
PL-0160	Brody - Thermo modernisation of public utility buildings	311 065	1	B	No
PL-0161	Ustrzyki Dolne - Thermal efficiency improvement	576 899	1	B	No
PL-0163	Przewrorsk - Modernisation of the heating system for housing cooperative	194 567	3,4	B	Yes
PL-0166	Brzesc Kujawski - Thermal modernisation of primary school and kindergarten	485 882	1	B	No
PL-0167	Walim - Thermo modernisation of a group of school buildings	347 471	1	A	No
PL-0172	Barcin - Thermo modernisation of public buildings	703 398	1	C	No
PL-0173	Bartoszyce - Thermo modernisation of educational facilities	546 252	1	B	No
PL-0176	Olsztynek - Thermo modernisation of the Voivodeship rahabilitation hospital for children in Ameryka	634 917	2	B	Yes
PL-0177	Kolno - Thermo modernisation of public utility buildings	660 902	1	B	No
PL-0179	Wagrowiec - Thermo modernisation of municipal buildings	634 195	1	B	No
PL-0180	Golancz - Thermo modernisation of municipal buildings	301 317	1	B	No
PL-0181	Lubaczow - Thermo modernisation of public buildings	257 972	1	B	No
PL-0182	Skarzysko-Kamienna - Thermo modernisation of buildings	880 399	1	B	No
PL-0183	Wabrzezno - Thermo modernisation of public utility buildings	959 192	1	B	No
PL-0184	Radom - Thermo modernisation of public premises	782 016	1	B	No
PL-0185	Stegna - Thermo modernisation of social assistance house	532 692	2	A	No
PL-0186	Bytow - Thermo modernisation of public buildings	278 895	1	B	No
PL-0187	Nowa Ruda - Thermo modernisation of public utility buildings	1070 857	1	B	No
PL-0188	Darlowo - Thermo modernisation of public buildings	869 144	1	B	No
PL-0189	Dzierzonlow district - Thermo modernisation of public buildings	790 058	1,2	B	No
PL-0190	Slupca - Thermo modernisation of public facilities	642 269	1,2	B	No
PL-0191	Jaslo - Thermo modernisation of public premises	726 436	1	B	No
PL-0192	Walbrzych - Thermo modernisation of public premises	1165 399	1	B	No
PL-0193	Nowy Dwor Gdanski - Thermo modernisation of public buildings	702 466	1	B	No
PL-0194	Chmielno - Thermo modernisation of public utility buildings	395 914	1	B	No
PL-0195	Nowosolski Poviat - Thermo modernisation of public premises	145 824	1	B	No
PL-0197	Opatow Poviat - Thermo modernisation of public premises	1101 358	1,2	B	No
PL-0198	Namyslow Poviat - Thermo modernisation of public premises	385 486	2	B	No
PL-0202	Ropczycko-Sedzioszowski district - Thermo modernisation of public premises	1723 871	1	B	No
PL-0203	Mecinka - Thermo modernisation of public premises	355 180	1	B	No
PL-0204	Gardeja - Thermo modernisation of public utility buildings	630 758	1	B	No
PL-0206	Nowa Sarzyna - Thermo modernisation of public premises	860 366	1	B	No
PL-0207	Opole Lubelskie - Thermo modernisation of public premises	596 352	1	B	No
PL-0208	Slawno - Thermo modernisation of public buildings	526 929	1	B	No