

Contents

ENGLISH SUMMARY	9
UKRAINIAN SUMMARY	11
Foreword	13
1. Introduction	15
Bibliography	16
2. Energy management and possibilities of increasing energy efficiency in public utility buildings	17
2.1. Calculation of heat demand according to PN-EN ISO 13790:2008 standard	17
2.2. Support for energy efficiency in buildings – Thermal insulation Act	19
2.2.1. Principles of assistance for thermal insulation	19
2.2.2. Stages of receiving co-financing	21
2.3. Energy audit	22
2.3.1. Review of assumptions adopted for calculations	22
2.3.2. Thermovision examinations	23
2.3.3. Opportunities for improvements in order to streamline energy consumption	26
2.3.4. Determination of capital expenditures and savings coming from improvements	27
2.3.5. Calculation of savings from projects and economic analysis	27
2.4. Energy certificates of buildings	28
2.4.1. Principles of preparing energy certificates for buildings	28
2.4.2. Calculation procedure	29
2.4.3. Calculations of the annual demand for primary energy	31
2.4.4. Calculations of the annual demand for final energy	34
2.4.5. Calculations of the annual demand for final energy for the needs of built-in lighting	36
2.5. Example of energy performance preparation for a public utility building	38

2.6. Passive buildings	46
2.6.1. Nomenclature and classification	46
2.6.2. Criteria of a passive house	47
2.6.3. Most recent changes in technical conditions to be met by buildings	49
Bibliography	51
3. Energy in Ukraine	54
3.1. The energy balance of Ukraine	55
3.2. Energy Strategy of Ukraine	58
3.3. Measures for implementing energy efficient technologies in the town and Region of Ivano-Frankivsk	67
Bibliography	70
4. Possibility of old oil and gas boreholes use for heating purposes	72
4.1. The legislative aspect of the use of wells preparing for close up or already closed up	72
4.1.2. Legal aspects of the possibility to use abandoned wells as a source of low-graded heat	76
4.2. Peculiarities of geological composition and development of oil and gas fields in Ivano-Frankivsk Region	77
4.2.1. Geological composition	79
4.2.2. Description of Nadvirna oilfield area	81
4.2.3. Description of Dolyna oilfield area	83
4.3. Analysis of structures of borehole heat exchangers	85
4.3.1. Structures of typical borehole heat exchangers	86
4.3.2. Untypical structures of borehole heat exchangers	89
4.3.3. Materials used in pipes	90
4.3.4. U-shape exchangers	91
4.3.5. Centric exchangers	92
4.3.6. Adaptation of drilling holes as borehole heat exchangers	99
4.4. Determination of the energy potential of the existing or removed boreholes	101
4.4.1. Methodology of calculating heat amount around a borehole	102
4.4.2. Hydrogeological conditions of heat exchange in borehole exchangers	105
4.4.3. Thermal response test	109
4.4.4. Temperature logging	114
4.5. Heating and heating/cooling systems relying on heat pumps and borehole exchangers	115
4.5.1. Sources of low-temperature heat	116

4.5.2. Kinds of low-temperature heat sources	117
4.5.3. Heat consumers	119
4.6. Adaptation of a borehole to a borehole heat exchanger taking the example of Nadvirna deposit in Ukraine	119
4.6.1. Technical condition of the borehole	119
4.6.2. Lithological profile	121
4.6.3. Thermal profile	121
4.6.4. Heat carrier	122
4.6.5. Structure of a borehole heat exchanger	122
4.7. Forecasts of borehole heat exchanger operation	129
4.7.1. Distribution of temperatures in rock mass around a borehole heat exchanger	138
Bibliography	144
5. Economic evaluation and sources of financing capital projects relating to rational energy management in Ukraine	148
5.1. Selected methods of calculation of economic indicators	149
5.2. Risk in geoennergetics projects	150
5.3. Sensitivity analysis	151
5.4. Possibilities of improving economic factors	152
5.5. Sources of financing capital projects relating to rational energy management in Ukraine	153
5.5.1. Ukraine's strategic plans in the area of energy management streamlining	154
5.5.2. Perspectives of economy modernisation relating to rational energy management	156
5.5.3. Sources of financing investments relating to rational energy management from assistance funds	157
5.5.4. The role of EU's environmental protection policy, Neighbourhood Policy and support for reforms for Ukraine as the source of inspiration for the activities taking place in Ukraine	166
5.5.5. Main barriers to investment projects and energy saving as well as conditions necessary for rational energy management	167
Bibliography	168
6. Conclusions	170