





# Common borders. Common solutions.



Market research of innovative technologies for EE and climate protection in historic buildings and areas in Bulgaria









# **INTRODUCTION**

The present research has been implemented under Activity T1 - Technical solutions in EE and climate adaptation within historic buildings and monuments in the frame of the *GreeTHIS Green Tourism and Historical heritage - a stepping stone for the development of the Black Sea Basin* Project, funded by CBC Black Sea Basin 2014-2020. **GreeTHIS** has brought together partners from 6 countries: Bulgaria, Moldova, Ukraine, Greece, Georgia and Romania.







Black COOPERATION

# CONTENT

CROSS BORDER 🗙

INTRODUCTION
LEGISLATION IN THE FIELD OF ENERGY EFFICIENT TECHNOLOGIES IN BULGARIA 4
LEGISLATION IN CULTURAL HERITAGE
LEGISLATION ON EE AND RES
EU legislation
EE Policy in Bulgaria8
ANALYSIS OF THE MARKET OF ENERGY-EFFICIENT TECHNOLOGIES
BUILDING SCALE (ENERGY EFFICIENCY)13
Building shell improvement
Natural lighting techniques
Energy efficient heating and cooling systems
Rational use of energy
RES (BUILDING SCALE)
Solar Energy Systems
Solar thermal/PV systems
Small scale building-mounted wind turbines47
Heat pumps
Biomass
COMMUNITY SCALE
Sustainable transport – car clubs, travel reduction measures, public transport improvement.56
PROPOSALS ON THE USE OF ENERGY EFFICIENT TECHNOLOGIES ON EXAMPLES OF HISTORICAL OBJECTS OF THE BLACK SEA BASIN
LIST OF TECHNOLOGIES, PRODUCERS AND DISTRIBUTORS AVAILABLE AND OPERATING IN BULGARIA
CONCLUSIONS
REFERENCES







www.greethis.net

# LEGISLATION IN THE FIELD OF ENERGY EFFICIENT TECHNOLOGIES IN BULGARIA

The implementation of energy efficiency measures in Bulgaria is executed in accordance with a number of laws and regulations. The Bulgarian legislation is harmonized with the requirements and directives of the European Union to a large extent.

Energy efficiency is applied over the entire cycle from recovery to end-user consumption. Since this is a case of buildings with historical knowledge, this study will focus on the issues of final consumption. At the same time, energy efficiency should not be an end in itself, but integrated measures must be applied to a number of other requirements, such as preserving the architectural and historical vision of the building. This requirement presupposes a challenge to designers and practitioners of energy efficiency measures. An additional challenge is the structural resistance of buildings of historical significance and the financial justification. All these problems have already been successfully solved in a number of European countries, and in Bulgaria there are successful examples.

Nevertheless, it should be noted that due to economic reasons a number of historic buildings disappear from the urban environment. When undertaking steps to implement energy efficiency measures, the most important elements of the building are affected in terms of its architectural and historical aspect. These important elements are generally the facades and windows of the building. At first sight, it is necessary to apply energy efficiency measures which are unacceptable in terms of preserving the historical appearance of the building.

# LEGISLATION IN CULTURAL HERITAGE

CROSS BORDER

The Cultural Heritage Act regulates the preservation and protection of the cultural heritage of the Republic of Bulgaria and ensures the protection of the cultural heritage, regardless of its whereabouts.

Buildings are considered as architectural sites and complexes (Chapter Four of the Act). The designation of a building or complex of architectural value is managed by the Minister of Culture through an official chosen by him. The control of compliance with the requirements of the Act is carried out by the State Inspectorate for the Protection of Cultural Heritage. The mayors of municipalities organize and coordinate the implementation of the policy on the protection of the cultural heritage on the territory of the respective municipality.

**The National Strategy for culture development** is adopted by the Council of Ministries for 10-year period of time. It sets strategic objectives for culture heritage management and protection according to the legislative documents related to culture development.







5

www.greethis.net

The National Act for Development and Protection of culture sets the basic principles and priorities of the national culture policy implementation, the cultural organizations and the bodies which protect the culture, the ways of supporting and financing cultural activities and artists. The Ministry of culture implements the state policy for culture protection and development through financing of culture institutes, initiatives, programmes and art projects; cooperation; information campaigns and publicity of cultural activities.

The Protected Areas Act regulates the categories of protected areas, the assigned use thereof and the regime of protection and use, designation and management of the said areas. The purpose of the act is to conserve and preserve protected areas as a national and universal human wealth and asset and as a special form of conservation of Bulgarian nature, conducive to the advancement of culture and science and to public welfare.

According to art.5 of the Act there are 6 categoris of protected areas defined: 1. strict nature reserve; 2. national park; 3. natural monument; 4. managed nature reserve; 5. natural park; 6. protected site.

The Ministry of environment and water and the regional authorities conduct and implement the management and control and commissioning activities in the forests, land tracts and aquatic areas within the protected areas constituting exclusive state property. The National Park Directorates and the Regional Inspectorates of Environment and Water are the regional authorities of the Ministry of Environment and Water in respect of protected areas.

Management plans are elaborated for protected areas under terms and according to a procedure established by a regulation endorsed by the Council of Ministers. Management plans of protected areas are commissioned by the Ministry of Environment and Water. Management plans of protected areas may furthermore be commissioned by the owners, municipalities, non-governmental organizations or associations and others upon the approval by the Minister of Environment and Water, or an official authorised by the Minister.

The National Institute for Immovable Cultural Heritage (NIICH) is a state-owned cultural institute of national importance and performs activities in the field of preservation of the immovable cultural heritage, including research and study on the immovable cultural heritage.

Buildings identified as architectural value are classified as "tangible cultural heritage" in the following way:

- Historical: buildings, facilities, other structures and memorial sites associated with remarkable historical events and personalities;

- Architectural-building: buildings, facilities, structures, parts or combinations thereof which have historical, aesthetic, technical, cultural and industrial-technical, spatial and functional value;







www.greethis.net

The designation of a building as architectural value is carried out by the NIICH, by scientific organizations, universities, museums, experts and juridical persons according to art. 57 of the Cultural Heritage Act.

Each municipality publishes a list of buildings of architectural value that is coordinated with NIICH from where owners can be informed about the status of their property and which activities need to be reconciled in advance. Prior to taking action to implement EE measures it is necessary to comply with the requirements that are reflected in the list of architectural monuments. For example, if thermal insulation is proposed on the outside and the list reflects that the façade has an architectural value and its original appearance should be preserved, then the EE measure must be adjusted and a solution must be proposed to preserve the architectural elements. Concrete examples are shown further.

## LEGISLATION ON EE AND RES

#### EU legislation

<u>ତ 🛓</u>

The EU is working to reduce the impacts of climate change and establish a common energy policy. As part of this policy, the Heads of State or Member States Government of the adopted in March 2007 binding targets for increasing the share of renewable energy. By 2020, renewable energy should account for 20% of final energy consumption in the EU (8.5% in 2005). In order to achieve this overall objective, each Member State must increase its production and use of renewable energy for electricity, heating, cooling and transport. These targets were updated in November 2018 by the European Parliament through the Clean Energy Package for all Europeans. By 2030, energy efficiency in the EU needs to improve by 32.5% and the share of renewable energy should account for at least 32% of the EU's gross final consumption. Both objectives will be reviewed before 2023 and can only be increased, but not reduced.

With more efficient energy, Europeans will have lower bills. In addition, Europe will reduce its dependence on external oil and gas suppliers, improve air quality and protect the climate. For the first time, Member States will be obliged to propose specific energy efficiency measures in favor of those affected by energy poverty. Member States must ensure that citizens have the right to generate renewable energy for their own consumption, store it and sell surplus production.

These new rules also aim to put consumers at the heart of the transition - in terms of giving them more choice, strengthening their rights, and enabling everyone to participate in the transition themselves by producing their own renewable energy and feeding it into the grid. By allowing electricity to move freely to where it is most needed and when it is most needed via undistorted price signals, consumers will also benefit from cross-border competition. This will drive the investments necessary to provide security of supply, whilst decarbonising the European energy system.







7

#### www.greethis.net

The EU package includes 8 different legislative acts as shown below:

- Energy Performance in Buildings Directive (press release 17/04/2018, Questions & Answers)
- Renewable Energy Directive (press release 14/06/2018)
- Energy Efficiency Directive (press release 19/06/2018)
- Governance Regulation (press release 20/06/2018)
- Electricity Directive (press release 18/12/2018)
- Electricity Regulation (press release 18/12/2018)
- Risk-Preparedness Regulation (press release 22/11/2018)
- Regulation for the Agency for the Cooperation of Energy Regulators (ACER) ( press release 12/12/2018)

	European Commissio n Proposal	EU Inter- institution al Negotiatio ns	European Parliame nt Adoption	<b>Council</b> Adoption	<b>Official Journal</b> Publication
Energy Performance in Buildings	30/11/2016	<u>Political</u> <u>Agreement</u>	<u>17/04/20</u> <u>18</u>	<u>14/05/201</u> <u>8</u>	<u>19/06/2018 -</u> <u>Directive (EU)</u> <u>2018/844</u>
Renewable Energy	30/11/2016	<u>Political</u> <u>Agreement</u>	<u>13/11/20</u> <u>18</u>	<u>04/12/200</u> <u>8</u>	<u>21/12/2018 -</u> Directive (EU) <u>2018/2001</u>
Energy Efficiency	<u>30/11/2016</u>	<u>Political</u> <u>Agreement</u>	<u>13/11/20</u> <u>18</u>	<u>04/12/201</u> <u>8</u>	<u>21/12/2018 -</u> Directive (EU) <u>2018/2002</u>
Governance of the Energy Union	<u>30/11/2016</u>	<u>Political</u> <u>Agreement</u>	<u>13/11/20</u> <u>18</u>	<u>04/12/201</u> <u>8</u>	<u>21/12/2018 -</u> <u>Regulation (EU)</u> 2018/1999
Electricity Regulation	<u>30/11/2016</u>	<u>Political</u> <u>Agreement</u>	<u>26/03/20</u> <u>19</u>	Scheduled in May 2019	-
Electricity Directive	<u>30/11/2016</u>	<u>Political</u> <u>Agreement</u>	<u>26/03/20</u> <u>19</u>	Scheduled in May 2019	-
Risk Preparedness	30/11/2016	Political Agreement	<u>26/03/20</u> <u>19</u>	Scheduled in May 2019	-
ACER	<u>30/11/2016</u>	<u>Political</u> <u>Agreement</u>	<u>26/03/20</u> <u>19</u>	Scheduled in May 2019	-

Fig. 1. European Commission "Clean Energy for All Europeans" Package, Status March 27, 2019.







The new rules are based on a package of proposals presented by the European Commission on 20 November 2016, which have now been politically or formally agreed by the co-legislators - the Council and the European Parliament.

Highlighting the objectives of putting energy efficiency first, achieving global leadership in renewable energies, and providing a fair deal for consumers, the detailed impact assessment of the proposals estimated that they would generate 900 000 jobs and an 1% GDP decade. increase of up to in over the next (Source: http://europa.eu/rapid/press-release\_MEMO-16-3986\_en.htm)

### EE Policy in Bulgaria

The state policy on energy efficiency on Buildings is conducted by:

1. The Minister of Energy - in the field of energy efficiency in production, transmission and distribution of energy, as well as in the final consumption of energy.

2. The Minister of Regional Development and Public Works - in the field of development and implementation of technical rules and norms in the field of energy performance of buildings, implementation of projects related to renovation of residential buildings and improvement of energy efficiency in residential buildings in Republic of Bulgaria.

The activities related to the state policy implementation for energy efficiency improvement are implemented by the Executive Director of the State Agency for Sustainable Energy Development. The governmental policy on energy efficiency is implemented by all state and local authorities.

Objective - The national energy efficiency target is defined as the amount of savings in primary and final energy consumption by 31 December 2020, and it is specified in the National Energy Efficiency Action Plan.

National indicative targets	2020
Energy savings in final energy consumption	716 ktoe / y
Energy savings at primary energy consumption	1 590 ktoe / y, of which 169 ktoe / yr. in the transformation, transmission and distribution processes in the energy sector

Fig.2 National indicative targets in energy

The laws governing the development of EE and RES are the following:

**The Energy Efficiency Act** - it aims to increase energy efficiency as part of the country sustainable development policy by using a system of activities and measures to increase

Common borders. Common solutions.

O CROSS BORDER +







energy efficiency in production, transmission and distribution as well as in the final energy consumption.

To support the achievement of the national targets on energy efficiency in all heated and / or cooled state-owned buildings used by the state administration, measures are taken annually to improve the energy performance of at least 5 percent of the total floor area. The target is calculated on the basis of the built-up area of the buildings with a total built-up area of over 500 square meters and from July 9, 2015 - over 250 square meters, which by 1 January of the respective year do not meet the minimum requirements for energy characteristics determined by the Ordinance under Art. 31, par.4.

The requirements shall not apply to buildings of cultural heritage covered by the **Cultural Heritage Act**, insofar as the fulfillment of certain minimum energy performance requirements results in a violation of the architectural and / or artistic characteristics of the building.

The activities for energy efficiency improvement in buildings are:

- reducing final energy consumption costs;

- auditing and certification of energy efficiency of buildings;

- verification of energy efficiency of heating installations with hot water boilers and of air-conditioning systems in buildings;

- energy efficiency management;

*Energy efficiency improvement measures* are actions that lead to verifiable or measurable increases in energy efficiency in the final energy consumption.

The order of soft energy efficiency application in occupied buildings is the followng:

An audit for energy efficiency is performed to establish the level of energy consumption, to identify the possibilities for its reduction and the recommend measures to increase the energy efficiency.

The audit ends with a report and a certificate of energy performance of the building. The report and the certificate shall be prepared under the conditions and by the order of the Ordinance under Art. 48 of the Energy Efficiency Act.

Buildings of cultural heritage refered by the Cultural Heritage Act may be audited for energy efficiency and certified as long as the fulfillment of certain minimum energy performance requirements does not lead to a violation of the architectural and/or artistic features of the building.

The energy efficiency audit, the certification of buildings, the preparation of the assessment of the compliance with the investment projects and the preparation of

Common borders. Common solutions.

O CROSS BORDER +







energy savings assessments are carried out by juridical persons registered under Art. 44, par.1.

#### Ordinances to the Energy Efficiency Act

**Ordinance No E-RD-04-3** dated 4.05.2016 on the eligible measures to achieve energy savings in the final consumption, the ways of proving the energy savings, the methodologies for their assessment and the ways of their confirmation.

**Ordinance** on the methodologies for the definition of the national energy efficiency targets and the determination of the cumulative target, the introduction of an energy savings obligation scheme and the allocation of the individual energy saving targets among the obligated persons.

**Ordinance No E-RD-16-647** as from 15.12.2015 for defining the content, structure, terms and procedure for collection and provision of information.

**Ordinance No. E-RD-04-05** as from 8 September 2016 for the determination of the energy consumption indicators, the energy performance of enterprises, industrial systems and external lighting systems, as well as the determination of the terms and conditions for carrying out the energy efficiency audit and the assessment of energy savings and its Annexes.

**Ordinance No. RD-16-347** as of April 2, 2009 on the conditions and the procedure for determining the amount and payment of funds under energy performance contracts leading to energy savings in buildings - state and / or municipal property.

**Ordinance No E-RD-04-1** as from 3.01.2018 on the conditions to sign the registers under the Energy Efficiency Act, receipt of information from these registers, the terms and procedure for acquiring qualification by the energy efficiency consultants.

**Ordinance No RD-16-932** as of 23 October 2009 on the conditions and procedure for performing an energy efficiency check of hot water boilers and of air-conditioning systems under art. 27, par.1 and art. 28, par. 1 of the Energy Efficiency Act and to create, maintain and use their database.

**Ordinance No E-RD-04-1** as of 22.01.2016 on energy efficiency audits, certification and assessment of energy savings in buildings.

**Ordinance No E-RD-04-2** as of 22.01.2016 on the energy consumption and energy performance indicators in buildings.

The Council of Ministers regulates the governmental policy to promote the production and consumption of electricity, heating and cooling energy from renewable sources, the production and consumption of gas from renewable sources, as well as the production and consumption of biofuels and renewable energy in transport.

The Minister of Energy develops, updates and submits the National Action Plan for Renewable Energy for adoption by the Council of Ministers.

Common borders. Common solutions.

CROSS BORDER







The state policy to encourage the production and consumption of electricity, heating and cooling energy from renewable sources, the production and consumption of gas from renewable sources and the production and consumption of biofuels and renewable energy in transport is implemented by the Executive Director of the Sustainable Energy Development Agency.

For public and other types of buildings in force since 31.12.2014 - when new ones are built or in case of reconstruction, major renovation, overhaul or reconstruction of existing buildings, an actionplan for production of energy from renewable sources is elaborated when this is technically feasible and economically feasible. For public buildings and for other buildings, at least 15 percent of the total heat and cooling energy needed for the building must be produced from renewable sources by introduction of:

1. Central heating using biomass or geothermal energy

2. Individual biomass burning facilities with conversion efficiency of at least 85 per cent for residential and commercial buildings and 70 per cent for industrial buildings

- 3. Solar thermal installations
- 4. Heat pumps and surface geothermal systems

#### Renewable Energy Act

The main objectives of this law are:

1. To promote the production and consumption of energy produced by renewable sources

2. To create conditions for the inclusion of heat and cooling energy from renewable sources in heat transmission networks

3. To provide information on support schemes, benefits and practicalities for development and use of renewable energy to all stakeholders involved in the production and consumption of electricity, heating and cooling energy from renewable sources, the production and consumption of gas from renewable sources, as well as the production and consumption of biofuels and renewable energy in transport

4. To create conditions for sustainable and competitive energy policy and economic growth through innovation, introduction of new products and technologies

5. To secure the energy supplies, procurement and technical safety

6. To protect the environment and limit the climate change

7. To raise the living standards of population through cost-effective use of energy from renewable sources











#### **Regulations on RES**

**Ordinance No RD-16-1117** as of 14.10.2011 on the conditions and procedure for issuing, transferring, revoking and recognizing guarantees of origin of energy from renewable sources

**Ordinance RD-16-869** as of 2 August 2011 on calculation of the total share of renewable energy in gross final energy consumption and the consumption of biofuels and energy from renewable sources in transport

**Ordinance No RD**-16-558 as of 8.05.2012 on the collection and provision of information through the National Information System on the potential, production and consumption of renewable energy in Republic of Bulgaria

**ORDINANCE** on the sustainability criteria for biofuels and bioliquids (State Gazette No. 95/2012, in force as of 4.01.2013).

#### Other relevant laws

**The Energy Law** - this Act regulates the public relations related with the implementation of the activities of production, import and export, transmission, distribution of electric and thermal energy and natural gas, transmission of oil and oil products through pipelines, trading in electricity and heat and natural gas, as well as the powers of state authorities in the definition of energy policy, regulation and control

**The Spatial Development Act** - it regulates the public relations connected with the spatial planning, investment design and construction in Republic of Bulgaria and defines the restrictions on the ownership for development purposes.

The amendments to the Spatial Development Act which concern the topic of the report are described in:

• Ordinance No 5 as of 28.12.2006 on the technical passports of the works

• Ordinance No. 7 as of 2004 on energy efficiency, heat conservation and energy savings in buildings

The above-mentioned directives, laws and regulations are relevant in the application of EE and RES measures in buildings of architectural value.

Common borders. Common solutions.

CROSS BORDER







www.greethis.net

# ANALYSIS OF THE MARKET OF ENERGY-EFFICIENT TECHNOLOGIES

# BUILDING SCALE (ENERGY EFFICIENCY)

#### Building shell improvement

#### Method 1: Insulation placement

When choosing heat insulation for the walls of historic buildings, there are two types applied accordingly: the internal and/or external thermal insulation. The two solutions have some advantages and disadvantages, the choice being determined by multiple factors. Below some guidelines are given how and when to choose the specific solution. The types of insulation are not described as manufacturers provide sufficient information about the technical characteristics and the building technologies. Due to the fact that each project is specific and the existence of many key factors is unique to each project presuppose a particular decision not applicable to others.

The choice between internal or external thermal insulation (as well as a combination of both options at the same time) can be a prerequisite for the operational quality of the system as well as for the overall energy-saving effect of thermal insulation. In order to make the right choice, it is of utmost importance to take into account the type of the room/building and the users. These are the factors that should guide the choice of different options for the thermal insulation system.

The precise use of the way of thermal insulation for each particular case guarantees appropriate heating comfort and reduction of the cost of its application.

The main issues to be answered when choosing a type of the thermal insulation system are:

#### How does an insulated wall work?



Internal heat insulation prevents the accumulation of heat from the walls of the building. This provides prerequisites for faster heating/cooling of the room at lower costs. However, the desire to achieve a faster heat effect also leads to the fact that the walls remain cold and the critical processes accompanying the heat exchange are carried inside the wall or between the wall and the

thermal insulation layer. In the long run (with the heating/cooling processes), the functional stability and operational quality of the wall and the frequent occurrence of moisture and mold behind the thermal insulation layer is being reduced.







#### How does an external insulated wall work?



External thermal insulation has the ability to interfere heat exchange between the wall and the external environment. Among other things, a well-designed thermal insulation system guarantees the transfer of all critical points (frost and condensation) out of the room, notably between the wall and the thermal insulation layer. In this way the wall is kept dry and its operational reliability for a long time.

External heat insulation can not guarantee fast warming and cooling of the premises. Unlike rooms with internal insulation, where reaching and maintaining the desired temperature takes place within a few hours, for the exterior insulated walls, full heating and cooling of the walls takes about 2 to 3 days.

#### The choice between external and internal thermal insulation

The choice between the two variants is entirely in accordance with the laws of building physics. Failure to take them into account often leads to unpleasant consequences, suboptimal results in terms of the thermal insulation effect achieved and costly investment in systems and materials.

Depending on the specificity of the structure / premises and the planned operating load, it is recommended that the choice be in accordance with the following principles:



Permanently occupied and heated premises - external thermal insulation

Rooms where we spend a lot of time require constant air conditioning. For this reason, an external thermal insulation system is recommended. The relatively constant energy generation assists in the even heating/ cooling of the heat insulating walls and the presence of external thermal insulation ensures the maintenance of the desired temperature and the comfortable climate in the room. The specificity of this type of thermal insulation helps to preserve the operational quality of the building structure, protecting it from aggressive external influences and the

critical processes running inside the walls.









<u>Temporary or rarely habitable premises - internal thermal</u> <u>insulation</u>

It is for this reason that the internal thermal insulation is the better choice as it ensures that the desired temperature in the rooms is reached for the shortest possible time. The retention of generated energy inside the building is made possible by the fact that internal thermal insulation acts as an active barrier with cold/hot walls.

#### Combining indoor and outdoor thermal insulation

In a number of cases, when budget is not concerned, for maximum thermal insulation effect, both types (indoor and outdoor insulation) can be combined at the same time. In such situations, however, an attention must be taken to observe the following principles:

- The thickness of the internal insulation must not exceed 1/3 of that of the outer with an identical density and thermal conductivity of the materials,
- It is desirable that the internal thermal insulation to be constructed of capillary conductive material. This reduces the risk of moisture retention in the structure

#### What are the risks of inproper choices?

Problems with the wrong choice of thermal insulation have appeared for the time being. Inproper planning and compliance with the construction features of the building leads to a number of negative consequences such as:

#### Formation of condensation and mold

The application of internal thermal insulation in permanently occupied premises, where there is relatively more energy generation (heating and cooling), proportionately increases the risk of condensation and the subsequent formation of mold. The specific type of thermal insulation is the relatively more constant wall temperature, which is in complete harmony with that of the outside environment (during summer the walls remain warm and in the winter cold). This is due to the fact that the structure is cooled

Common borders. Common solutions.

🗩 CROSS BORDER 🕇







www.greethis.net

or warmed by the outside temperature because the barrier that the thermal insulation layer provides is located in the inside walls. The generated energy in the room fails to come into direct contact with the walls and therefore prevents heat exchange with them. Thus, the hot air vapors generated by the heaters meet the cold barrier (the wall) and condensation forms on its surface (and vice versa). The moisture remains sealed between the inside of the thermal insulation layer and the wall. The constant circulation of this type of process leads to the inevitable formation of mold. In such a favorable environment, mold spores need less than twenty-four hours to begin their proliferation, leading to a significant deterioration of the healthy climate in the premises.

#### Degraded thermal insulation properties



9

A major weakness of the internal thermal insulation is the reduced efficiency in the thermal protection of key building components. The structurally important connections of the heat insulated wall with the ceiling and adjoining walls represent the so-called "thermal bridges". Themal bridges represent barriers disrupting the integrity of the heat insulating layer. The presence of such critical plots leads to a significant reduction in overall system performance. This results in serious losses and increased costs as the generated energy leaves the room throughout the thermal bridges. This is a good example that despite situations where the investment is in thermal insulation, the final result

may prove to be inadequate if preliminary planning. A reliable assistant in this complex process is THERMOCALCULATOR, with which all the key features of a heat insulation system can be calculated quickly, easily and conveniently.

#### Increased risk for stability of structural elements

The facades of the buildings are the parts of the structure subjected to the most serious and constant aggressors, variable atmospheric conditions, lateral precipitation, winds, mechanical particles, etc. The constant cycle of occurrence of these negative influences during the period of operation of the building proves to be a real challenge for the integrity of the finishing layer of the facade. Even the occurrence of tiny cracks can be a serious problem threatening the strength and operational quality of the facade. Their presence inevitably leads to the penetration of moisture in the wall. The effect of this problem is also reinforced in cases where there is an internal thermal insulation because it is a negative barrier that prevents heat flowing through the structure. Stopping this flow is a key factor bringing the moisture out and drying of the wall. By the season change, penetrated moisture transforms from liquid to solid and vice versa, resulting in







significant linear shrinkages and expansions. Thus, the stability and performance of a seemingly healthy façade begins to deteriorate significantly.

In order to avoid the above mentioned risks and negative consequences, the choice between internal or external thermal insulation must depend on the planned operation of the premises and on the façade requirements. In some cases thermal insulation may prove to be inappropriate. Although a low coefficient of thermal conductivity will not be achieved, it is also acceptable from the point of view of the Energy Efficiency Act.

#### Example from Bulgaria



The building is located in the real center of Varna. It is a two-floor building used as a restaurant. The side thickness is 37 cm made of solid brick. The walls are lined with mix of 3 parts lime and 1 part Artificial thermal cement. insulation is not allowed to be applied on sides because the original appearance of the facade must be preserved. The window slots are of shaped stone blocks ending with caps. The horizontal stones used to close the windows

17

are friezes.

6

The processing method of facades built with solid bricks includes the following steps:

1. Crunching the demolished areas - it is made to remove weak plasters until they reach a solid base. Moldy or greasy spots are removed. In the present example, the crunching is processed up to the brick.

2. Silicate deep ground coat - the purpose is to brace the mineral base, to improve adhesion, to preserve vapor permeability, to counteract the formation of mold. The product should be transparent so as not to change the color of the wall. Application conditions: During processing and drying, the air temperature and the substrate must not fall below + 8°C. Drying time depends on the conditions of the site. At a relative humidity of 65% and ambient temperature of 20°C the surfaces are dry after approx. 5 hours and can be coated with single component plasters and paints. They must be protected from freezing, fast drying (under direct sunlight, wind) and additional humidity (as from rain fall) until complete drying. On the day after the drying, the next coat is applied.







Treatment: The plasters are laid manually as saturated and thick cover with a suitable brush saw blade or roller. The machine cover is applied with a suitable device. It should be taken care to avoid the formation of shiny surfaces after the ground coat has dried. The consumption coefficient) is approx. 0.4 l / m.

3. Restoration of severely damaged surfaces - common renovation and leveling plaster is used

It is possible single layer with a thickness of 3 to 30 mm to be applied. The material is used for treatment of old plasters (alkali-resistant polymer plasters) and paints (alkali-resistant dispersion paints), as well as for structural cracks. It is especially suitable for leveling rough and unevenly absorbent substrates, at different laying thickness, as well as for plating wall heating pipes. It should be noted that after thorough drying of the lining plaster, only vapor permeable, mineral, finishing plasters should be used.

4. Silicate paint for exterior application - it is made with single-component, non-fading, sun-resistant, silicate paint for internal and external application according to DIN 18363 2.4.1. (silica paints) with less than 1.5% dispersion (based on dry substance). It is used for repainting and egalisation of mineral surfaces, new and old lime surfaces, which should provide vapor permeability.

Heat transfer coefficient -  $U = 0.76 \text{ W} / \text{m}^2$ . °K. This coefficient meets the requirements for EE at the date of the building construction.



#### **Replacing windows**

৩ 📐

CROSS BORDER

\*\* действителната икономия на разходи зависи от множество фактори, както и от индивидуалното потребителско поведение. Предвид това посочената калкулация има само примерен характер. Изходни данни за калкулацията: площ на дограмата 30 m<sup>2</sup>, цена на течен енергоносител 0,75€/. The practical application of this measure is likely to have significant effect because the warm inward air and the cold outside atmosphere are so close to each other unlike no other place in the building. The new joinery of profiles with high thermal protection and energy efficient glazing has a massive wall effect. Perfect sealing stops moisture and flow.

The Uw heat transfer coefficient, where higher values indicate lower energy efficiency, determines how much energy is lost through the old window profiles: Single glass windows typically have a very high heat transfer coefficient (4 to 5 W / (m2K) and this factor can be even greater in a long term exploitation. There is a great deal of heat loss in this situation. Older glass joinery with ordinary glass has an average thermal transmittance of 3 W / m2K. Modern windows and profiles with energy-







efficient glass panels achieve effective Uw values  $\,$  below 0.8 W / m2K - they insulate six times higher than the old single glass frames.

Whereas they fit harmoniously in the facade or contrast with the extravagant - colorful windows the home style is defined and gives personality. With the support of contemporary designers, the appropriate color could be chosen from a color palette.

It does not matter if one-color windows or different interior and exterior decorations are chosen, yet it is an easy task for the rich choice of stylish décor - vivid colors, modern gray shades, or imitation of wood flader. It is important that the colored coatings are resistant to UV radiation, atmospheric effects, and impact and scratch, and are easy to clean. Smooth or striated, natural looking surface is necessary to withstand decades of wind and rain without fading.



#### Examples from Bulgaria



In the present building the windows have been replaced with new triple glazing plastic ones. The original joinery outlook has been saved in the present shapes. It was necessary the change to be made because the windows had been extremely outdated. The coefficient of heat content of the joinery is 1.40 W / m2K which fully correspond to the present requirements of the Energy Efficiency Act.











The present building is located on Preslav str. in Varna, Bulgaria and is currently the Bulgarian Naval headquarters. The building has a nice vestibule which makes the structure architecturally semi-circle appearing. The application of energy efficiency measures in the building was an extreme challenge because the windows could not be replaced and the facade cannot be intervened. The realized eligible measure aimed to reduce the air permeability of windows and doors. This has been achieved by mounting a special sealing strip on the sash windows. The tape is self-adhesive and seals air permeability from 0.7 h-1 to 0.5h-1. In addition, a plan for the maintenance of the joinery has been developed which includes periodically removal of the frames by heating and application of new lacquer paint coat.

#### Natural cooling techniques

**0** 

Ventilation of the premises is required according to sanitary and hygienic standards. It is necessary to ventilate the rooms to remove excess moisture, odors, CO2; dust, other harmful substances - at least 0.3 - 0.5 h-1l. The amount of required fresh air is at least 25-30 m3 / h per person.

The ventilation system consists of a suction and discharge (fresh air) installation. Prior to feeding the fresh air into the premises, it is necessary to process it - in the winter it is heated and in the summer it is cooled.



20







www.greethis.net

The air that is sucked out of the room is thrown into the environment. However, this air is warm during the winter (room temperature is usually 20-25  $\degree$  C) and in the summer it is cooled (20-22  $\degree$  C).

The energy costs of heating or cooling fresh air that is fed into the premises are very high. For example, for the heating of 1000 m3 of air in winter with an ambient temperature of  $-16^{\circ}$  C to a room temperature of  $+ 20^{\circ}$  C, 12.96 KW are needed.

#### Example from Bulgaria



The present example is a building situated in the historic center of Varna built over ruins dated from XIXC. Window mirrors were mounted to reduce the heat from direct sunlight and to reflect the sun rays. At the same time, some of the windows are open-top to provide continuous air flow. This technique is widely used. Cooling and fresh air flow is particularly important for the internal climate. Varna is located on the Black Sea coast at 43 ° N.L. Typically, breeze circulation prevails in the summer, due to the open water surface and the temperature. The specific

Black Sea climate is milder despite the lack of mountain hills. Therefore, natural circulation provided by the air is a very good solution for natural cooling in the building. The heating of the room is obtained by the sun, but at the same time the air is not so hot.

Examples of natural cooling techniques applied in other buildings.











Ventilation with recuperator

If a recuperator is used as a component of the ventilation system, these costs are reduced by 50-90%. The recuperator is generally a plate heat exchanger and two fans. The two air streams pass through the plate heat exchanger - feeds and discharges. In winter, in the heating mode, the air from the premises passes through the heat exchanger and, instead of being discharged, the +20 is ejected at a temperature of +2  $^{\circ}$  C, and the fresh air supplied for treatment instead of being fed at -16  $^{\circ}$  C is fed at a temperature + 3, + 4C. This reduces heating costs almost twice.

The heat exchanger is so designed that there is no mixing of the two streams. In this way, there is no danger of transmission of odors from fresh air.

#### Design and construction of ventilation systems

Types of ventilation are determined by the rooms that need to be ventilated:

- Kitchen ventilation
- Industrial premises and halls
- Manufacturing enterprises
- Swimming pools and houses
- Administrative buildings
- Agricultural premises
- Production halls







- Hotels
- Residential buildings
- Garages
- Precision ventilation



1. Ventilation - design requirements:

- Kitchen heated surfaces, therefore the presence of considerable heat, separation of different types of vapors or aromas from the preparation of different types of dishes.
- The construction and design of the ventilation system must not cause air drafts.
- An advantage for this type of installation would be an easy maintenance and cleaning, it is possible to select high-performance oil-purifying filters that will prevent the accumulation of fat on the walls of the ducts. The presence of such filter would reduce the presence of stagnant smells and microbes would also reduce the prerequisite for the presence of fires.
- Silent operation of the ventilation system leads to greater comfort in the workplace. But, this often has to be in line with the available space. The main purpose of each manufacturer and installer is to enable its installation to operate at full speed and to bring in constant fresh air.

What type of ventilation to choose?

<u>Centralized</u>, which consists of installing one main ventilation unit.

Decentralized, where several small units are mounted.

Common borders. Common solutions.

CROSS BORDER







After many years of research by specialists in the field, it has come to the conclusion that the use of several small units turns out to be a better and cheaper solution and there is more flexibility in operation.

#### Example from Bulgaria



Another natural ventilation technique provides a quick diffuse of the inside air. It is effective especially during the winter months in restaurants because the air is quickly refreshed, the inner walls are not cooled and the premises can be warmed up with little heat loss. Undoubtedly, the mild climate in Varna also is an advantage in this cooling method.

The picture shows a covered terrace of a restaurant. The roof is made of a special movable structure which makes it possible to

open the roof completely in case of need. Thus, the warm indoor air disappears and the interior space is filled with fresh air. On the other hand, during hot summer days the structure protects the space from direct sunlight.

#### Natural lighting techniques

#### Facade lighting

Outdoor lighting is what gives the final touch in the radiance and that completes the building, the garden or any other exterior part of the building. Appropriate selection of luminaires for external lighting to be built, as well as their skillful fitting with measured light requirements, is a combination that guarantees the unique emission of the building or garden in night or dusk. Following the vision and ideas in the overall home lighting, the outdoor lamps can be that part of the lighting that impresses at first glance, creating the visitor the pleasant sensation and suggests a high degree of functionality and aesthetics.











When selecting exterior lighting, we must be guided by the high quality requirements, exterior vision and unique style. The variety of outdoor lighting lamps has in most cases a technological requirement for damp-proofing, which must be observed at all costs in order to avoid accidents and any complications in operation.

#### Advantages and disadvantages of LED bulbs

Advantages:

- LED lamps have a longer life than other types of bulbs if used in a suitable environment. Their life is measured in tens of thousands of hours, which is a great deal. This logically results in good savings from future maintenance and cost of lighting.
- Significantly higher efficiency and lower power consumption compared to incandescent lamps (up to 80% lower at approximately the same brightness level).
- Minimum heat output, as opposed to conventional incandescent lamps, where about 90% of the power goes to heat dissipation.
- Lower separation of infrared and ultraviolet rays. This may mean a lower risk of fire, especially when compared to halogen freckles.
- Increased turn-on time and increased start-up and stop endurance.
- At the moment there are solutions for retrofitting for almost all kinds of luminaires.
- Common LED bulbs are sturdier. Generally, there is no glass to break, as well as no incandescent filament to be damaged by vibration (for example, when carrying it).
- They are more environmentally friendly. They last longer, do not lead to harmful  $CO_2$  emissions, and do not contain any toxic materials.
- Some LEDs can be set to dynamically changing their color.

Disadvantages:

- Expensive for initial purchase. Replacing bulbs in one apartment can reach a quadruple sum.
- Most LED bulbs are not dimmable. Naturally, dimmable LED lamps are more expensive.
- Possible negative effects may occur in compatibility with existing retrofitting lamps.

Common borders. Common solutions.

O K CROSS BORDER







- Possible problems may derive from compatibility with existing low voltage transformers during retrofitting.
- In high-temperature conditions, their life may significantly decrease.
- Color temperature of light is not always as good as light bulbs or halogen lights, but there is constant improvement.
- The color quality of the and the light intensity may deteriorate during the lifetime of the bulb.
- The need for a radiators leads to installation restrictions some LEDs can not be mounted in specific locations due to potential cooling problems.
- They are more fashionable and therefore more complex products than the incandescent lamps.
- The quality of the LED bulb depends on the good engineering, chip performance, good cooler and stable power supply.

#### Natural lighting

The most preferred way to provide illumination is to provide natural lighting. Natural light is available only during the daylight. Daylight is a collection of light from the sky and sunlight.

Advantages of natural lighting:

- Mental and physiological conditions
- Energy savings
- Psychology and physiology
- Ultraviolet rays and health







- Vitamin D absorbtion
- Seasonal disturbances

But natural lighting is at risk from:

- Economic welfare
- Consumption
- Greater building density
- New landmarks / image
- Legal misconceptions
- Ignorance

Window characteristics

- Type
- Size: Absolute surface

Glazing

- Form
- Positioning
- Orientation
- Control

Room

- Relative dimensions
- Photometry on the surface
- Orientation
- Opening, through which the light comes

Photometry of materials

Reflection + absorption + passage = 1

Common borders. Common solutions.

CROSS BORDER





www.greethis.net









Blindness is technical solution which may solve some major problems. Dazzle that breaks down the working capacity - directly reduces the ability of the person to see the objects in his sight. Bright light sources in a relatively dark environment.

Dazzle that causes discomfort - does not significantly reduce the ability of a person to see, although he continues to feel discomfort because of the bright light sources in his sight.

Blurring reflections - Blurring reflections are caused when the reflected image of the light source is brighter than the level of illumination at the workplace.

Reflected dazzle - When light from the light source is reflected by mirror surfaces in the eye or in the field is called reflected blinding.

Redirection of daylight.

Horizontal blinds.

The Light Shelf - The second most used form of light redirection.

Improves the even distribution of daylight, but at the same time reduces the average total daylight.

Light shelf = Evenness and Does not increase daylight

Micro blinds









(1)



www.greethis.net

Black Sea

Examples from Bulgaria



Natural lighting is a very important component for the indoor living comfort. There are about 2300 hours of sunshine per year in the region of Varna, as in July they are 333 hours and in December - 74 hours. According to the data Varna can be defined a sunny city. The more important how to limit direct sunlight into the room because two negative effects may derive - warming the room and dazzling. The present historic building was renovated in 2017. Natural techniques for shading side walls have been used. Exterior wrapped blinds which can be bended to 40 C° have been mounted. The colour is white in order to better reflect the sun rays. The idea behind is the following: the windows are bigger and provide much more natural light. During summer days the blinds are unwrapped and are shaded. However due to the white colour and the direct sunlight, the natural lighting is secured. In autumn, spring and winter periods the blinds are partially or entirely wrapped and thus natural lighting is secured despite the fewer hours of sunlight.











Interior roll up blinds have been mounted in the present building. The investment is supplied by local funding and thus less resources have been required than the previous example. The applied method is the similar, as on sunny days the blinds are pulled down tightly and thus reduce sunlight penetration the room. During spring and autumn they are partially opened and entirely in winter. From an energy point of view a disadvantage compared to the previous example is that in the summer months some sun rays enter the room and heat it needlessly. The measure is appropriate when there is an explicit prohibition on placement of external elements or the budget is relatively small.

(3)



The present example is of installation of windows with variable reflectivity. This technology is relatively new for the Bulgarian market. The window glasses are heliomatic, thus their permeability depends on the sun radiation or sunshine. The relation is the following: the oftener the sun shines, the darker the windows become and the less sun shines the more transparent it becomes. The advantage is that it meets the energy-efficient requirements applicable to every facade and has no maintenance costs. Disadvantages are related with that a high investment is required and there is no possibility for the building energy management by its users.







Conclusions

- Psychological and physical well-being
- Energy saving potential
- Dynamics of natural lighting
- Design in terms of quality but also quantity form, room, window
- Technological optimization penetration, reflection, distribution of light
- Redirecting light requires careful design and simulation

#### Energy efficient heating and cooling systems

The air conditioning system is the most important system in applying EE measures. There are many solutions in this regard, each of them having its advantages and disadvantages.

The calculations for the air conditioning in Varna are based on the following data:

Summ	er Period	Winter period		
Outside air p	parameters	Outside air parameters		
t <sub>вн</sub> =34 °С	<del>0</del> =44%	t <sub>вн</sub> =-11 °С	<del>0</del> =85%	
Indoor air parameters		Indoor air parameters		
t <sub>п</sub> =25 °С	<del>0</del> =50%	t <sub>n</sub> = 20 °C	<del>0</del> = 50%	

The installation must be designed in accordance with "Designing standards for ventilation, heating and air-conditioning installations", and all requirements of "Firefighting construction - technical standards" shall be respected.

The best of efficiency is delivered by ground-water heat pump.

Common borders. Common solutions.

CROSS BORDER







This is a very promising source of pure energy. There are several types of heat pumps and they can be classified generally in relation to the environment from which the energy is taken. By its essence a heat pump is a technical solution whereby energy in the form of heat is moved from one place to another.

#### HEAT PUMP

A well-known fact is that the temperature on the ground is almost constant - about 10-15 degrees. This temperature is higher than the outside air in the winter and during summer is vice-versa. This constant position makes it possible to extract energy from the ground with very good efficiency. The drawback is that the extraction of heat itself requires the laying of special pipes under the ground, which is not always applicable. On the other hand, this heat pump has the highest conversion factor, and the ratio of the useful heat obtained to the energy used to drive the compressor is called the heat pump conversion coefficient. Typically, Coefficient of Performance (COP) is used as the primary indicator of heat pump efficiency when operating in heating mode. For the same purpose, in cooling mode, the EER (Energy Efficiency Ratio) coefficient is used in most air conditioners. The coefficient of conversion of a land-water thermopump is from 4.3 to 4.4. Because architectural monuments are usually located in the central city areas and there is not enough free space, it is necessary to provide a place for drilling where pipes are to be placed, which will be the external heat exchangers.

However, despite the obvious advantages of the land-water heat pump in the process of operation, we also want to show economic expediency. That's why a study of the value of drilling-assembling works has been accomplished. It has been found out that the pumps are at a very high price, making it unreasonable to invest in them. As an example, only the drilling works for a building with a total area of 300 m2 (materials and human resource) amount to over BGN 30,000, adding the heat pump as well as just over BGN 50,000. By adding the ventilation system, the investment only for HVAC part amounts to more than BGN 60,000. On the other hand, most of the year temperatures are favorable for the operation of a heat pump with a primary source as air. Based on preliminary estimates, this will work with a satisfactory CPA over 90% of the year. During the rest of the time, additional back-up power is required to provide internal comfort. The estimated investment costs for air conditioning and ventilation amount to about BGN 30,000 or two times less. The heat pump type "land-water" comes out to be profitable after more than 12 years of operation making it economically unreasonable choice.

That is why heat pump "air-water" type is recommended as a backup power electric boiler of the air-conditioning system.

Common borders. Common solutions.

CROSS BORDER







Due to legislative procedures applied in Bulgaria the realization of similar activities is economically ineffective.

#### Rational use of energy

In this section the answer on the questions about the technical requirements for energy monitoring systems in the pilot buildings are given. These questions and the relevant opinions are provided below:

- *How many measuring points?* - That depends on the number of circuits that have to be measured. Each circuit will have several measuring points.

- How many energy circuits? - Measuring the total electricity and gas or heat consumption of the building does not provide enough information in order good energy monitoring to be made. Several years are needed to get sufficient information to take conclusions of the data gathered in those years.

Therefore it is necessary the different main energy users to be monitored separately in each pilot building. These are: Heating and cooling system, Hot water system, Ventilation system, Lighting system. Other equipment: office equipment, kitchen equipment, other equipment.

- How many parameters?

- Inside temperature (optional in different rooms), Outside temperature
- Inside humidity, Outside humidity
- CO/CO<sub>2</sub> in meeting room(s)
- kWh consumption, Power consumption, Voltage and Amperage per circuit
- If applicable: m<sup>3</sup> natural gas/used heat

- Where do the sensors need to be located? - Usually the suppliers of energy monitoring systems know the locations.

- Parameters counting living comfort? - Parameters for living comfort are temperature, humidity and, especially for meeting rooms  $CO/CO_2$ .

- The period of measuring the parameters?

• Monitoring through Energy Monitoring System is a continuous process.

Common borders. Common solutions.







• In order to make conclusions on energy consumption it would be best to have a measuring period of at least one calendar year.

#### Example from Bulgaria

The example provides a showcase of energy flow management of the Palace of sport in Varna. This includes geothermal energy as source; two old chillers type water-water, two new chillers type water-water and air-water. The activities are mainly connected to automation and management of processes, access and remote management, charters and database. For the purpose 2 controllers "UniStream" of Unitronics Jewish company, 2 seven-inch controllers and one head 15,6 inch controller have been used.

The images show the following:

- 1. Geothermal center for mineral water supply for heating
- 2. Management of Congress Hall k19
- 3. General management system of all processes



The images are made by "UniLogic" programe of UniStream controllers.

#### General requirements for Energy Monitoring Systems

In some countries Energy Management Systems are mounted as obligatory equipment in buildings.









35

www.greethis.net

Energy monitoring Systems need to provide sub metering or equivalent combinations of sensor measurements and thermodynamic calculations to record energy use data for each major energy system in the building.

The system needs to provide virtual sub metering via sensor measurements and a long-term data storage capability to satisfy the energy monitoring requirements. It is advisable to have a system that can provide trend logging and analysis based on 1 min. intervals. By providing real-time information on all building systems the system allows the building owners to trim costs and reduce environmental impacts of day-to-day operations.

The system provides sub metering or equivalent combinations of sensor measurements and thermodynamic calculations, to record energy use data for each major energy system in the building; heat pumps, AC systems, fans, pumps, boilers and other heating systems, lighting systems and process loads. This energy use data, once collected, shall be stored in a data management system.

The data management system must electronically store energy data and creating user reports showing energy consumption for each major energy system by hour, day, month and year metering. Hourly data shall be retained at least 30 days, daily data shall be retained at least 6 months and monthly data shall be retained at least 2 years.



Fig.3. Monitoring







www.greethis.net

#### Energy Savings Measures by means of simple control systems

Energy Monitoring Systems can often be upgraded into Energy Management Systems or Building Management Systems. This can be an option for a municipality to distantly control the energy systems in a number of buildings.

For small buildings local technical measures can contribute to more efficient building performance, without a need for centralised control of the system. The following technical energy saving equipment is suitable for a pilot building:

- Day lighting sensitive sensors on office luminairies (savings 20 %)

One central light sensor for controlling the lighting level, or

A sensor per luminairy that controls the lighting level in the whole room

- Day lighting responsive sensors on office and corridor luminairies (20 to 40 % savings). For adjacent to outside wall and windows mounted luminairies savings can be up to 70 %.
- Movement sensor (occupancy control) on toilet lighting and storage rooms (savings 10 to 30 %, in storage rooms up to 80 %

Avoids the lights on for a longer period

It can also be used in the halls or corridors

- Frequency control on circulation pumps of heating- and cooling system

Controls the heat or cold transport based on the demand in the building

Pumps can be switched off in idle periods

### **RES (BUILDING SCALE)**

#### Solar Energy Systems

The main parameter of photovoltaic systems defining their performance is their wattage output (Wp), which corresponds to their maximum power under standard test conditions: solar radiation  $1000W/m^2$ , temperature of the photovoltaic cells  $25^{\circ}C$ , coefficient of air mass AM 1.5.

Factors that determine the performance of PV modules are the following: solar radiation that changes overnight and annual seasons, temperature, panel angle, panel mounting (fixed and sun-tracking), shading, dust, wind and mist. Solar radiation is the most important parameter for productivity.






Technology	Efficiency	m²/Kwp	Kwp/m²
Monocrystalline	13-15%	7	0,142857
Polycrystalline	12-14%	8	0,125
a-Si (Thin Layer)	5-7%	15	0,066667
CdTe (Thin Layer)	7-11%	11	0,090909
CIS (Thin Layer)	7-11%	10	0,1
a-Si/µSi (Thin Layer)	8%	12	0,083333
Average for Crystal Technology	12,50%	8	0,125
Average for thin film technology	8,60%	11,5	0,086957

Table 1. Average efficiency values of photovoltaic panel production technologies required toinstall 1kWp.

# Photoelements of monocrystalline silicon

Circular silicon monocrystals are grown by the Chochralski (Cz-Si) method by slowly drawing and rotating the seed crystal above the melt surface. The industrial companies produce crystals with a diameter of 30 cm and a length of longer than one meter. The circular crystal is cut longitudinally on a square pole and then, with the help of multi-threaded cutting, it is transversally cut into plates with thicknesses of about 0.3 mm.

In most cases, the starter plates are p-type and have a specific resistor of 1 to 10 Ohm.cm. The most important technological step is diffusion from a phosphorus source and formation of an n-type layer. The next steps are the deposition of a metallic metal contact, an anti-reflection coating and metal comb on the front.

Advantages and disadvantages include:

- Monocrystals have excellent properties but are relatively expensive.
- High efficiency obtained under production conditions (14 17.5%).

Common borders. Common solutions.

CROSS BORDER





Black Sea

www.greethis.net

#### Hybrid elements

This type of panel is a combination of monocrystalline photoelements and amorphous silicon. The structure of the photoelectric element is a "i-Si thin layer i-layer & quot".

The base material is a n-type monocrystalline plate, both sides coated with a double a-Si layer - a very thin i-layer and a coated layer. On the front there is a thin p-type emitter layer, and the back is covered with a highly doped n-type a-Si layer that serves as a BSF layer (n + / n field on the face surface). This type of heterodyne conducts surprisingly high efficiency ~ 20%. The photoelectric structure allows production processes to be performed at relatively low temperatures - 200 ° C. The low processing temperature not only reduces energy consumption but also leads to lower diffusion of impurities in the substrate during production.

Advantages are the following:

- ★ Optimal use of the entire spectrum of sunlight
- **\*** Excellent performance in diffuse light, partial shading and high temperatures
- ★ Very low consumption of raw materials and energy for production
- ★ Raw material containing silicon Silane (Silan) is a second material on the prevalence in the Earth's crust
- \* No rare metals such as Indium or Tellurium are used

When shading the crystal module, the output power is reduced by 50%, while the output power decreases by 10% when the hybrid module shades.

Hybrid modules have very good absorption of diffused light, making them suitable for installations in buildings or where it is not possible to install the pure South system. In this way, a better absorption of façade and roof spaces, which are often not oriented to the south, is obtained.

#### CdTe photoelements

Today, the CdTe photo element is the only II-VI-based compound of interest to the industry. Its production is relatively easy and therefore a number of production technologies have been developed.

Common borders. Common solutions.

CROSS BORDER 🔶







Out of all the different techniques (screen printing, galvanic deposition, spray-pyrolysis, evaporation), the sublimation technology for near-distances (CSS) has only survived today. CdTe is deposited as a thin polycrystalline layer (several  $\mu$ m). The finished photo element is a heterodimer between CdTe and CdS, but the CdS layer should be extremely slim. The entire structure used today is shown in the Figure.



Fig. Structure of CdTe / CdS Photo Element, (Scheme: Fraunhofer ISE, Freiburg, Germany).

By contrast to the amorphous silicon photoelements, the thin film elements can be structured and bundled sequentially onto a common glass substrate. In the

case of CdTe, the separation of individual photoelements can not be done by laser cutting, as CdTe easily breaks down during processing. Instead, mechanical abrasion with a diamond tool is used.

CdTe modules contain a certain amount of cadmium, which is a dangerous chemical element (carcinogenic and poisonous). Many expert conclusions have stated that there is no danger of health problems in the case of PV modules. The CdTe compound is stable and does not decompose under the influence of the environment. It is additionally encapsulated in the modules and even in case of glass breakage, it does not come into contact with the atmosphere. However, there is no guarantee that this technology will be well received by people, so a number of companies have decided not to invest in it.

Advantages and disadvantages

- Relatively simple technology providing modules with efficiency about 10%;
- Companies claims that production costs are low;
- Cadmium is a problematic element for the environment; this may cause problems with the authorization mode for application, it should be encapsulated.

The measurement of the actual production of the three technology types is within 11 consecutive months and this survey is sufficient to be able to determine the proficiency of the photovoltaic technologies. During this period, the production technologies are as follows:

\* Monocrystalline photovoltaic modules - 754.57 kWh / kWp.

Common borders. Common solutions.

O 🗙 CROSS BORDER 🚽







- ★ Hybrid photovoltaic modules 704.83 kWh / kWp.
- ★ Thin Film Photovoltaic Modules 693,19704,83 kWh / kWp.

From these results it is clearly shown that the monocrystals have the greatest productiveness in the climatic characteristics of Varna.

There is clearly expressed dependence of productivity on solar radiation. Solar radiation is different for each month and season.

# Solar thermal/PV systems

Technical analysis examines solar production according to geographic location, the selected collector, the slope of the collectors and design specifications. 5 types of collectors have been analyzed - 3 with sample values for the types of collectors and 2 with specific values according to producer data for specific market models, 1 out of which is produced in Bulgaria and 1 is abroad.

	Оптическа ефективност	Термозагуби от първи ред	Термозагуби от втори ред
Вакуумни тръби	0.75	1	0.005
Високоефективни плоски колектори	0.80	3	0.008
Стандартни плоски колектори	0.75	4	0.010
Вносни плоски колектори Х	0.955	2.858	0.015
Български плоски колектори Х	0.95	3.77	0.015

Тип колектор	Януари	Февруари	 Средно:
Вакуумни тръби	64.0%	67.2%	 69.4%
Високоефективни плоски колектори	51.0%	59.2%	 65.1%
Стандартни плоски колектори	36.7%	47.6%	 55.2%
Вносни плоски колектори Х	63.8%	72.8%	 79.3%
Български плоски колектори Х	55.8%	66.9%	 74.9%

Table 2. Characteristics of solar collectors

The efficiency of each collector can be seen in the following graph on annual basis. It's worth to mention that vacuum tubes retain high efficiency and high temperature differences in winter time, while there is a significant fall in the efficiency of flat collectors over the same period.





The efficiency as from the different temperature regimes was measured on the basis of winter and summer differences (for Bulgaria) between working and ambient temperatures. Switching to low-temperature heating systems and low-temperature distribution network is fundamental to the efficiency of the solar installation and the losses on the distribution network.





Common borders. Common solutions.







By analyzing the yield at a working temperature of 70 degrees, for different radiation levels and average daily temperatures, the collector output ranges from 370 (standard flat collectors for regions like Sofia and Vidin) to over 600 kWh (imported collectors for areas like Kardzhali and Petrich). The total system efficiency (including heat exchangers, pipe losses, etc.), depending on collector, radiation and outdoor temperatures, is within 20-37%.

Case-specific analysis

The selected parameters for this case are as follows:

Работна температура	70
Местоположение	Варна
Климатична зона	Северно Черноморие
Наклон	35
Тип колектор	Български плоски колектори Х

Table 3. Type of collector depending on the climate charateristics of the region

For the specific case, it appears that nearly 74% of production is concentrated in the six months between April and September. For bigger part of Bulgaria, the percentage of summer-time heat generated is about 80%, and only on the Black Sea the mild winters slightly increases the share of winter production. The total production for each type is shown in the following graphs:





Fig.6. Efficiency of collector types correlated to temperature difference between operating temperature and ambient temperature













Fig.9 Factors influencing the identical production with different type of collector







# Example from Bulgaria (1)



The example is of a building used as administrative office three solar energy where techniques have been applied: poly crystal solar panels, mono crystal solar panels and window integrated panels. The building is regarded as zero-emission e.g. the electricity is supplied by photovoltaic system. As the main consumption is in the morning, solar modules

have been mounted on the Eastern part so that much more energy to be produced then. The system itself is supplied with module batteries which are charged when the production exceeds the consumption. The system functions since 2013 and so far lack of electricity supply has been registered only for 4 days.

(2)



The use of thermal modules for hot water supply is applied in specific cases. It is necessary a big hot water consumer to be available all over the year and mostly in summer months. In the present case  $4m^2$ solar vacuum pipes of high efficiency have been mounted. The technology works very efficiently when there is a direct sunlight. The efficiency is calculated to 1800 kWh/y per m2. The proper design of the system is of high importance for avoiding leakages and incidents.











#### Conclusions

- There is a higher potential in the Eastern and Southeastern parts of the country to produce heat from solar radiation
- The unit heat prices of all district heating companies tend to keep at a constant price or depreciation
- The average price per 1 MWh of heat supplied by the different district heating plants is around EUR 45 (2018)
- Solar thermal installations have the highest specific energy yield per unit of occupied land area (annual heat yield / area)
- The most common are the selective coated flat collectors and the vacuum tube collectors
- Collectors, as a major element of the solar installation, have forced manufacturers over the years and advancing technology to improve their quality and durability; high-class flat solar collectors can now function without any problems over 20, even 30 years
- For the different regions of Bulgaria the annual energy consumption for hot water is equal to or higher than that for heating

Common borders. Common solutions.

CROSS BORDER







In the case of a solar installation as a complementary energy source, the energy costs for heating and hot water in the residential sector would be reduced between 30% and 70%

# Small scale building-mounted wind turbines

Standalone, off-grid wind turbines are suitable for powering installations in isolated areas, camping sites, farms, mountain shelters, seasonal homes, remote sites with non-maintenance mode, security systems, air conditioning systems.

Small wind generators can power telecommunication systems such as repeaters, cellular antennas and other devices that are installed in remote, non-electrified areas. They can also be used successfully in pumping and drainage installations, for street lighting and energy supply of protected natural areas.

This type of wind turbine is produced with a power of up to 10 kW, and the towers of which are mounted have a height of 1.80 m to 20 m. They are designed to run at a low wind speed of 3.0 m / sec, making them massive. In combination with photovoltaic cells, their application range is increased to the possibility of completely autonomous power supply to different objects.

#### Stages in building autonomous systems

The initial stage of the construction of autonomous wind power facilities involves presizing the system. According to the customer's specific requirements for power supply, work area, etc., the optimal typology of the autonomous system is determined. It is planned the supporting structure to be built, to install the wind turbine, the wiring and the installation of the rest of the electrical equipment.

Due to the wide variety of terrains where wind turbines are installed, the facilities must be sized according to the climatic conditions in which they will operate: flat, mountainous (hilly), marine (offshore) and coastal. The air density in each of the listed areas is not the same, and this determines the differences in operating settings as well as in the materials used to produce the turbines and their structures.

An essential stage in system planning is wind speed measurement. The average wind speed should not be taken as the single dimension in the calculations but as the prevailing for a given wind speed. Contributions to wind power also carry all other speeds that are different from the predominant but are in the same wind speed band. Parallel to the wind speed measurement, the density of the wind power and the temperature differences of the terrain and the air above it at the time of the measurements are controlled. The wind power density, calculated in W/m2, is an important wind energy characteristic that is influenced not only by the horizontal wind speed but also by the other wind and air characteristics. After comparing the measured







data with the calculated wind model, the model is calibrated and refined for the specific measurement site to make, although roughly, an initial selection of better wind power points in the course of the measurement itself.

The atmospheric pressure, temperature and relative air humidity are also important factors for the amount of wind power produced by the wind generator. Atmospheric pressure can easily be measured at any convenient height. In contrast, temperature meters must be installed at least 10 m high to avoid the influence of heat emitted by the ground. The relative humidity of the air does not affect the energy produced, but it is useful to know the assessment of the risk of ice.

#### Selection of wind turbines

After analyzing the results of the wind energy audit, a selection of suitable for conversion of the available wind turbine is made. The choice is made after a detailed analysis of the wind energy characteristics of wind turbines that have been pre-selected so that their electrical performance is highest at the relevant wind conditions and other energy-relevant indicators of the sites. For this purpose a realistic estimation of the electricity generation for the selected variants of wind turbines is made, which includes the expected full potential of the annual electricity generation and the expected hourly electricity generation, according to the type of wind turbines and their energetic parameters. When selecting a turbine, it is advisable to use data from the technical tests of wind turbines under real operating conditions, made by independent technical auditors.

# Types of wind turbines

Among the most commonly used small wind turbines are propeller type turbine models, vertical axis turbines and multipurpose (turbine) turbines. Propeller types are the horizontal axis wind turbines that use the reactive principle of rotor blades. The turbines have two or three blades. The coefficient of speed (ratio of peripheral wheel speed to wind speed) is from 6 to 10. This type of turbine only works at wind speeds above 5 m/s. Today, the design of almost all modern wind turbines has a horizontal axis of rotation because its efficiency is higher. Vertical axis wind turbines are also known as Darius turbines. They are characterized by a coefficient of rapidity of 5 to 6. The power factor is Cp = 0.40. They have a relatively low starting torque.

Vertical-axis turbines are used more often for local power supplies in places where there is no staff because they do not follow the direction of the wind. They are simpler to manufacture and more reliable for operation. They are not large and, exceptionally, can be connected to a public network. Vertical axis turbines have several major advantages. For example, the construction allows the generator and the gearbox to be mounted at the base, and no mechanism is required to orient the wind turbine in the wind direction.







As a drawback, the difficult drive, defined by low wind speeds near the ground, is often mentioned; lower efficiency compared to horizontal axis turbines and more.

Multi-wind turbines are a reactive type of wind turbine. Among their technical characteristics are their coefficient of rapidity of 3 to 4; power factor Cp = 0.35; efficiency (CPA) of 20 to 43%. They have a mean starting point. They can also work at lower wind speeds. They are also used for applications other than for electricity generation (e.g. for pumping water).

Due to restricted regulations it is not possible wind turbines to be mounted in urban areas.

#### Heat pumps

#### Air to air systems

Contrary to popular perception, multi-split air conditioners do not go cheaper to the customer than the number of single split air conditioning systems. Quality branded multi-unit are 30 to 50% more expensive than air conditioning with separate air conditioners. In addition, the cost of the multi-unit air conditioning system is more expensive because the multi-unit air conditioner often requires longer routes. Longer routes are usually more violent and problematic to discharge condensate. In the event of a fault in the outdoor unit, all indoor units are switched off.

Another disadvantage of the multi-unit air conditioners is that, under extreme loads / at very low outside temperatures in heating mode or very high in cooling / multi-mode, it can not deliver the power that gives the respective number of single splits.

In new constructed buildings when preliminary routes are made to build a drainage system, the air conditioners are suitable as they do not load the facade with external bodies.

When there is a power limit, the multi-split air conditioner is also the better choice.

The biggest advantage of the multi-unit air conditioning system is the lower minimum heat output and therefore better comfort than less switching on and off of the machine and thus avoiding the on / off effect in relatively warmer heating mode.

#### Example:

Daikin FTXS / RXS 25G / single split / - minimal heat output of 1.3kW with minimum consumption of 0.31kW, with heat loss below 1.3kW in the room, the air conditioner switches off.

Common borders. Common solutions.

CROSS BORDER 🗙







Daikin 2MXS52 and three indoor units FTXS25G - minimum heat output 1.45kW with minimum consumption 0.32kW. The machine switches off when the total heat losses of the three rooms are below 1.45 kW.

And ultimately, for each specific site, all pros and cons of multi-unit systems are judged in terms of the client's terms and financial capabilities.

#### Air to water

The heat pump heating system is characterized by durability, easy maintenance and low operating costs. Eurostat data shows that heating is still an important part of the cost of a household. That's why a properly selected, designed and professionally built heating system is extremely important for every owner.

How does a heat pump work?

By using 1 kWh of electricity, the heat pump gives 2 to 4 kWh of thermal power from the energy source to the rooms, thus providing an efficient 3-5 kWh of thermal energy. It can be assumed that  $\frac{3}{4}$  of the house heating comes from the energy accumulated by the ground, water and air, and only  $\frac{1}{4}$  of the power plants.

If a house is heated by electricity, then a heat pump is installed during renovation, then it would reduce electricity bills by 75%. With current oil and gas prices, it means that heat pump heating is more than 4 times cheaper than heating oil or 2 times cheaper than natural gas. Currently, this is the cheapest heating solution in most European countries.

Principle of the heat pump











Heat pumps generate the thermal heat from free ambient energy by means of a 4-stage cycle:

- The refrigerant in the heat pump is made to evaporate. The huge amount of energy required for this purpose is obtained from the ambient energy (air, ground, water).
- The refrigerant vapour is heated to a higher temperature by compressing it in a compressor. Electrical energy is used to drive the compressor.
- The heated refrigerant vapour condenses (becomes liquid) and releases the energy stored inside it (approx. 75% «evaporation energy» + 25% drive energy) in the form of heat to the heating system.
- 4. The refrigerant is expanded and the cycle begins again.

\* This example relates to a COP of 4, i.e. 1 part (25%) electrical energy generates 4 parts (100%) heating energy.

Fig. 10. The heat pump principle

COP (Coeficient of Performance) and SCOP (Seasonal Coeficient of Prformance) - how to compare bids for different types of heat pumps?

In order to compare something, it should be reduced to a common denominator. In the case of heat pumps parameters are needed that allow the end user to compare the energy efficiency of different types made by manufacturers and to assess the energy costs needed to heat home.

COP and the new SCOP are used as parameters in accordance with standard EN 14825. Heat pumps are counted against the outdoor air temperature of +10, +7, +, 2, -7 and -  $15^{\circ}$ C.

The COP values show the ratio of the heat output to the supplied electricity. The higher the value, the more cost-effective and energy efficient the pump.

Common borders. Common solutions.

CROSS BORDER







SCOP, however, is the ratio of the thermal energy received or needed to heat the building during the heating season and electricity consumed throughout the season.

While it takes energy during the season is fairly easy to determine as it stems from the parameters of the house, the electricity used to produce the heat pump is more difficult to assess. This is specifically applicable for air heat pumps.

Enterprise Resource Planning /ERP/ - in addition, the new EU Directive further facilitates the lives of consumers by defining the energy class for heat pumps in relation to the SCOP parameter, which is shown in the table below. Therefore, heat pumps with the A +++ label are considered to be most energy efficient, meaning their SCOP parameter is equal to or higher than 5.10.

Energy class and its corresponding efficiency factor

A+++	SCOP ≥ 5,10
A++	4,60 ≤ SCOP < 5,10
A+	4,00 ≤ SCOP < 4,60
A	3,40 ≤ SCOP < 4,00
В	3,10 ≤ SCOP < 3,40
С	2,80 ≤ SCOP < 3,10
	2,50 ≤ SCOP < 2,80
E	2,20 ≤ SCOP < 2,50
F	1,90 ≤ SCOP < 2,20
G	SCOP < 1,90

Fig. 11. Energy class and corresponding efficiency factor

# Air-to-water heat pump

CROSS BORDER

The air-to-water heat pump uses energy from free air to heat and cool rooms and provides domestic hot water for the home. Thus, they are highly efficient and offer an attractive price / performance ratio.

Even for old renovated buildings, where existing systems require high temperatures above  $60^{\circ}$ C, conventional air to water heat pumps reach their limits. With the air heat pump, clean air can be used as a low-temperature energy source up to  $-20^{\circ}$ C. Of course, the lower outdoor temperature leads to lower heat output. For this reason, air-to-water heat pumps are sometimes equipped with additional electric heaters and they cover peak heat demand when outside temperatures are extremely low. The heat content of the air is used to heat the whole house, using electricity as propulsion energy. 1 Kilowatt of electricity can produce up to 5 kilowatts of heat. The air-to-water heat pump can also be used in the summer for air-conditioning of the building.









# Examples from Bulgaria (1)



These types of heat pumps are particularly suitable for use in the present latitudes. The challenge of application of this technology in historic buildings is the external bodies to be hidden as it is not permitted to be placed on the facade. This example is for utilization of air-water type technology where the heat pump warms or cools the water in a water reservoir. The heat carrier is water and a convector is mounted in each room.

In the present building the external bodies of the sirconditioning system have been placed on the roof and the water reservoir is in the technical room. Thus the air-conditioning of the building is secured and the façade is preserved. The advantage is that one external body provides heating for the whole building. The heating is of low temperature and it is highly efficient. A negative element is that the investment is high and the time for switching in between of different modes of the system is longer compared to other types of systems.

(2)



"Air - air" technology of a heat pump works by direct evaporation of the working fluid in the internal body. This presupposes more efficient work of the air conditioner. The advantage of the system is that it can operate on a different mode in each room or a group of premises, the investment is relatively lower and the work of the bodies is faster. A negative moment is that the system needs more external bodies. In this specific example, the bodies are located on the hidden facade of the courtyard.









#### (3)



The external bodies are mounted on external balcony and the parapet hides them. This solution is for buildings which do not have hidden facades or it is not possible to be mounted on the roof.

# Biomass

The use of biomass for generating electricity and heat is a particularly attractive form of energy conversion from environmental point of view. When growing, the biomass first removes the greenhouse gas  $CO_2$  from the atmosphere and binds the carbon in the biomass. This carbon is later released into the atmosphere again - e.g. as a result of combustion or when the biomass is rotting. Therefore, when biomass is used for energy purposes, then only that  $CO_2$  is released which was previously removed from the atmosphere when the plant was growing.

Not all biomass is identical. Organic waste, wood, liquid manure, but also cereals, maize, or other materials origi nating from plants or animals and their consequential and secondary products can be employed for climate- compatible energy production.

Included among the most important biogenous fuels are of course wood and leftover timber accumulating from forestry, in sawmills or as old timber. Fast-growing trees, e.g. poplars and willows, can be planted in so called short-turnaround plantations and be harvested within a few years.

Reed (miscanthus) is potentially a very high-yield regenerative raw material, however it requires high-quality fertile land and a good water supply. Residuary straw, as well as special grain plants like e.g. the wheat-rye hybrid triticale are also suitable for producing energy. Plants which contain sugar and starch, like maize and sugar beets, can be used for making bio-alcohol. Also included as biomass are those oil-containing plants which, by pressing and subsequent processing, can be converted into liquid energy carriers.

Organic leftovers are also suitable energy sources. Liquid manure, bio-waste, sewage sludge, and municipal sewage and food leftovers can be converted into high- energy biogas. Even landfills release biogas which can also be utilised.

Common borders. Common solutions.

CROSS BORDER





Black Sea

www.greethis.net

# The oldest form of use: Burning

The oldest and simplest way of using energy is to burn the biomass. Different types of burning were developed for various plant sizes to assure complete combustion and low emissions, considering the ash content, the fuel composition, and the shape and size of the fuel particles. They essentially differ in the type of fuel processing and the fuel feed method.

Present use of biogenous solid fuels in Bulgaria is mostly in very small systems (less than 15 kW) or in small-scale systems. Automated fuel feed, together with a suitable combustion control system, have increased the ease of operation. Small-scale plants are thereby subject to the emission limits of the emission control legislation in Germany.

Wood-pellet furnaces are currently enjoying a wave of popularity. Wood pellets are small compressed beads of untreated wood, usually from sawdust and plane shavings. They can be delivered like heating oil by tank trucks, or sold in sacks. Pellets can be fired in chimney stoves just like in large-scale, fully-automated and low- emission central heating systems. The pellets are automatically transported from a storage container to the furnace chamber by means of screw conveyors or suction feeders. The space needed for storing this type of fuel is hardly larger than for an oil-fired central heating system.

Generating heat is not limited to small-scale systems only. Firing wood can also be used for district heating networks. In Austria, a country which has been systematically supporting the use of biomass for many years now, there are already several hundred district heating plants running on biomass. It is worthwhile to invest in greater technical optimisation of these larger incineration facilities.

Both the efficiencies and the emissions of modern furnaces have been improved. For example, the efficiency can be increased considerably by condensing the flue gases, since the transformation energy when the water vapour condenses into liquid can be used, and by pre-drying the biomass. The exhaust-gas values can be improved by a continuous combustion process and efficient dust recovery. In recent years, it has also been possible to considerably reduce the emissions of carbon dioxide and unburned hydrocarbons in small systems (see "Ecological qualities of renewable energy" chapter).

# Electricity from biomass

The interest in producing electricity from biomass has increased considerably since the adoption of the biomass regulation in 2001 and the Renewable Energy Sources Act in 2004. Biomass for electricity generation is particularly important to the power industry because it is always available and can be converted to electricity according to the demand. In modern wood-fuelled power plants, the biomass is burned and steam is usually generated with the heat. This steam then drives a turbine or a motor. It is







particularly efficient to use the waste heat for heating buildings or for drying processes, instead of simply dissipating it into the surrounding environment.

A promising alternative to burning is the gasification of biomass. In this process, the biomass is decomposed at high temperatures and transformed into a gas, which is then cooled off, cleaned, and then fired in a motor co-generation plant or a turbine. The future use of biomass in fuel cells, which provide high yields of electricity even from small-power units, is possible with gasified wood. The principle of wood gasification is not new. It was used e.g. after the war for powering lorries due to the lack of more motor-gentle fuels. The trick is to produce a high-quality and tar-free gas, whose continuous use is tolerated by motors, from varying fuel qualities. Newly developed wood-gasifier pilot plants coupled with co-generation units are currently undergoing long-term operation tests.

#### Example from Bulgaria



The present example is from a restaurant which uses a fireplace for heating inside. Dried firewood is used for the purpose. This type of heating has the lowest cost per kWh of heat. The advantages are related with: the low investment, the low cost of heating, comfortability. Disadvantages are related with the need for serious maintenance, the relatively high risk of fire or burns.

# COMMUNITY SCALE

Sustainable transport - car clubs, travel reduction measures, public transport improvement

A defined transport plan can only be called sustainable if certain economic, social and environmental criteria are taken into account. Fundamental understanding of the

Common borders. Common solutions.

🕑 🖌 CROSS BORDER 👌







elements and principles of sustainable development is essential for the development of a comprehensive plan for sustainable urban mobility at a strategic level.

It is necessary to make a self-assessment at the beginning of the development process to identify the strengths and weaknesses of current practices, to plan and identify your own potential, to successfully prepare for a sustainable Urban Mobility Plan. The evaluation should determine how accurate current practices in transport planning are aligned with best practices and identifying barriers that could influence the development process. This will help to determine the process and the development plan according to local conditions.

# Car clubs - car sharing

1. What is "shared travel"? - There is no explicit regulation in the law about what a shared journey is. It can be defined as a contract (in most cases oral) between a driver of a car and another person / co-driver in order to split fuel costs. For example - Ivan and Marie want to go to the Seven Rila Lakes /Bulgaria/. They know that Peter has a car and, instead of taking a bus, they wind him up and travel with his car by sharing gasoline costs.

2. How can I find companions in the direction I travel? - It is perfect if I have a friend or acquaintance to travel in my direction - to work or to rest. Once, however, it is impossible. In such cases, the unlimited possibilities offered by the Internet come from help. Because of the convenience of this type of trip there are many shared travel sites as well as social groups for shared trips. When we use these ways to find a shipment, it's good to know a few basic things about them.

Shared Travel Websites - These sites play the role of an intermediary between one-way travelers - those with a vehicle on the one hand and those who do not have a car on the other. Sites work as "search engines" on the basis of criteria such as urban/intercity travel, date, time, etc. When using the services of the site a person has to register, to provide personal data and agree with its general terms and conditions (e.g. a contract under general conditions is made). Important! Sites are the sole intermediary of the shipment and everyone's terms of service contain a similar clause. "The site is not responsible for any direct or indirect loss that may have been incurred by you." What does this mean - for example, if the trip fails and misses your engagement, I can not claim compensation from the site.

3. Social groups for shared trips - the special thing here is that there is no intermediary between the travelers - I post a publication that I will travel to Plovdiv on Friday and look for two or three for a company and I'm waiting for proposals.

Accordingly, what duties do I have for passenger transport with my personal vehicle? -For shared journeys, the general rules on road safety laid down in the Road Traffic Act apply.

Common borders. Common solutions.

O 🗙 CROSS BORDER







Before leaving, the driver is required to check if his car is working - brakes, closing and opening doors, etc.

It is forbidden to exceed the load capacity of the vehicle - if the car is four-seater, we can not travel six (even if we are the coolest company).

Carriage of children under 12 years of age is prohibited in the front seat of the car unless the child is in a special seat.

When traveling with an unknown driver, som specific issues arisen as: Is it a legal guide? Has he used alcohol? Has the car passed a mandatory technical inspection? Is it at the moment? Does the driver own the car, is it stolen? By law, only a road police officer can check a driver's license. However, shared travel is a contractual agreement, so when negotiating before paying the shipping cost, one can require the driver to show that he has the relevant documents like a driving license, a registration card, etc.

What are the "pros and cons" of shared trips?

- Depending on the end point of travel, it often goes cheaper to travel "shared" than other modes of transport.
- > The company is nce and the people are not bored travelling alone.
- It can be said that it is so environmentally friendly to the harmful gases instead of use of more vehicles.
- Road traffic is decreasing instead of everyone to ride alone in the car, people travel together (one car instead of four is really a relief for the road).

Foreign travel also has its drawbacks, such as the possibility of dropping the deal at the last minute and breaking up the plans. There is another much more important argument against them - as an informal arrangement, in most cases the only obligation that is assumed is to pay a relevant part of the price. In case of a road traffic accident the passenger will take the treatment, not the driver. While traveling by public transport, train, bus, taxi, etc. the consequences of harm to health will be covered by the mandatory Accident Insurance of Passengers, which is necessarily maintained by the carriers. There is the maximum that the ticket materialized the insurance.

There are ideas for tying in the law of shared travel rules, such as - the payment of tax by persons performing such services for profit; performance of roadworthiness tests for cars by the Automobile Administration Executive Agency, etc. How, however, the law can give a legitimate definition of shared travel and distinguish joint trips between friends and colleagues, and stopping from transporting a personal vehicle for profit is really a curious question.

# Travel reduction measures

One of the most disturbing aspects of city life is street traffic, especially congestion that clogs the streets and pollutes the air. Unfortunately, there is no prospect that this

Common borders. Common solutions.

O CROSS BORDER







59

www.greethis.net

everyday test, which is subject to the millions of inhabitants of the cities, will diminish. The cause of street congestion is not difficult to find. Cities are constantly expanding and today about half of the world's population lives in urban areas. With the growth of cities, the number of vehicles increases. An author describes this situation in the following way: "Too many people are driving too many cars in the same limited space."

As people rely on vehicles, cities have to find a way to cope with their growing numbers. In Los Angeles (USA), for example, the number of cars exceeds the number of the population, about four million people! Although the situation elsewhere has not yet reached the point, few towns can cope with the increasing influx of vehicles. "Cities are not designed for cars," said Carlos Guzman, director of the Madrid Urban Planning Commission. Old cities with their narrow streets are most vulnerable to congestion, but even in modern large cities, broad roads are rapidly overflowing, especially in the morning and evening peak hours. "Today in big cities there are traffic jams for most of the day and the situation is getting worse," says Jean-Paul Rodriguew in his report "Urban traffic problems."

As cars are sold much faster than governments can build roads, their growing numbers can make even the best road system difficult. The book, "Getting stuck - how to deal with congestion at peak hours," says: "In the long run, building new roads and expanding existing ones do not greatly reduce the traffic load in the peak hours." The lack of sufficient parking space also leads to congestion. At any time of the day, a significant number of cars go around the streets only to find a parking space. It is estimated that air pollution from street traffic - especially in cities - causes the deaths of around 400 000 people per year. According to one study, the air in Milan (Italy) is so polluted that if one spends one day breathing the air through the streets of the city, it is as if it has smoked 15 cigarettes. The cost of congested street traffic also includes the lost time and stress on drivers. While emotional damage can hardly be calculated, according to a study in the United States, the economic congestion losses in 75 of the country's largest cities amount to \$ 70 billion a year. Is there anything that can be done to improve the current situation?

In some cities, extreme measures have already been taken. Singapore, which has the highest concentration of vehicles in the world, controls the number of vehicles that consumers can buy. In many historic cities, for example in Italy, car access to the city center is forbidden most of the day.

Another solution that some cities resort to is setting the "traffic tax" that drivers pay to get into the city center. In London, the use of this approach has reduced the number of delays caused by congestion by 30 percent and other cities seem to be ready to take similar measures. In Mexico, cars are only admitted to the city center on certain days, depending on the car's registration number.

In addition, city authorities are investing enormous amounts to modernize the transport system, improve roads and build ring roads or surrounding routes. Computerized traffic







60

www.greethis.net

light control systems and timely communication with the police in the event of road accidents and congestion resulting from them are also implemented.

To facilitate movement, special buses and road lanes are also used, the direction of movement of which can be changed as needed. However, the success of all these measures depends to a large extent on the cooperation of citizens.

Here are some suggestions that could help to cope with the overwhelming movement in the city.

At short distances, it is best to go on foot or use a bicycle. In many cases, each of these two options turns out to be faster, easier and healthier. Longer distance could be an ideal option for public transport. In many cities efforts are being made to improve bus and rail transport and the subway to convince people to leave their cars in the garage. Using these services can also mean saving money. Even if you have to drive a part of the route, you could probably use public transport to get to the city center.

If you have to drive, think if you could take someone with you. This is one of the most effective means of reducing peak hour traffic. In the United States, 88 percent of people who regularly travel to work use a car and about two-thirds of them travel alone. If a significant percentage of people are convinced to travel together for work, this "can have a major impact on the level of delays and congestion in the peak hours," says the book "Getting stuck." In addition, in many places there are high-speed road lanes for cars in which two or more people travel. Cars with only one person are not allowed to these canvases.

If you have a chance to decide when to travel alone, try to avoid peak hours. This will make it easier for you and your other guides. If you park in the right way, you will not interfere with the traffic. Of course, even the best plans are not a guarantee that you will not get stuck. What can help you keep calm in such a situation is the right attitude.

It is clear that if you live in a big city you will have to get used to congestion. However, by taking the appropriate measures and by treating kindly and patiently the other drivers, you can learn to cope with the challenges of the street movement.

# Public transport improvement

Public transport comprises all transport systems in which the passengers do not travel in their own vehicles, but share the transport mode. It usually provides scheduled services on fixed routes on a non-reservation basis.

Guarantee the quality of PT network and constantly improve PT network by:

- Daily schedules at close cadence
- Regularity and amplitude







Intercity connection

• Attractive tariff (for different target groups: students, seniors, commuters, tourists etc.)

- Good connections by night bus covering the entire surface of the city
- Stops covered and lighted
- ITS
- Green PT fleet

• Low floor vehicles to ensure accessibility to all, as part of a global policy dealing with accessibility to all

- Demand response travel service
- Partnership between different PT-operator
- Synchronisation of timetables PT services
- Camera surveillance (security)
- Real-time information in PT
- Payment system based on GSM technology
- Electronic ticketing (SMS tickets, online-tickets)
- Increased safety on PT

• Integration of public transport with train, suburban and regional bus service

Priority is given to public transport:

- PT lanes (more lines or more optimal lines)
- Traffic light control, green wave for PT
- Info table-display for arrival the bus at bus station
- Definition of minimum building density around public transport stations
- Parking standards in new buildings related to public transport services









#### Examples from Bulgaria

#### (1) ICT applications for efficient and integrated transport solutions

The action tackles a set of actions and measures aimed to optimize the urban transport systems in the big cities through application of integrated soft measures and investment activities. Based on the assumption that the big cited suffer from the heavy traffic and transport dependencies, the present solutions are based on combination of innovative and advanced applications using ICT technologies, infrastructure development and campaigning measures. ICT technologies incorporate establishment of intelligent online transport system, installation of GPS modulesto track the bus lines and regulate the transport. Infrastructure development regards reorganization of urban transport through construction of BRT corridor, bicycle paths, update of public transport fleet. Campaigning measures include organization of information and dissemination activities targeted to the residents and guests of the city.

The present measure has been successfully applied and operated in Burgas municipality.

http://www.transportburgas.bg/

# (2)

# Active and autonomous mobility for students - The Traffic Snake Game

Traffic Snake Game has been inaugurated in Varna municipality with the general aim to improve the public transport and enhance the use of sustainable transport modes. It is working on the promotion of active and autonomous mobility in commuting to schools with the aim of reducing the environmental impact of car use, improved public health, encouraging sustainable transport solutions, intervening in the public space, in the collective perception of the relationship between the city and childhood and education of children to build their capacity to discover the immediate environment and to remove obstacles that limitchildren's autonomy.

The Traffic Snake Game has started in Belgium as a small project and has evolved into a European wide campaign with more than 2,000 schools involved in a network in 18 countries across Europe and abroad. 20 national contact points and 46 local actors support the implementation of the game in their countries.

https://www.trafficsnakegame.eu/









63

www.greethis.net

# PROPOSALS ON THE USE OF ENERGY EFFICIENT TECHNOLOGIES ON EXAMPLES OF HISTORICAL OBJECTS OF THE BLACK SEA BASIN

Applying Energy Efficiency Measures to Historic Areas is geared to improving energy efficiency in the scale of historical areas that are compatible with the protection of their hereditary value. Economies of scale can be best achieved by looking beyond the limited extent of the legacy and covering over 23 percent of the European building stock built before 1945. This optimizes the energy-efficient and creative potential of re-using the broad definition of urban inheritance, thus allowing easy transfer of retrofitting technology and increased adaptation measures.

In addition, many suitable technologies for renewable energy generation and energy management become viable on an urban scale, regardless of whether the individual components or areas are designated as an inheritance.

The possibilities for improving energy efficiency are:

- Development of variety of technologies particularly suited to use in historic areas
- Use a software tool to support strategic decision making

- Education and training for the reconstruction of historic city districts and their buildings

Modernization measures fall into three directions:

- Technologies for the modernization of building fabrics and building services
- Advanced energy management systems, and

• Renewable energy generation systems in historic cities

Three measures are particularly relevant for the reconstruction measures:

- first step: insulating mortar for external application as plaster or internally as gypsum;

- second step: aerobic fiber insulation to fill the cavities behind the existing walls, such as gypsum boards or gypsum boards;

- third step: modern window system with built-in air supply valves and blinds connected to a building management system.



9





64

www.greethis.net

Given the inherent properties of the lime-cement mortar material, especially their lower hardness and higher vapor permeability and moisture absorption than cement solutions, these properties make them particularly suitable for use in historic buildings and old masonry, but their thermal insulation properties are insufficient.

Bofimex, ISOCAL, is based on natural hydraulic lime (NHL), combined with extruded polystyrene beads as insulating and other additives. As a mortar NHL 5 is used and is of higher strength in the range of NHL. However, since the content of polystyrene filler is up to 80%, the resulting solution is significantly weaker and more permeable than conventional NHL 5 solutions, making the new product more suitable for use as a plaster and plaster for historic masonry.

The new solution was first tested in the laboratories of the Stuttgart MPA, the Stuttgart University Material Testing Institute.

A field study by Fraunhofer-Gesellschaft was conducted at the Holzkirchen outdoor test facility at their Institute of Building Physics, where a test house with a wooden construction already exists. The insulation lining is applied to the wall facing west to a brick panel placed in the wooden frame. Measurements of performance continue. Bavaria's alpine foothill location has severe weather conditions for Germany, heavy wind exposures, high radiation heat losses at night and frequent freeze and thaw cycles. The wall facing the west receives extreme values of atmospheric loads - the worst test conditions for the mortar applied.



Fig.12. Applying a lime-spray spray on a wall forming the climate chamber (Photo: MPA Stuttgart)]

At the same time, the plaster was used as a plaster in a nearby building in Benediktbeuern, at the Fraunhofer Center for the Preservation and Energy Presentation







of Historic Buildings, located in the historical colony of the Baroque Monastery. Here the hygrothermal efficiency of the plaster is carefully monitored under controlled indoor climatic conditions.

The development of the second product is an aerobic fiber insulation formulated initially to respond to the extreme conditions of exploration of space. The new product, SpaceLoft, is produced by the A Proctor Group (APG), using an aerogel supplied by Aspen Airgel.

This product is associated with the traditional use of plaster on slats as an inner wall and is common in Bulgaria. This historical construction includes air cavities between the lamellas supporting the laths. When these cavities are not required to evaporate moisture from the masonry, they can be filled by blowing into the cavity insulation. This installation process minimizes time and cost as well as damage to existing tissues. The retrofitting technique can also be used for cavities behind plasterboard.

Existing cavity filling products have limitations for use with older construction types, such as masonry, impermeable to vapors or water absorbers, with lower thermal efficiency or with a risk of migrating the plasticizer. The newly developed product is made of non-woven silk-impregnated polyester fiber blankets. Air is a light product obtained from a gel whose liquid component is replaced with gas. When the liquid is removed, what is left is similar to swollen sand, with up to 99% porosity. The result is extremely low density material with several remarkable properties, especially its efficiency as a heat-insulator that is ultra-light, extremely water-repellent and vapor-permeable.

APG already installs the product in a 19th-century residential building where observation takes place.

Improving window performance is usually limited to simplified measures, such as window design and double glazing, without taking into account many related conditions. Double windows are typical of many regions of continental Europe. There is an advanced system for windows with built-in air valves and shading blinds connected to a building management system. The development of the window is collaboration between the Hungarian architectural firm HorBer, the Norwegian University of Science and Technology (NTNU), DWEcoCo and Snekkeriet, a Norwegian woodworking company. The building management system was developed by the Italian company RED Srl.

The new double windows replace the existing windows and are equipped with thinwalled, high-performance double and triple glazing. Built in the wide 150 mm space between the inner and outer wings are motorized darkening blinds. Special air supply valves are installed in the interior and exterior window frames. Differences in pressure and air temperature create passive airflow. The internal air is inserted into the space between the frames and preheated by the heat transfer through the window glass before entering the room, which greatly improves the energy efficiency of the window. If the levels of internal carbon dioxide rise above the set threshold, the building control







system activates a mechanical fan in the room. This in turn increases the pressure difference, thereby accelerating the air flow through the air supply valves in the window frame. This combination of passive and active ventilation improves room air quality while reducing associated energy losses.

The security blinds built into the windows are controlled by daylight sensors connected to the building control system to control sunlight, solar heat and lighting conditions. When window shading decreases to prevent overheating due to solar gain, the building management system responds to lighting and occupancy sensors to activate the lighting. The system can be manually operated, for example if a darkened room is required for presentation. The building management system also controls a motorized radiator valve that modulates the room's thermal power to maintain comfortable conditions.



Fig. 13. The building management system is associated with blinds and air valves, radiator valves, lighting and various sensors



Fig. 14. Integrate air supply valves and shade blinds into double windows











Double-window replacement systems with air valves and built-in blinds for blinds connected to a building management system.

# Practical example of use of energy efficient technologies in Bulgaria



The present is a historical building situated in the historic centre of Varna. The example shows an installation of windows with variable reflectivity. This technology is relatively new for the Bulgarian market. The window glasses are heliomatic, thus their permeability depends on the sun radiation or sunshine. The relation is the following: the oftener the sun shines, the darker the windows become and the less sun shines the more transparent it becomes. The advantage is that it meets the energy-efficient requirements applicable to every facade and has no maintenance costs. Disadvantages are related with that a high investment is required and there is no possibility for the building energy management by its users.









# LIST OF TECHNOLOGIES, PRODUCERS AND DISTRIBUTORS AVAILABLE AND OPERATING IN BULGARIA.

No	Name of organisatio	<b>Contact details</b> (website, phone number, address, contact person)	Description of the organization	Field of activity /energy efficient measures, lighting, transport, BMS (building management system), energy services, RES	Examples of good practice (Links)
1.	Terazid OOD (Terazid Ltd.)	Website: <u>www.terazid.com</u> Address: Sofia 1528 Gara Iskar, Street 5004 No. 5 Tel: +359 2 979 99 71 Fax: +359 2 979 99 70 e-mail: office@terazid.com	Terazid Ltd. is a leading Bulgarian manufacturer of top quality paints, plasters and insulating materials. TERAZID Ltd combines the traditions in the production of building materials with the high quality standards. The company has a Certificate of Quality ISO 9001:2000 and a Certificate according to the Bulgarian State Standard for the entire integrated system for heat- insulation.	Heat insulation	https://www.terazid.com/ en/?act=news&do=list&dat e=&sql_which=
2.	Baumit	Website:	Baumit Bulgaria Ltd. has been created in	Heat insulation	https://baumit.bg/za-

Common borders. Common solutions.



68







			www.greethis.net		
	Bulgaria Ltd.	www.baumit.bg Address: Elin Pelin 2100 38 Bulgaria str. E-mail: office@baumit.bg	1995 with the main objective of Baumit Ltd. is development of new concepts and ideas to contribute to CO2 and energy consumption reduction through integraton of specific company products. Baumit Bulgaria Ltd. offers three types of thermal insulation systems System Opens, Star and Pro. Baumit is a synonym for building competence, modern and high- quality products, dynamic and innovative companies, and future-oriented marketing.		nas/baumit-novini
3.	Weber Bulgaria	Website: <u>www.weber.bg</u> Address: Kostinbrod 2230 Industrial zone, 13 Imperator Konstantin Veliki Str. E-mail: office@weber.bg	Weber Bulgaria is part of the international group Saint Gobain /www.saint-gobain.bg/ and was created in 2001 to produce innovative and user-friendly products of facades improvement, heat insulation systems, industrial flooring and technical liquid solutions. Weber is the building market leader offering innovative ideas for energy efficiency and environment protection. The major company priority is the creation, production and dissemination of sustainable and stable products and services. Weber offers highly efficient thermal insulation systems based on thermal insulation boards of EPS or mineral wool. The systems are designed to maximize compatibility and effective operation of all	Heat insulation	https://www.bg.weber/sai nt-gobain-weber-predstavi- prvata-v-sveta-naplno- recikliruema-sistema-za- toploizolaciya https://www.bg.weber/se arch- content/content_type/cas e_studies











			www.greethis.net		
			components together and are offered with a warranty of 5 to 15 years.		
4.	Saint- Gobain Weber Bulgaria Ltd.	Website: www.saint- gobain.bg Address: Kostinbrod 2230 Industrial zone, 13 Imperator Konstantin Veliki Str. E-mail: office@saint- gobain.bg	The company was established as a national branch in 2004 to work for sustainable building solutions. It is part of Saint-Gobain Group which develops products and provides services to improve environment and daily lifestyle. Innovative materials sector is the technological driving force, Building materials sectoroffers internal and external building solutions to improve the buildings comfort. Distribution of building materials sector facilitate the cusomers access to the products and services.	Heat insulation	
5.	Marisan	Website: <u>www.marisanbg.co</u> <u>m</u> Address: 15 Kalna Dere Str. East Industrial Zone 7009 Ruse, Bulgaria e-mail: <u>info@marisanbg.com</u>	Marisan is a company working on the Bulgarian market striving to develop and improve building materials by incorporating the experience of the European and global technology leaders, along with leading trends and know-how in the field. By virtue of its long experience in the production and supply of integrated and sustainable systems of products and services for construction, MARISAN has established itself as a proven market leader and reliable supplier with a top priority - to work in service to its clients and partners!	Heat insulation	https://www.marisanbg.co m/en/heritage- building/page/1382#.XScZN P5S_IU











	LONOF LAN UNION				
			<u>www.greethis.net</u>		
			The company offers its own development of heat isolation system as well as decorative elements, which are suitable for renovation of old buildings.		
6.	Fibran Energy Shield	Website: <u>www.fibran.bg</u> Address: 33 "Okolovrusten pat" str. Sofia 1404 E-mail: fibran@fibran.bg	Fibran Energy Shield is a company working to produce and offer insulation materials, applied by an experienced installer and according to current regulations and rules of good practice, create a long-lasting and valuable ENERGY SHIELD for building constructions and industrial applications. The energy shield concept minimises thermal losses and reduces energy consumption, provides sustainable thermal comfort to our living and working environments and limits environmental pollution and the waste of energy sources. The products are guaranteed by own laboratory with high-tech equipment, which monitors the quality of the production round the clock: stability of the dimensions; $\lambda d$ - guaranteed coefficient within decades.	Heat insulation	
7.	Isover Saint- Gobain	Website: <u>www.isover.bg</u> Address: Kostinbrod 2230	Saint-Gobain Isover is the insulation department within Saint-Gobain group.Isover offers effective thermal and audio insulation solutions for the construction of energy efficient buildings	Heat insulation	https://www.isover.bg/new s/pasivni-sgradi- energospestyavane-i-borba- s-izmeneniyata-na-klimata

71









			www.greethis.net
		Industrial zone, 13 Imperator Konstantin Veliki Str. E-mail: office@saint- gobain.bg	and provides safety of residents and contributes to the environment protection. As for the accomplishment of these goals lsover has the best technology for the production and application of glass mineral wool, rock mineral wool, expanded and extruded polystyrene. As a leader in insulation, lsover seeks to develop a socially responsible business and actively contribute to market education and the development of good construction practices by offering its partners clear and effective energy saving solutions. Isover has developed a wide range of solutions and systems integrating a wide range of materials and accessories to provide the market with the best technical and economic solutions for all applications, independent of the type of building of project - new construction and renovation.
8.	Rockwool Bulgaria	Website: <u>www.rockwool.bg</u> Address: 1113 Sofia, Bulgaria E-mail: <u>info@rockwool.bg</u>	Rockwool Group is the world leader in the manufacture of stone wool insulation solutions covering building insulation, industrial and technical insulation for process industry. The company offers a full range of high-performing and sustainable insulating products with high technical characteristics for the construction industry. The insulation products are based on innovation technology of stone wool










	LONOI LAN UNION				
			www.greethis.net		
			developed and distributed wroung the		
			world. Rockwool Group incorporates several		
			companies working in the field of gardening		
			and marine activities.		
			The work of the company is realized in 27		
			factories in three continents (Europe, North		
			America and Asia) and the global network		
			consists of sales, distrbutor and partner		
			representation. The company products are		
			found in residential and industrial buildings		
			of all types of construction and		
			performance. The products are various and		
			are used for the creation and maintenance		
			of circular economy thus increasing the		
			resource efficiency, healthy lifestyle and		
			safety of users.		
9.	ISS	Website:	ISS Engineering was established in 1993 in	Thermal insulation	Conservation, restoration,
	Engineering	https://iss-bg.net	Varna. It combines experience and focuses	systems	adaptation and color facade
	Ltd.	Address: bul.	on the efforts of highly educated staff in		and cultural value of a
		"Hristo Botev" 10,	the field of building practice. The company		builiding in Varna, Bulgaria
		2nd floor, Varna,	has two partners. For the fulfillment of its		
		Bulgaria	tasks the company maintains permanent		
		E-mail:	staff of about 30 employees. The main		
		info@iss-bg.net	activities are related with design and		
			construction of commercial, industrial and		
			residential buildings as well as furniture		
			manufacturing and carpentry services.		
10.	Planex ltd.	Website:	Planex is one of the leading Bulgarian	Thermal insulation	
		https://www.plane	construction and investment companies		
		<u>x.bg/index.html</u>	with 25 years of experience and many		

73









			www.greethis.net		
		Address: Varna	realized projects. The company portfolio		
		9000	includes a diversity of sites: hotels and		
		55 Luben karavelov	holiday complexes, residential buildings,		
		Str.	shopping and office centres, shopping		
		E-mail:	malls, industrial and logistic buildings,		
		office@planex.bg	infrastructure projects. It has won the		
			professional respect of the building branch		
			and the investors with our own know-how,		
			high technological and organizational levels		
			of performance and adherence to quality		
			standards. Throughout the years of		
			experience Planex expanded its operations		
			through investments in supplementary		
			activities and products related to the		
			optimization of the building process. Since		
			2007 Planex has been rated among the top		
			huilding field		
11	"Cargan	Wabsita	Duitding field.	Thormal insulation	
11.	Cargon Dro" Itd	http://www.corgon	the company Cargon Pro Llu. Is	mermal insulation	
	FIO ILU.	ha com	buildings and design and installment of		
		Address: Varna	thermal insulation systems. The company		
		9000	disposes of large number of equipment		
		12 Slavvanska str.	machinery and highly qualified personnel to		
		E-mail:	satisfy the needs of the client, regardless of		
		cargonbg@gmail.co	the scale of the site.		
		<u>m</u>			
12.	CoolConsult	Website:	Cool Coonsult is a nationally operating	Heating, ventilation,	http://coolconsult.com/en/
		http://coolconsult.	company, the main fields of which	air conditioning and	%d0%b4%d0%b0%d1%80%d0%b
		<u>com/en/</u>	operation are: design and installation of	technological systems	5%d0%bd%d0%b8%d0%b5-











	LUNOFLAN UNION				
			www.greethis.net		
		Address: 2 Nikolai Haitov Str., 1113 Sofia, Bulgaria E-mail: office@coolconsult. com	heating, ventilation, air conditioning and technological systems, development and consultancy for energy efficiency of buildings and processes.		%d0%bd%d0%b0- %d1%85%d1%80%d0%b0%d0%b c- %d1%80%d0%be%d1%82%d0%b e%d0%bd%d0%b4%d0%b0- %d1%81%d0%b2- %d0%b2%d0%bc%d1%87%d0%b a- %d0%b3%d0%b5%d0%be%d1%8 0%d0%b3/
13.	MMC	Website: https://mmc.bg Address: Varna 9000, 121 "Knyaz Boris I" E-mail: varna@mmc.bg	MMC is an official importer of Japanese Daikin air conditioning equipment and provides comprehensive delivery, installation and service services throughout the country. Daikin air conditioners feature high energy efficiency, quiet operation and long service life. The extremely diverse portfolio of Daikin includes domestic air conditioners, efficient heat pumps, VRV systems for air conditioning, refrigeration, ventilation and application systems	Air conditioning systems, RES	https://mmc.bg/%D0%94%D0 %B2%D0%BE%D1%80%D0%B5% D1%86%D1%8A%D1%82- %D0%95%D0%B2%D0%BA%D1% 81%D0%B8%D0%BD%D0%BA%D1% 81%D0%B8%D0%BD%D0%B4- %D0%BF%D0%B0%D0%B7%D0% B8- %D0%B0%D0%B0%D0%B7%D0% B8- %D0%B0%D0%BD%D1%82%D0% B8%D0%BA%D0%B8-%D0%B8- %D0%BA%D0%BE%D0%BC%D1% 84%D0%BE%D1%80%D1%82%D0 %B0-%D0%BD%D0%B0- %D0%B3%D0%BE%D1%81%D1% 82%D0%B8%D1%82%D0%B5- %D1%81%D0%B8-%D1%81- %D1%8F%D0%BF%D0%BE%D0% BD%D1%81%D0%BA%D0%B0- %D1%82%D0%B5%D1%85%D0% BD%D0%BE%D0%B5%D1%85%D0% BD%D0%BE%D0%B5%D0%BE%D0%











					0%B3%D0%B8%D1%8F- nid96.html
14.	Climamarke t Efendulov Ltd.	Website: <u>https://www.clima</u> <u>market.bg</u> Address: Varna 9000, 11 Slavyanska str. fl.1 E-mail: office- var@climamarket.b g	Climamarket Efendulov" Ltd. has over 20 years of experience in the trade, design and service of air conditioners. Along with the supply, installation and service of air conditioners, the company also deals with heating equipment, ventilation equipment and solar hot water installations. The company is an importer and service center of air conditioners of leading trademarks, solar thermal collectors etc.	Air conditioning	
15.	Muhtarov	Website: <u>https://clima.muht</u> <u>arov.com</u> Address: Industrial zone Planova 926 e-mail: muhtarov.clima@g mail.com	"Muhtarev Klima" Ltd. was founded in 2006 with the main activity of sale, installation, maintenance and service of household splitters and multi-split systems, heat pumps and VRF systems. Over the years, the company has proven itself to be a reliable and loyal partner in its field and has gained extensive experience, as a specialized company in construction of HVAC systems and equipment supplier in Northeastern Bulgaria.	Air conditioning, energy management, heat pumps	

Common borders. Common solutions.

76









	LONOI LAN UNION				
			www.greethis.net		
16.	Ataro Clima	Website:	Ataro Clima Ltd. was founded in 1990 and is	Air conditioning,	https://ataro.bg/portfolio/
	Ltd.	<u>https://ataro.bg/at</u>	certified by ISO 9001. It is a winner of a	ventilation	<u>%d0%b0%d1%80%d1%82-</u>
		<u>aro-klima</u>	gold medal from the International Technical		<u>%d0%b3%d0%b0%d0%bb%d0%b</u>
		Adress: Varna 9009,	Fair 1997. Thanks to its rich scientific and		<u>5%d1%80%d0%b8%d1%8f-</u>
		1 "Academik Igor	production experience Ataro Clima is a		<u>%d1%84%d0%b8%d0%bb%d0%b</u>
		Kurchatov"	leader in building heating, ventilation and		8%d0%bf%d0%be%d0%bf%d0%
		Tel.: +359 52 502	air conditioning. The activity covers design,		<u>be%d0%bb%d0%b8%d1%81/</u>
		776	production of elements and complete		https://ataro.bg/portfolio/
			construction of RVC installations, warranty		%d0%be%d0%b1%d1%80%d0%b
			and post-warranty services Innovation		5%d0%b4%d0%b5%d0%bd-
			technologies are used for hightech		%d0%b4%d0%be%d0%bc/
			appliances and unique environmental-		
			meintenance activities are ensured by the		
			maintenance activities are ensured by the		
			facilities		
			lacificies.		
17	Prizma -	Website	"Prizma - FS" Ltd. is specialized in design	Energy efficient	http://www.prisma.bg/bg/g
17.	FS"Itd	http://www.prisma	and realization of architectural lighting of	lighting	allery/1 html
	25 200.	hg	facade buildings. Exemplars of these are	Energy management	
		Address: Varna	significant buildings of culture heritage and		
		9000, 47 Vasil	and monuments in some major cities in		
		Drumev str.	Bulgaria. The company is proud to offer the		
		E-mail:	customers unique lighting schemes of high		
		prisma@prisma.bg	quality, modern energy efficient design		
			projects, delivery of products and		
			maintenance supply.		
18.	Polaris	Website:	Polaris Lighting Ltd. is one of the most	Lighting systems	
	Lighting Lts.	http://polarislighti	dynamically developing and innovative		
		ng.bg	production and commercial companies of		



77







			www.greethis.net		
		Address: Varna	lighting equipment in Bulgaria. The		
		9000, 5 Murgash	company is characterized by its long-		
		str.	standing presence in the market for over 20		
		E-mail:	years.		
		sklad@polarislightin			
		g.bg			
19	Gabrovski	Website:	Gabrovski Ltd. is a company specialized in	Lighting,	
	Ltd.	http://www.gabrov	design, manufacturing and sales of lighting	engineering	
		<u>ski-light.com</u>	and lighting accessories, development of		
		Address: Varna	interior projects for public buildings, hotels		
		9000, 10 Tsonio	and restaurants, industrial sites, residential		
		Todorov str.	buildings. Exterior projects include facade		
		E-mail:	solutions, urban environment, parks and		
		office@gabrovski-	gardens. A shining example is innevitably		
		light.com	connected with the production of boutique		
			lapshades from textile and various premium		
			designed by design specialists		
20	Paytox	Wabsita: raytay	Deviter Engineering Ltd has been	Eporgy officionay	
20.	Raylex Engineering	ba com	astablished in 2001 in Varna as ongineering	energy enriciency,	
		Address: Varna	company. During the years of experience it	management enginee	
	Ltu.	9000 66 Vladislav	has developed as a leading engineering	ring	
		Varnenchik Blvd	company in the field of video surveillance	1 11 15	
		F-mail:	communications, computer technologies,		
		info@ravtex-bg.com	security systems, automation of buildings		
			and processes, access control and working		
			time, hotel security systems, perimeter		
			security and others. The company offers		
			complex design, construction and		
			maintenance of all types of low-voltage		











			www.greethis.net		
			www.greethis.net installations, electronic equipment and special systems in hotels, business buildings and luxury homes. It manufactures specialized products and systems in the field of radiocommunications, security and access control systems, supplies products and complete systems in these areas and in the field of video surveillance and fire detection. Retex Engineering is an authorized provider and integrator of		
			computer and network equipment and		
			software, GSM and office equipment.		
21.	RTM auromation Ltd.	Website: <u>http://rtm-</u> <u>automation.com/ab</u> <u>out</u> E-mail: v.vasilev@rtm- automation.com	RTM auromation is a company experienced in automation projects. The main activities are related with elaboration of projects in the field of electrical engineering. Supplementary to standard home and family houses projects, RTM Automation manufactures many projects in the field of automation and management, both for industrial sites and building automation and BMS.	Energy management systems	
22.	Energoeffec t Ltd.	Website: http://energoeffec t.net/ Address: Sofia 1336, 3 Lyulin q. E-mail: office@energoeffect	Energoeffect Ltd. is one of the first companies which have obtained license for energy audits of buildings issued by the Agency for energy efficiency. Energyeffect is certified according to ISO 9001:2008 for energy audits of buildings and industrial companies, assessments of industrial	Energy efficiency, energy audits	http://energoeffect.net/?ac t=content&do=detailed&rec =8 http://energoeffect.net/?ac t=content&do=detailed&rec =150











			mummer and atlain wat		
			www.greetnis.net		Γ
		<u>.net</u>	projects, engineering services by SGS		
			Bulgaria Ltd., under acreditation of UKAS,		
			Великооритания. The company is co-		
			founder of the Chamber of Dusiness		
			companies for energy audits. During the		
			years of experiences it has accomplished		
			over 900 audits of builidings in many		
			Bulgarian cities and developed energy		
			certificates for 200 buildings.		
23.	Bulgarian	Website:	Bulgarian Energy Company is specialized in	Energy management;	
	Energy	<u>http://www.velgra</u>	energy efficiency; energy efficiency audits	Energy efficiency.	
	Company	<u>f.biz/becbg.html</u>	of industrial systems; development and	building energy	
	Ltd.	Address: Sofia	preparation of applications for funding	management	
		1000, 8 Tsar	under the European programs. The	management	
		Kaloyan str., fl.5	following spheres of implementation are		
		E-mail:	referred to:		
		bulgenergy.co@vel	project design, construction;		
		graf.biz	construction and maintenance of		
			technological facilities of energy		
			production.		
			The company implements energy audits of		
			street lighting, buildings, etc.		
24.	Center for	Website:	CTEC is a recognized company in the field	Energy management;	
	testing and	https://ctec-	of laboratory testing and certification of	engineering;	
	European	<u>sz.com/</u>	technical products, management systems	Construction	
	certification	Address: Stara	certification,technical inspection, control,	products	
		Zagora 6000, 23	energy efficiency audits and trainings.	products	
		Patriarh Evtimij	With regard to energy efficiency audits and		
		E-mail: <u>ctec@ctec-</u>	buildings certification, CTEC performs:		
		sz.com	<ul> <li>Assessment of compliance of</li> </ul>		











	www.greethis.net						
			<ul> <li>investment projects in phases of technical and detailed designs;</li> <li>Issuance of a design characteristics certificate for new buildings before commissioning;</li> <li>Energy Efficiency Audits and Certification of Buildings in Operation;</li> <li>Verification of energy efficiency of boilers and air conditioning systems in buildings;</li> <li>Assessment of achieved energy savings in buildings as a result of implemented energy saving measures in order to obtain Energy Savings Certificates.</li> </ul>				
25.	"Odiko-69" Ltd.	Website: <u>https://www.odiko</u> <u>.net/consultations-</u> <u>en.html</u> Address: Plovdiv 4000, 100 Maritsa Blvd. E-mail: <u>odiko69@gmail.co</u> <u>m</u> .	Odiko-69" Ltd is certified under ISO 9001 and is profficient in carrying out consultancy services. Principal direction of the comapny activities are the following: - Consultations - Occupational medicine Center - Medical center - Energy efficiency survey and certificate	Energy management			
26.	Veolia Energy	Website: https://energy-	The company mission is to make energy accessible to all places that need it, by	Energy management			

81









			www.greethis.net		
	Varna Inc.	<u>varna.bg/</u> Address: Varna 9000, 5, Janosh Huniadi blvd E-mail: <u>clients.BG-</u> <u>veolia@veolia.com</u>	optimizing the costs and reducing its impact on environment. The main activity involves energy supply to our customers, at guaranteed effectiveness and acceptable prices. The efforts are targeted to increase the use of renewable energy and applying eco- friendly technologies as the activities are fully oriented to the needs and behavior of the customers.	Building energy management	
27.	Eurobuild Ltd.	Address: Burgas 8000, 1 Stara Planina str., fl.7 Phone: +359 56 803 120	<ul> <li>Although still being a young company, Eurobuild Ltd. has managed to position itself as a one of the biggest construction companies in Bulgaria.</li> <li>The principal business of the company is focused on: <ul> <li>Industrial construction.</li> <li>Infrastructural projects related to the construction and maintenance of sewer systems, water supply networks, road pavements, etc. Landscaping.</li> <li>Construction of hotel complexes and their adjoining infrastructure.</li> <li>Construction of commercial, administrative and residential buildings and their adjoining infrastructure.</li> <li>Construction of sports grounds and</li> </ul> </li> </ul>	Construction, engineering	









	LUNOPLAN UNION				
			www.greethis.net		
			<ul> <li>facilities.</li> <li>Guarantee service and maintenance of the completed construction projects.</li> <li>Production of concrete mixtures and precast concrete products.</li> <li>Production of precast reinforcement elements.</li> <li>Production of metal structures and items.</li> <li>Services with construction machinery and equipment.</li> <li>Transportation of cargo, including oversized loads.</li> <li>Transportation of passengers.</li> <li>Since January, 2008 Eurobuild Ltd. has been a member of the Bulgarian Construction Chamber thus implementing additional activities for restoration and conservation</li> </ul>		
28.	Build	Website:	Single-member limited liability company	Construction,	http://www.buildcontrolbg.
	control Ltd.	http://www.buildc	"Buildcontrol" was established in 1999. The	supervision	com/projects
		ontrolbg.com/conta cts	company is managed through two offices in the country - Dobrich and Rousse, each of	Energy efficiency	F - J
		Address: Dobrich	which has the rights to sign and execute		
		9300, 5300000	contracts independently. In the years		
		su., 11.12 Phone/fax: +359 58	other cities - Varna and Kavarna Extensive		
		603 198	experience has been accumulated in		
			project management, performing energy		
		603 198	experience has been accumulated in project management, performing energy		











			www.greethis.net		
			assessments, audits and prescriptions of		
			EJN, supervision activities, selection and		
			attraction of contractors, evaluation of the		
			received offers, ensuring reliable		
			protection of the investor's interests during		
			the implementation of the project. The		
			company carries out legal and		
			administrative consultations in the process		
			of feasibility study of investment		
			intentions.		
29.	"High -	Website:	"High - Technology Park - Technical	Energy efficiency,	
	Technology	<u>http://vtp-</u>	University Varna" Ltd. is registered under	Energy management	
	Park -	<u>tuv.com/index_en.ht</u>	the trade Act in 2001 with sole owner	Lifergy management	
	Technical	<u>ml</u>	Technical University - Varna. "HTP - TUV"		
	University	Address: Varna 9000,	Ltd. is a research organization with		
	Varna" Ltd.	1 Studentska str.	activities in science research, design and		
		Phone: +359 52	introduction of new technologies,		
		383 573	consulting, controlling and certifying of		
			materials, equipment and products at all		
			stages of projecting, production and		
			exploitation, etc.		
			The company is certified by ISO 9001:2008		
			and is a form of organizing the applied		
			science research and is in synchronicity		
			with the overall development of the		
			University.		
			Main trends in the activities of "HIP - IUV"		
			Ltd. are as follows:		
			Control of Vibrations and diagnostics		
			of construction objects;		









	LUNOFLAN UNION				
			www.greethis.net		
			<ul> <li>Technologies for casting and precise</li> </ul>		
			processing of tools and equipment;		
			<ul> <li>Technological processing for heat,</li> </ul>		
			and heat and chemical treatment;		
			<ul> <li>Technology and methods of welding;</li> </ul>		
			Systems for diagnostics, control and		
			management of energy objects;		
			Production and repairing of		
			machines and structures for the		
			industry;		
			<ul> <li>Investigation and certification of</li> </ul>		
			objects for energy effectiveness;		
			Renewable energy sources;		
			<ul> <li>Research in the field of ecology;</li> </ul>		
			Shipbuilding and sea machinery.		
30.	Gas Flow	Website:	Gas Flow Control Ltd. was established in	Energy efficiency,	
	Control Ltd.	https://gasflowbg.co	2005 to provide consulting services in the	Energy menagement	
		m/%d0%b7%d0%b0-	energy sector. The main company activities	chergy management	
		%d0%ba%d0%be%d0%	are related with:		
		bd%d1%82%d0%b0%d0	<ul> <li>Building energy efficiency surveys</li> </ul>		
		%ba%d1%82%d0%b8/	- Energy efficiency surveys of industrial		
		Address: Varna 9000,	systems		
		16 Loza str., entr.1,	- Assessment of compliance of investment		
		fl.1, app.1	projects with the requirements for "energy		
		E-mail:	efficiency - energy savings and heat storage		
		office@gasflowbg.co	in buildings"		
		<u>m</u>	- Consulting services and preparation of		
			energy audits under Operational programs		
			- Energy consulting and investment project		
			management		











			www.greethis.net		
			- Design and commissioning of energy		
			systems		
31.	Teatom	Address: Burgas	Teatom Ltd. certifies buildings to assess	Building Energy	
	Ltd.	8000, 32 Strandja	and verify the conformity of buildings with	management	
		str.	the regulatory requirements for energy	Energy efficiency	
		E-mail:	efficiency and the implementation of		
		teatom@abv.bg	energy-saving measures to improve the		
			energy performance of buildings.		
			The certification process includes:		
			research, measurement, calculation and		
			analysis of the energy performance		
			elements of buildings; assessment and		
			comparison with reference technical		
			standards. Provision of proposals for energy		
			saving measures.		
22	Ectal Group	Wabsita	Ectal Group Ltd. was astablished in 1999	Building operay	
52.	Ltd	http://ostol-	with main scope of activities implemented	management:	
	Llu.	arup com/	in the field of construction consulting	construction	
		<u>grup.com/</u> Address: Varna 0000	auditing project management operav	construction	
		181 Mihail Koloni str	efficiency and energy management of		
		F-mail	buildings Since 2006 the company actively		
		estel grun@abv.bg	works in energy efficiency offering energy-		
		cstet_grup@ubv.bg	saving measures and complete solutions for		
			residential and public buildings		
33.	Team	Address: Varna 9000.	Team experts Ltd is a consulting company	Building energy	
	Experts ltd.	32 Rali Mavridov str.	established in 2009. The field of expertise	management,	
	r	E-mail:	is sustainable energy development at		
		team4experts@gmail	regional level, energy efficiency auditing.	Energy efficiency,	
		.com	and energy management for municipalities,		











	LONOI LAN UNION				
			www.greethis.net		
			developing new energy models for business,		
			engineering projects for using local energy		
			sources, innovative energy projects such as		
			virtual energy power plants, etc.		
			Team experts Ltd. has experience in the		
			field of energy planning, energy auditing,		
			energy management, energy efficiency		
			projects, energy regulations, gap analysis,		
			benchmarking activities, development of		
			planning documents, etc.		
<u> </u>					
34.	Bulpro Ltd.	Website:	Bulpro Ltd. is an engineering company	Energy efficiency	https://www.bulpro.eu/obj
		www.bulpro.eu	specialized in design and construction of	Energy management	ects
		Address: Varna 9000,	energy-saving facilities and installations for	5, 5	
		145 AKChelar str.	neating, ventilation and air conditioning.		
		E-mail:	The company mission is to provide		
		office@bulpro.eu	customers with innovative products for		
			neating with neat pumps, solar systems,		
			ventilation, in accordance with the		
			increased requirements for energy		
			enciency and environmental mendliness.		
			investments in energy-saving technologies		
			for neating, ventilation and air conditioning		
25	Thormal	Wobsita	Termal Engineering 1td is an engineering	Construction	https://thormal.bg/%D0%BC
35.	Engineering	website:	company opgaged in the design supply and	Engineering	
		Address: Burgas	installation of boating air conditioning	Energy officiency	85%D0%B6%D0%B4%D0%B
	LUU.	8000 157	ventilation solar and gas installations	Energy management	00%BA%D1%83%D0%BB%D1%
		Kravezerna str	construction of buildings and energy		82%D1%83%D1%80%D0%B5%D0
		F-mail.	officiency audits		<u>02/001/003/001/000/000/003/000</u> %BD-
		L-mail.	erriciency audics.		<u>/000-</u>











	LONOI LAN UNION				
			www.greethis.net		
		<u>office@thermal.bg</u>	<ul> <li>www.greethis.net</li> <li>The services offered by the company include: <ul> <li>Design, supply and installation of heating, ventilation and air-conditioning systems, solar installations, biomass installations:</li> <li>wood, pellets, wood chips; gas installations for methane / natural gas / and LPG / propane-butane /</li> <li>Heating, air-conditioning, gas and solar installations</li> <li>Construction and repair of residential and public buildings EE services / energy efficiency /: inspection of EE buildings, EE part projects, EE conformity assessment, energy passport, EE buildings certification, EE measures implementation of buildings.</li> </ul> </li> </ul>		%D1%86%D0%B5%D0%BD%D1%         82%D1%8A%D1%80-         %D0%B1%D1%83%D1%80%D0%         B3%D0%B0%D1%81_o14         https://thermal.bg/%D0%B4         %D1%80%D0%B0%D0%BC%D0%         B0%D1%82%D0%B0%D0%BC%D0%         B0%D1%82%D0%B8%D1%87%D0         %B5%D0%BD-         %D1%82%D0%B5%D0%B0%D1%         82%D1%8A%D1%80-         %D0%B0%D0%B4%D1%80%D0%         B8%D0%B0%D0%B4%D1%80%D0%         B8%D0%B0%D0%B4%D0%B0%D0%B0-         %D0%B1%D1%83%D1%80%D0%         B5%D0%B0%D1%81_o27         https://thermal.bg/%D1%81         %D0%B6%D1%83-         %D0%B6%D1%83-         %D0%B6%D0%B8%D1%80%D0%         B8%D0%B8-%D0%B8-         %D0%B6%D0%B5%D1%82%D0%         B8%D0%B6%D1%83%D0%B9-         %D0%B1%D1%83%D1%80%D0%         B8%D0%B6%D0%B8%D1%80%D0%         B8%D0%B6%D0%B8%D1%80%D0%         B8%D0%B6%D0%B8%D1%80%D0%         B8%D0%B6%D0%B8%D0%B9-         %D0%B1%D1%83%D1%80%D0%         B8%D0%B6%D1%81_o45
36.	Energoefekt Varna ltd.	Website: http://energoefekt. com Address: Varna 9000.	Energoefekt Varna Ltd. offers a wide range of services related to the implementation of the energy efficiency, more specifically inspection, certification and certification of	Energy efficiency Energy management	









	www.greethis.net
6 Hristo Botev	Blvd., buildings.
entr.B, app.5	Energoefekt Varna Ltd. offers additional
E-mail:	services regarding the inspection and
office@energe	efekt. certification of buildings, the preparation
<u>com</u>	of energy passports and the reports on
	conformity assessment of energy efficiency:
	<ul> <li>Analysis and assessment of the</li> </ul>
	structure of energy consumption of
	buildings and industrial sites;
	• Energy efficiency audit;
	Recommendations for implementation
	of measures to improve the comfort of
	the inhabitants and reduce energy
	costs;
	Estimation of energy costs of the
	proposed measures;
	Recommendations for the preparation
	of an Energy Cost Management Plan;
	Assistance in applying for projects
	with proven energy efficiency;
	Certification of buildings for energy
	efficiency;
	Issue of Energy Passports of buildings.









## CONCLUSIONS

The application of EE measures in buildings of historical value is a challenge that is perfectly achievable to be fulfilled in an excellent way. Proper organization and comprehensive and conscious implementation of measures are needed for the purpose. The current laws in Bulgaria allow the culture heritage buildings to be low energy performed thus efforts to preserve the architectural value could be taken. The present market share is defined in a way that the companies dispose the necessary materials, technologies and faicilities which could be perfectly integrated into the buildings. Most of all, this is to be achieved by a considerable partnership and collaboration between all stakeholders, key actors and with the active support of the locals. The availability of financial instruments is a significant asset for the context management.









## REFERENCES

- 1. National Strategy for Culture Development in Bulgaria
- 2. Culture Heritage Act
- 3. Law on Protection and Development of Culture
- 4. Protected Areas Act
- 5. Energy Efficiency Act
- 6. Ordinances to the Energy Efficiency Act
- 7. Energy from Renewable Sources Act
- 8. Ordinances to the Energy from Renewable Sources Act
- 9. Energy Law
- 10. Spatial Development Act
- 11. Ordinances to the Spatial Development Act
- 12. Guidelines on harmonization of energy and sustainable urban mobility planning, project "SIMPLA - Sustainable Integrated Multisector Planning" <u>www.simpla-</u> <u>project.eu</u>
- 13. Guidelines for municipal energy planning, Project "MODEL Management of domains related to energy in local authorities"
- 14. Project "Invade Smart system of renewable energy storage based on integrated EVs and batteries to empower mobile, distributed and centralized energy storage in the distribution grid": <u>https://h2020invade.eu/</u>
- 15. Project: "Innovative and effective energy management in public buildings in Burgas municipality"
- Project: "Best practical model of sun solar energy production in Northern Black Sea coastal area"
- 17. Project "GEODH Promote geothermal district heating systems in Europe"
- 18. EuropeanClimateAdaptationPlatform:<a href="http://climate-adapt.eea.europa.eu/knowledge/tools/urban-ast">http://climate-</a>adapt.eea.europa.eu/knowledge/tools/urban-ast

Common borders. Common solutions.

O 🔶 CROSS BORDER 🚽







- 19. Clean Energy for all Package: <u>https://ec.europa.eu/energy/topics/energy-</u> strategy/clean-energy-all-europeans\_en
- 20. Agency for Sustainable Energy Development: https://www.seea.government.bg
- 21. https://energee-watch.eu
- 22. https://www.mpa.uni-stuttgart.de
- 23. http://www.superefficient.org/
- 24. http://ec.europa.eu/energy/intelligent/projects





## Union of Bulgarian Black Sea Local Authorities (UBBSLA)

9000 Varna, Bulgaria Tel: +359 888 601 500 E-mail: office@ubbsla.org Website: www.ubbsla.org

## Joint Operational Programme Black Sea Basin 2014-2020 Union of Bulgarian Black Sea Local Authorities September 2019

Joint Operational Programme Black Sea Basin 2014-2020is co-financed by the European Union through the European Neighbourhood Instrumentand by the participating countries: Armenia, Bulgaria, Georgia, Greece, Republic of Moldova, Romania, Turkey and Ukraine. This publication has been produced with the financial assistance of the European Union. The contents of this publication are the sole responsibility of the Union of Bulgarian Black Sea Local Authorities and can in no way be taken to reflect the views of the European Union.