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Sustainability Assessment: Offsetting Carbon Emissions from Energy Use at the Orthodox Academy of Crete (OAC)

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Abstract

Mitigation of climate change and development of ecological practices is an important goal in religious organizations. Current work aims in the investigation of the possibility of offsetting the net carbon emissions due to energy use in the Orthodox Academy of Crete (OAC), Greece. Energy generated by fossil fuels and renewable energy sources is currently used in the premises of the Academy. The total annual energy consumption and the energy sources currently used in the religious organization are initially estimated. Various future scenarios are investigated regarding energy consumption in the Academy, energy sources used and their carbon emissions, as well as the possibility of carbon emissions sequestration with various tree plantations. The annual energy consumption in the Academy has been estimated at 264,257 KWh while its energy consumption per covered area is 31.31 KWh/m^2. Among various energy sources used, electricity has the highest share at 95.76%, while 32.47% of the overall energy consumption is currently generated by a solar-PV system installed on-site. It is indicated that the combined use of energy-saving techniques and technologies, the higher use of various renewable energy sources and the sequestration of any remaining carbon emissions with tree plantations could eliminate all carbon emissions due to energy use in the Academy.

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The most appropriate sustainable energy technologies are solar-thermal, solar-PV and high efficiency heat pumps which are currently mature, reliable and cost-effective. Additionally olive tree orchards, carob tree orchards and Eucalyptus tree plantations could be created for carbon emissions sequestration. It has been concluded that with the reduction of the current energy consumption by 20%, the installation of a solar-PV system at 50 $KW_{p,}$ and the creation of an olive tree orchard at 14 ha, the net annual carbon emissions due to energy use in the Academy could be eliminated. The results indicate the way that the Orthodox Academy of Crete could zero its impacts on climate change due to energy use in its premises.

Keywords: carbon emissions; energy saving; energy use; Orthodox Academy of Crete (OAC); renewable energies; tree plantations.

1. Introduction

Mitigation of climate change is very important for avoiding major destabilization of planetary ecosystems. Buildings use approximately 40% of the total energy consumption in Europe, emitting large amounts of CO_2 into the atmosphere. Reduction of energy and fossil fuels use in various buildings is of primary importance for achieving the EU targets for climate change mitigation. Our current research is related with the possibility of offsetting carbon emissions due to energy use in the OAC located in Western Crete, Greece. The OAC operates under the spiritual auspices of His All Holiness the Ecumenical Patriarch Bartholomew I and it is a Conference Venue and a Research Center (Official Government Gazette 4610/7-5-2019, Art. 255). The Institute of Theology and Ecology (IThE) was established as a Department of the OAC, as a response to the Ecumenical Patriarchate’s call for addressing ecological issues and protecting the Divine Creation. The Institute develops its activities by fostering the dialogue between ecology and theology as inter-dependent notions, with sustainability as a common starting point and a common goal, based on the protection of the natural environment and the respect for the generations to come. The IThE has a critical role in attracting innovative programs and implementing scientific activities of the OAC´s Research Center. It is assumed that the use of energy-saving techniques and various renewable energy technologies, locally available in Crete, combined with carbon offsetting in tree plantations could zero the net carbon emissions due to energy use in the OAC. The current work is important because it could indicate the way that a religious organization could zero its carbon footprint due to energy use in a cost-efficient way according to [1,2,3,4]. It is also aligned with the policy of the Orthodox Church for the adoption of ecological practices and living with harmony with nature. His All-Holiness Ecumenical Patriarch Bartholomew I has persistently proclaimed the primacy of spiritual values in determining environmental ethics and action. His endeavors have earned him the title "Green Patriarch" – coined and publicized by the media in 1996, while being formalized in the White House in 1997 by Al Gore, Vice President of the United States. In 2008, Ecumenical Patriarch Bartholomew I was named one of Time Magazine's 100 Most Influential People in the World for "defining environmentalism as a spiritual responsibility".

2. Literature survey

2.1 Energy consumption in religious organizations

A report on energy efficiency in religious buildings has been published [5]. The report mentioned that 80-85%

of the energy used in a church is for heating and ventilation. Energy use in religious buildings is distributed as follows: heating 76.8 %, ventilation 7.8 %, lighting 4.2 %, hot water 2.7 %, motors 2.7%, cooking 1.7%, air-conditioning 0.7%, car plugs 0.2% and miscellaneous equipment 3.2%. The installation of a hybrid autonomous electricity supply for monasteries with reference to the Chilandar monastery located in Mount Athos, Greece has been studied [6]. The authors proposed the installation of a new hybrid system with peak load at 80 KW, generating 400 KWh of electricity daily. The hybrid system was based on three diesel engines and a set of solar-PV panels. The use of renewable energy technologies in Buddhist monasteries with reference to the Bodhiyana Buddhist monastery in Serpentine has been studied [7]. The author mentioned that in countries such as Thailand, Myanmar and Sri Lanka, monasteries play a social role in the local communities teaching the citizens how to live in harmony with nature and the environment. He also stated that energy savings and use of RES in monasteries complies with the Buddhist doctrine for a "right livelihood" using "appropriate technologies". The development of ecological practices in monasteries and the role of spirituality with reference to six Benedictine monasteries located in Austria and Germany has been investigated [8]. The authors stated that the studied monasteries follow individual pathways in ecological practices which are based on economic and technical criteria. They also mentioned that future engagement of young monks in them, who are more engaged with sustainability and spirituality, could motivate monasteries in the institutional promotion of ecological practices. The ecological responsibility in three Benedictine monasteries has been investigated [9]. The author mentioned that the studied monasteries had developed ecological practices focused on self-sufficiency, promotion of energy savings and renewable energies, as well as the creation of herb gardens. A survey on energy use in various buildings in Canada has been implemented [10]. The survey, using data gathered in 2009, mentioned that the annual energy consumption in religious buildings is at 183.33 KWh/m^2. It is also stated that religious buildings had low energy consumption, compared with other types of buildings, since they have reduced hours of operation while they do not use much energy-consuming equipment.

2.2 Energy consumption and use of renewable energies in various buildings including hotels and conference centers

A report on the sustainability of convention and exhibition centers has been published [11]. The report mentioned that their total annual energy consumption has been estimated between 28.65 KWh/m^2 and 703.98 KWh/m^2 with a mean value at 246.28 KWh/m^2. It is also stated that among the best practices for their energy sustainability is the on-site energy generation from renewable energy sources. The energy conservation and retrofitting potential in Hellenic hotels has been estimated [12]. The authors have collected and analyzed data from 158 Hellenic hotels, estimating their average annual energy consumption at 273 KWh/m^2 while 72% of it was used in heating. They also reported that the annual average total energy consumption in hospitals was 406.8 KWh/m^2, 187 KWh/m^2 in office buildings, 152 KWh/m^2 in commercial buildings, and 92 KWh/m^2 in school buildings. The energy consumption in Hellenic school buildings has been estimated [13]. The authors audited 238 school buildings and they calculated their average annual energy consumption at 93 KWh/m^2. They also mentioned that approximately 72% of their energy was consumed in space heating. The feasibility of creating net zero carbon emissions residential buildings in Mediterranean region has been investigated [14]. The author mentioned that by using endogenous renewable energy resources, the creation of carbon neutral residential buildings is technically and economically feasible. The creation of hotels with zero CO_2 emissions due to energy use in the island of Crete, Greece has been studied [15]. The author mentioned that the use of solar thermal energy, solar-PV energy and ground source heat pumps can cover all the energy requirements in heat, cooling and electricity in hotels located in Crete, Greece offsetting their carbon footprint due to energy use. The installed solar thermal systems in EU and Greece have been studied [16]. The author mentioned that the average EU capacity of solar thermal systems is 30.7 KW_{th} per 1,000 inhabitants while Greece is ranking third among EU countries with an installed capacity at 220 KW_{th} per 1,000 inhabitants. The majority of the installed solar thermal systems in Greece are used for hot water production in residential buildings. The solar energy market in Greece has been analyzed [17]. The analysis mentioned that the existing building block in Greece is energy inefficient, providing significant room for de-carbonization. It also stated that micro-generation should be promoted in buildings based on the notion of procumer. The solar-PV market development in Greece with the net-metering initiative has been studied [18]. The author has presented two case studies regarding the viability of the PV net-metering program for a residential building and a commercial enterprise. His results indicated that the solar-PV investments were in both cases profitable, having low payback periods, below 12 years for the residential building and below 8 years for the commercial enterprise. Various heating systems in the Greek residential sector based on efficiency and fuel costs have been compared [19]. Their findings indicated that woodstoves and high efficiency heat pumps had the lowest operative cost. The development of ground source heat pumps has been investigated [20]. The report mentioned that geothermal heat pumps have many applications in residential houses as well as in offices and commercial buildings. It also stated that their current uses in Greece are rather limited compared with other EU countries. An analysis on energy use by European hotels in the framework of a European project has been realized [21]. The report mentioned that in EU hotels, various renewable energy technologies have been used including solar thermal, solar-PV, solar cooling, biomass and geothermal energy. The increase of energy efficiency in the European hospitality industry has been studied [22]. The report mentioned that the hotel industry, complying with the Paris Climate Agreement, will need to reduce its greenhouse gas emissions per room per year by 66% by 2030 and by 90% by 2050.

2.3 Carbon sequestration from tree plantations

The carbon sequestration and the carbon footprints in olive groves in Southern Spain has been investigated [23]. The study was covering an area of 1,121 ha and the estimated annual carbon removal rate in olive tree plantations was varying between 2.05 tC/ha to 4.10 tC/ha. The authors mentioned that improved practices in soil management and reincorporating pruning residues into the soil could double the carbon removal rate. The carbon sequestration rate of carob trees with reference to Algarve, Portugal has been studied [24]. The authors estimated that the annual carbon removal rate was at 0.184 tC/ha, which is low compared with carbon sequestration by other tree species. The carbon storage in Eucalyptus tree plantations in Southern China has been investigated [25]. The authors studied carbon storage in Eucalyptus species, which grow rapidly and accumulate large quantities of biomass carbon. They found that the average annual carbon sequestration rate of trees between one and eight years old was at 8.8 tC/ha. They also mentioned that more carbon was stored below ground than above ground. The energy consumption in religious and other buildings is presented in Table 1.

Table 1: Energy consumption in religious and other buildings

Author/report	Type of building	Energy consumption (KWh/m^2)
Energy efficiency in various buildings in Canada, 2013	Religious buildings, Canada	183.33
Energy efficiency in religious buildings, 2018	Churches	80-85% of energy is used for heating and ventilation
Sustainability of convention and exhibition centers, 2017	Convention and exhibition centers	28.65-703.98 (Average 246.28)
Santamouris, 1996	Greek hotels	273 (72% for heating)
Santamouris, 1996	Greek office buildings	187

Source: Data in published literature

The aims of the current study are:

a) *The estimation of energy consumption in the Orthodox Academy of Crete, and*
b) *Investigation of the possibility of offsetting its net carbon emissions due to energy use*

The methodology followed includes the survey of existing literature followed by the estimation of the current energy consumption and generation in OAC. An appraisal of future energy savings and use of renewable energies for covering part or all of its energy requirements has been made followed by the calculation of the area of various tree plantations which are necessary to offset any carbon emissions due to fossil fuels use in the OAC. The OAC has taken these initiatives in order to be a paradigm for the local and international society by pointing out the necessity of the energy transition from fossil fuels to renewable energy sources in a fair and environmental friendly way. The study ends with the discussion of the findings and the conclusions drawn. Constraints of the current study are related with the energy consumption in OAC which may vary depending on the annual activities implemented in the Academy. They are also related with the assumptions made regarding the reduction of energy consumption due to future energy savings as well as with the data used for annual carbon sequestration from various tree plantations according to the published research.

3. Energy consumption in the Orthodox Academy of Crete

3.1 Description of OAC

The Orthodox Academy of Crete (OAC) is located in Kolympari, Municipality of Platanias, Western Crete. Its premises include a conference center, residence rooms for conference participants and visitors, offices, kitchen, dining room, warehouses and auxiliary rooms. The total covered area of its premises is 8,441 m^2 while the area of the conference center is 1,067 m^2, the residence rooms 1,917 m^2, the kitchen and dining room 324 m^2, the offices 197 m^2 and the remaining space 4,936 m^2. Energy is consumed in OAC for lighting, air-conditioning, hot water production, cooking and operation of various electric apparatus and machinery. Electricity is used for lighting, air-conditioning and operation of electric devices. LPG is used for cooking while solar thermal energy is used for hot water production. A heat pump is used for the air-conditioning of its premises.

3.2 Electricity consumption

The annual electricity consumption during the last years in OAC was at 253,047 KWh. It should be noted that electricity is currently generated in Crete mainly by fossil fuels including heating and diesel oil (75-80%), and additionally with renewable energy technologies mainly with wind farms and solar-PV systems (20-25%).

3.3 LPG consumption

The annual liquid pressurized gas consumption in the kitchen is 400 lt with energy content at 2,760 KWh.

4. Energy generation in the Orthodox Academy of Crete

4.1 Generation of electricity

Electricity is generated in OAC with a solar-PV system with nominal capacity at 50 KW which generates 77,359 KWh annually. This amount corresponds to 30.57% of its total electricity consumption. The annual grid electricity consumption is estimated at 175,688 KWh.

4.2 Production of hot water

Hot water is produced in OAC with a solar thermo-shiphonic system with flat plate collectors installed on the rooftop of its buildings. The area of the flat plate collectors is 24.15 m^2 which corresponds to thermal power at 16.9 KW_{th}. The thermal energy produced annually with the solar thermal system is estimated at 8,450 KW_{th}.

5. Annual energy consumption in the Orthodox Academy of Crete

The annual energy consumption in OAC is the sum of the electricity consumption, the energy of the LPG used and the energy of the hot water produced with solar energy which is 264,257 KWh in total. The annual specific energy consumption in OAC is 31.31 KWh/m^2. The annual energy consumption in OAC is presented in Table 2, while the energy generated on-site compared with the external energy use is presented in Table 3.

Table 2: Annual energy consumption in OAC

Energy/fuel	Energy content (KWh)	% of the total
Electricity	253,047	95.76
LPG	2,760	1.04
Solar thermal energy	8,450	3.20
Total	264,257	100

Source: Own data

Table 3: Energy generated on-site in OAC compared with external energy sources used

Energy/fuel	Energy content (KWh)
Electricity generated on-site	77,359
Solar thermal energy produced on-site	8,450
Total energy generated on-site	85,809
Grid electricity use	175,688
LPG use	2,760
External energy sources use	178,448
Total annual energy consumption in OAC	264,257
Percentage of energy generated on-site to total energy consumption	32.47 %

Source: Own data

6. Energy savings and use of renewable energies in the Orthodox Academy of Crete

6.1 Energy saving

The building stock in OAC is old and energy inefficient since in the period of the buildings' construction the thermal insulation requirements were not as strict as they are now. Various equipment currently used for hot water production and air-conditioning are old and their replacement with new equipment, which is more energy efficient, will improve the overall energy behavior of the organization. There are various possibilities for reducing energy consumption in OAC with various energy-saving measures including:

a) Changing the old windows with double glazing, and insulating the roof and the facades of the buildings,
b) Use of energy-efficient lighting,
c) Replacing LPG in the kitchen with electricity using new electric equipment for cooking,
d) Replacing the old solar thermal system with a new one which will be more energy-efficient,
e) Replacing the heat pump currently used for air-conditioning with a new one which will have a higher COP.

6.2 Use of solar-PV energy

Grid electricity use could be replaced with solar electricity generated on-site in OAC. Solar-PV systems are already operating in OAC, according to net-metering regulations, generating part of its annual electricity consumption. Additional solar-PV systems could be installed in the future, generating a higher percentage of its annual electricity requirements.

6.3 Use of solar thermal energy

Solar thermal energy is already used in OAC for hot water production. Hot water is used in the kitchen, in the residence rooms and in the laundry.

6.4 Use of high efficiency heat pumps

Modern heat pumps, including geothermal heat pumps, are energy-efficient devices with COP higher than 4. Their use for covering the heating and cooling needs in OAC is indicated. The energy required for their operation could be provided with solar electricity while a significant part of their energy needs is provided by low enthalpy ambient heat. The energy sources and technologies which will be used in OAC are presented in Table 4.

Table 4: Energy sources and technologies which will be used in OAC

Energy source	Energy technology	Energy generated	Energy use
Solar energy	Solar-thermal flat-plate collectors	Hot water	Kitchen, residence rooms, laundry
Solar energy	Solar photovoltaic-crystalline silicon panels	Electricity	Lighting, operation of various electric equipment including the heat pump
Electricity and ambient heat	High efficiency heat pump	Heat, cooling, hot water	Air-conditioning, kitchen, residence rooms, laundry
Grid electricity		Electricity	Lighting, operation of various electric equipment including the heat pump

Source: Own estimations

7. Possibility of offsetting carbon emissions in the Orthodox Academy of Crete with tree plantations

Carbon emissions which are due to fossil fuels or grid electricity use in OAC could be offset with tree plantations which could be created by the Academy. Carbon sequestration could be achieved either with endemic tree species in Crete like olive trees and carob trees or with non-endemic tree species like Eucalyptus trees.

7.1 Olive tree plantations

Olive tree plantations currently dominate in Crete and new olive groves could be created by OAC in order to sequestrate the CO_2 emitted into the atmosphere due to fossil fuels used in it.

7.2 Carob tree plantations

Carob trees are also grown in Crete. Annual carbon removal from carob trees is lower than the corresponding removal by olive or Eucalyptus trees. However, carob is an endemic tree in the island which was cultivated more during the past while its fruits can be used for the production of various products generating income to the farmers. Therefore carob tree groves could be created by OAC for sequestrating the required carbon quantities.

7.3 Eucalyptus tree plantations

Eucalyptus trees are not endemic species in the island. However they are fast growing trees while their annual carbon sequestration rate is higher compared with olive trees and carob trees. Eucalyptus tree plantations could also be created for removing the required atmospheric CO_2 due to fossil fuels use in OAC. Carbon removal rates in various tree plantations are presented in Table 5.

Table 5: Carbon sequestration rates from various tree plantations

Tree plantation	Annual carbon removal (tC/ha)	Annual carbon dioxide removal (tCO_2/ha)
Olive tree groves	2.05	7.52
Carob tree groves	0.184	0.67
Eucalyptus tree plantations	8.8	32.27

Source: Lopez-Bellido and his colleagues 2016 , Geraldo and his colleagues 2010, Du and his colleagues 2015

8. Examining various scenarios for offsetting carbon emissions in the Orthodox Academy of Crete

Various scenarios are examined for the creation of a net zero carbon emissions OAC by combining energy-saving techniques, by using renewable energies and by offsetting any remaining carbon emissions with carbon sequestration from various tree plantations. The main energy sources which will be used in the future in OAC include solar-thermal and solar photovoltaic energy, ambient heat as well as grid electricity. The four scenarios examined include:

Scenario 1. Offsetting the existing carbon emissions with carbon sequestration from tree plantations,

Scenario 2. Installation of an additional solar-PV system with 50 KW_p nominal power, similar with the existing one, and offsetting the remaining carbon emissions with carbon sequestration from tree plantations,

Scenario 3. Reduction of the overall energy consumption by 20%, using energy-saving techniques, and offsetting carbon emissions with carbon sequestration from tree plantations, and

Scenario 4. Reduction of the overall energy consumption by 20%, using energy-saving techniques, installation of an additional solar-PV system with 50 KW_p nominal power, similar with the existing one, and offsetting the remaining carbon emissions with carbon sequestration from tree plantations.

It is assumed that the LPG currently used in the kitchen for cooking will be replaced with electricity and fossil fuels are not going to be used in the future in OAC. Energy consumption, carbon emissions and the required area of tree plantations for offsetting any remaining carbon emissions due to energy use in OAC are presented in Table 6.

Table 6: Possibility of offsetting annual carbon emissions due to energy use in OAC

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Annual electricity consumption (KWh)	253,047	253,047	202,438	202,438
Annual electricity generation from PV (KWh)	77,359	154,718	77,359	154,718
Net annual electricity consumption (KWh)	175,688	98,329	125,079	47,720
Annual CO_2 emissions [1] ($kgCO_2$)	105,041	58,997	75,047	28,632
Area of olive trees for offsetting CO_2 emissions (ha)	14	7.9	10	3.8
Area of Eucalyptus plantation for offsetting CO_2 emissions (ha)	3.2	1.8	2.3	0.9
Area of carob trees groves for offsetting CO_2 emissions (ha)	157	88	112	42.7

[1] *Carbon emissions = 0.6 $kgCO_2$ per KWh_{el}. Source: Own estimations*

Energy consumption and carbon emissions per covered area in OAC are presented in Table 7.

Table 7: Energy consumption and carbon emissions per covered area in OAC

Annual energy consumption without including the current generation of solar electricity	31.31 KWh/m^2
Annual CO_2 emissions without including the current generation of solar electricity	18.18 $kgCO_2/m^2$
Annual energy consumption including the current generation of solar electricity	21.14 KWh/m^2
Annual CO_2 emissions including the current generation of solar electricity	12.68 $kgCO_2/m^2$

Source: Own estimations

9. Discussion

Our results indicate that the specific energy consumption in Orthodox Academy of Crete, at 21.14 KWh/m^2, is very low compared with the specific energy consumption in similar types of buildings including religious organizations, conference centers and hotels, which is significantly higher. This is partly due to the fact that many of its buildings have limited use every year. Solar energy technologies, generating heat and electricity, are currently mature, reliable, cost-effective and already used on the OAC premises. The current share of heat and electricity generated on-site, with solar energy in OAC at 32.47% of its total annual energy consumption is very satisfactory and encouraging. It should be noted that some energy equipment like the heat pump used in air-conditioning and the solar thermal system used for hot water production are old having low efficiencies. The energy performance certificates of OAC's buildings will better reveal the possibilities of energy saving in them. The possibility of using solid biomass produced from the tree plantations for heat generation in OAC, increasing the share of renewable energies, should be also investigated. It is also indicated that by using energy-saving techniques, renewable energy technologies and carbon emissions offsetting tree plantations, the carbon footprint due to energy use in the OAC could be offset. Solar energy which is abundant in Crete could be used, providing most of the required energy in OAC.

Our results show that the target of net zero carbon emissions due to energy use in OAC is achievable with the use of existing and commercially available sustainable energy technologies. However the investment cost in the required sustainable energy systems for the achievement of the abovementioned goal has not been estimated, neither the profitability indexes like the payback period of the investments, or their net present value. All these OAC's actions are a result of many ecological programs and environmental initiatives, which are organized and hosted by the OAC in cooperation with Universities, Academic Institutions and International/Local Stakeholders: Conferences, Research Projects, Educational Programs, Good Practices Guides.

10. Conclusions

The present work is focused on the estimation of energy consumption in the Orthodox Academy of Crete as well as in the investigation of the possibility of offsetting its net carbon emissions due to energy use. Annual energy consumption in OAC has been estimated at 264,257 KWh or 31.31 KWh/m^2. Electricity has the highest share, at 95.76%, in the total energy consumption.

The main energy sources used are grid electricity, LPG, solar thermal energy and solar-PV energy. Currently 32.47 % of its total energy consumption is generated on-site with solar energy. Net annual carbon emissions due to energy use in the Academy could be offset using commercial and well known technologies. This could be achieved with the combined use of the following measures:

a) Reducing the energy consumption in OAC using various energy-saving techniques and technologies,
b) Installing a solar-PV system, additionally to the existing one, generating solar electricity, and
c) Offsetting any remaining carbon emissions with the creation of tree plantations which sequester atmospheric carbon. This could be achieved with endemic to Crete tree species like olive or carob, or even with fast-growing eucalyptus trees.

With the reduction of the overall energy consumption in OAC by 20%, the installation of a new solar-PV system with nominal power at 50 KW_p and with the creation of an olive tree grove in an area of 14 ha, OAC could zero its current net annual carbon emissions due to energy use.

The results indicate that eliminating the carbon footprint in OAC is achievable with the use of various reliable, mature and cost-effective energy technologies allowing the religious spiritual organization to promote ecological and environmentally-friendly practices, offsetting its impacts on climate change.

11. Recommendations

Further work should be focused on the estimation of the investment cost of the required energy systems, achieving its energy sustainability in different scenarios examined, as well as the estimation of the profitability of the required energy investments. The energy performance certificates of the different buildings in OAC should also be issued in order to assess their energy behavior and to investigate the possibilities for energy improvements.

The possibility of installing a small size wind turbine in OAC should be considered for increasing the penetration of renewable energies in the overall energy balance. Organization of international conferences and seminars consist of a main activity in OAC contributing in its annual energy consumption. During 2020 the most of these activities were cancelled due to Covid-19. Comparison of the energy consumption in 2020 with the consumption in OAC during the previous years will indicate the impacts of the pandemic in the energy behavior in OAC.

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