

Use of Renewable Energy Sources through the Installation of Solar Water-Heating Systems in the Municipality of Cacak (Serbia)

Korišćenje alternativnih izvora energije instalacijom solarnih
panela za zagrevanje sistema centralnog grejanja punjenog
vodom u gradu Čačku (Srbija)



ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΥΠΟΥΡΓΕΙΟ ΕΞΩΤΕΡΙΚΩΝ



ΚΑΠΕ
CRES



ΠΕΡΙΛΗΨΗ ΤΟΥ ΕΡΓΟΥ

Η ενέργεια αποτελεί χωρίς αμφιβολία μία βασική προϋπόθεση για την ανάπτυξη της παγκόσμιας οικονομίας και την εξασφάλιση της κοινωνικής ευημερίας, γεγονός που καθιστά την ενεργειακή πολιτική σημαντική παράμετρο της εξωτερικής πολιτικής και της πολιτικής ασφάλειας όλων των κρατών.

Η ενεργειακή πρόκληση απαιτεί συνολική απάντηση, δηλαδή νέο ενεργειακό σύστημα βασισμένο στην αποτελεσματική συνεργασία μεταξύ παραγωγών και καταναλωτών, στις προσπάθειες για την αύξηση της ενεργειακής αποδοτικότητας και σε ένα μεγάλο άλμα για την ευρύτερη χρήση των ανανεώσιμων πηγών ενέργειας.

Στοχεύοντας προς αυτή την κατεύθυνση, η Γενική Διεύθυνση Διευθνούς Αναπτυξιακής Συνεργασίας (ΥΔΑΣ) του ελληνικού Υπουργείου Εξωτερικών (ΥΠΕΞ) χρηματοδοτεί, παρακολουθεί και διευκολύνει αναπτυξιακά προγράμματα στον τομέα της ενέργειας σε χώρες προτεραιότητας της ελληνικής διμερούς κρατικής αναπτυξιακής συνεργασίας. Η ΥΔΑΣ διαχειρίζεται την αναπτυξιακή βοήθεια (κοινωνικές υποδομές και υπηρεσίες, οικονομικές υποδομές και υπηρεσίες, τομείς παραγωγής, πολυτομεακές δράσεις, ανθρωπιστικός / επιστημονικός τομέας), καθώς επίσης και όλες τις πιστώσεις που παρέχονται από Υπουργεία, Οργανισμούς και δημόσιους και ιδιωτικούς φορείς εντός και εκτός Ελλάδος.

Από την άλλη πλευρά, το ΚΑΠΕ, εκ του ρόλου του, μπορεί να αποτελέσει τη βάση για την Ελλάδα του σχεδιασμού και της εκκίνησης μεγάλων πρωτοβουλιών Ανανεώσιμων Πηγών Ενέργειας (ΑΠΕ) και Εξοικονόμησης Ενέργειας (ΕΞΕ) για ολόκληρη την περιοχή της Ν.Α. Ευρώπης, του Ευξείνου Πόντου και της Μεσογείου. Ειδικά όσον αφορά τα αναπτυξιακά προγράμματα του ΥΠΕΞ (Hellenic Aid), το ΚΑΠΕ αποτελεί φορέα υλοποίησης τέτοιων προγραμ-

μάτων στον τομέα της ενέργειας στοχεύοντας στη δι-αμόρφωση εξειδικευμένων πολιτικών αναπτυξιακών έργων ΑΠΕ και ΕΞΕ ανά χώρα, μέσω εστιασμένων δράσεων υψηλής προστιθέμενης τεχνολογικής και επιστημονικής αξίας σε βάθος χρόνου.

Χαρακτηριστικό παράδειγμα τέτοιων δράσεων αποτελούν και οι δράσεις που υλοποιήθηκαν στο πλαίσιο του αναπτυξιακού έργου «Αξιοποίηση Εναλλακτικών Μορφών Ενέργειας με την εγκατάσταση Συστήματος Ηλιακών Θερμοσυσσωρευτών στο Δήμο Cacak (Κεντρική Σερβία)» σε συνεργασία με το Δήμο του Cacak (τοπικό εταίρο) και την ελληνική ΜΚΟ "E-CONET". Κατά τη διάρκεια του παραπάνω έργου (10/2006 - 11/2008) σχεδιάστηκε και κατασκευάστηκε ηλιακό θερμικό σύστημα για ζεστό νερό χρήσης σε δύο κτίρια στο Cacak, σε σχολικό συγκρότημα και σε νηπιαγωγείο της πόλης. Προμηθευτής των απαραίτητων ηλιακών θερμικών συστημάτων ήταν η ελληνική εταιρεία Stiebetherm A.E., η οποία και συνεργάστηκε με την τοπική εταιρεία Elsol για την εγκατάστασή τους. Συνολικά 40m² ηλιακών συλλεκτών τοποθετήθηκαν σε κάθε κτίριο εξασφαλίζοντας την παροχή ζεστού νερού χρήσης με φιλικό προς το περιβάλλον τρόπο και ενθαρρύνοντας επισκέπτες και χρήστες να εφαρμόσουν παρόμοιες τεχνολογίες στις κατοικίες τους. Ακόμη για εκπαιδευτικούς κυρίως λόγους, τοποθετήθηκε ένα μικρό ηλιακό θερμικό σύστημα για ζεστό νερό σε άλλο ένα νηπιαγωγείο και ένας στύλος φωτισμού από φωτοβολταϊκά στοιχεία στο σχολικό συγκρότημα. Επιπλέον, σε ξεχωριστή δράση μελετήθηκαν οι επεμβάσεις εξοικονόμησης ενέργειας που θα μπορούσαν να υλοποιηθούν σε άλλα κτήρια δημόσιου ενδιαφέροντος του Δήμου Cacak. Ο προϋπολογισμός που εγκρίθηκε για τις δύο εγκαταστάσεις ήταν 173.300€ με 75% χρηματοδότηση από την ΥΔΑΣ και 25% χρηματοδότηση από ίδιους πόρους των εταίρων.



About Hellenic Aid

The General Directorate for International Development Cooperation (Hellenic Aid) was established in 1999 of the Directorate of the Hellenic Ministry of Foreign Affairs (**MFA**). It is the most recently established Directorate General of the Foreign Ministry. Hellenic Aid is mainly responsible for the supervision, coordination, monitoring and promotion of emergency humanitarian, food aid and development activities, as well as aid for the reorganization and restoration of the infrastructures, conducted by implementing institutions such as ministries, universities, NGOs or other players in developing countries of developing countries.

Hellenic Aid is the competent department in the Greek Foreign Ministry that coordinates and monitors programs of humanitarian and development aid.

The Hellenic development policy

Greece takes active part in the international alliance against poverty and, from 2000 onwards, grows into a bilateral donor country.

The MFA, through the exercise of policy in international development cooperation and assistance, undertakes initiatives and actions that serve the **Millennium Development Goals and are fully compatible with the Development Assistance Committee** (the principal body through which the OECD deals with issues related to co-operation with developing countries) and EU priorities as well as national policy.

Within the context of the new strategy of the MFA, orientated towards the accomplishment of the Millennium Development Goals, Hellenic Aid promotes:

- Humanitarian and food aid programmes
- Development programmes, materialized by NGO's, directed towards the economic and social amelioration of the populations of developing countries
- Volunteerism and the establishment of new development NGO's
- Co-operation among national NGO's and respective organizations taking action in developing countries.

Greece allocates 0,17% of the Gross National Income to Official Development Assistance to developing countries, aiming at the 2010 EU target of 0,51%.

For more Information please visit the website of the Hellenic Ministry of Foreign Affairs: <http://www.mfa.gr>

About the Centre for Renewable Energy Sources (CRES)

CRES was founded in September 1987 by Presidential Decree. It is a public entity, supervised by the Ministry of Development, General Secretary of Research and Technology, and has financial and administrative independence. Its main goal is the research and promotion of Renewable Energy Sources (RES), Rational Use of Energy (RUE) and Energy Saving (ES) applications at a national and international level, as well as the support of related activities taking into consideration the principles of sustainable development

CRES has two main roles: as a Research and Technology Centre for RES/RUE/ES and as the National Energy Centre of Greece.

In the framework of its mission, CRES:

- is the official consultant of the Greek government on matters of RES/RUE/ES;
- carries out applied research and develops innovative technologies which are technically and economically viable and environment-friendly;
- organises, supervises and carries out demonstration and pilot projects, to promote the above technologies, etc...

Over the years, CRES has participated in over 600 national and international projects. Through these projects, CRES has developed co-operation with numerous public and private organisations, at a national and international level.

For more information please visit: <http://www.cres.gr>

About the Municipality of Cacak

The Municipality of Cacak is located in the middle of Central Serbia, 145km south-west from Belgrade. Cacak is also the name of the municipality's capitol and with its population of ~75.000 habitants it is the biggest town and the administrative centre of the Moravica District.

Cacak is one of the major economic centres of Serbia. Its economy is dominated by industrial production. Above all, by metal-processing, paper production and chemical industry. The agricultural sector is also well developed and mainly managed by individual farmers.

The City of Cacak networks with several, so called, sister cities. One of them is the Greek City of Katerini, located in Central Macedonia, Greece.

For more information about the Municipality of Cacak please visit: www.cacak.org.yu

About the Partners

Stibetherm S.A., one of the leading solar manufacturers in Greece, took place as the general contractor and as the provider of the solar thermal products for the projects. www.stibetherm.gr

Elsol, a Serbian constructor company took place as the local subcontractor and was responsible for the proper installation of the projects. www.elsol.co.yu

Econet S.A., a Greek consulting company with high expertise in providing economic and financial services gave support in the issues of analysis and simulations. www.econet-sa.gr

Targets of the Project

Two of the main targets of the projects were the development of cooperation in the sector of solar energy and the research about available potentials of the use of RES in Serbia. In this framework, the 3 below described pilot projects took place.

A3rd main topic for CRES was, to made a theoretically analysis about the improvement of also existing buildings. The background of the evaluated data based on a choice of public buildings in the Municipality of Cacak. Find below a more detailed description of this procedure.

The specific targets of the proposed programme were the

- Decrease of energy consumption in the public buildings of the Municipality of Cacak by utilising in the maximum possible the solar energy.
- Creation of the conditions for social, environmental and economic benefits for the entire population and mainly the poorest social groups.
- Enhancement of the business co-operation between Greece and Serbia in the field of RES Technologies.

- Creation of opportunities for new projects of great scale solar applications in the Buildings and of RES in the area.

- Broad awareness and acceptance for the application of RES Technologies

The results of the Programme will contribute in many sectors of the social and economic life of the people of Serbia, such as:

- Energy saving and the reduction of the energy imports (e.g. Oil and Gas) which consequential brings Serbia to a more independence position from energy-exporting countries.
- The cost-reduction of warming up domestic water in public buildings.
- The increase of employment due to the creation of new business, especially for small and medium enterprises.
- The use and the accustomed to RES also for the private house sector.
- The protection of the environment and the improvement of life quality which is attended by the above measurements.

Further aims for the continuance e.g. in a project-independent environment are, to

- Create new potential of long term technological and economic co-operation between Greece and Serbia.
- Contribute the transfer of experience and know how on solar energy matters and in general to the new applications - friendly to the environment with direct results and fiscal benefits.
- Support the broad use of the various forms of RES in several sectors of the economy, such as in the tertiary sector, in Industry, in the public administration, in the housing and agricultural sector etc.

1 st Action	Installation and functioning of a solar water-heating system
2 nd Action	Seminar of transfer of specialised technical know-how for the use of solar energy in buildings
3 rd Action	Evaluation of new large scale projects of solar energy use and energy saving in the municipality of Cacak
4 th Action	Evaluation, monthly progress reports for supervision

Table1: Activities

Technical description of the Solar Projects

The first installation was realized in a **secondary school** (Prehrambeno Ugostiteljska Skola). 40m² of high-selective flat-plate- collectors warm up the total volume of 2m³ of domestic water. This system is a so called closed system. The solar heated water is transported from the collectors (producer) to the boilers (water storage) via a pump. The solar pre-heated domestic

water in the boilers can be used for consumption, e.g. for the bathrooms and the restrooms. On this way, the energy costs decrease immensely, especially because the former method of heating up all the needs of domestic hot water (**dhw**) was due to electricity devices. These electrical devices are still preserved through as a back-up system, to warm up the dhw in case of a sunless period. Furthermore, a small Photovoltaic-device which supplies a light bulb was installed, mainly for educational issues.



Picture 1:
Pipework in boiler room

Slika 1:
Sistem cevi u prostoriji za bojlere

The **second installation** took place at the 'Bambi'-kindergarten. The philosophy of the solar application and the technical circumstances are similar to the system in the secondary school, which is described above. The only difference is that the solar panels at the kindergarten will reduce the energy-costs in form of oil-savings instead of electricity as it is the case in the school. The net energy savings of both installations amounts more or less the same and are estimated to 45.000 kwh/year which is adequate to approximately 5.000 L fuel oil.

3rd installation - the Sunce-kindergarten - the existing circumstances reached a decision to implement a so called solar Thermosiphon-system. This technology is long time tested and in successful use all over the world to heat up domestic water with the power of the sun. The simple installation, the effectiveness mode of operation and the trivial technique (working with the

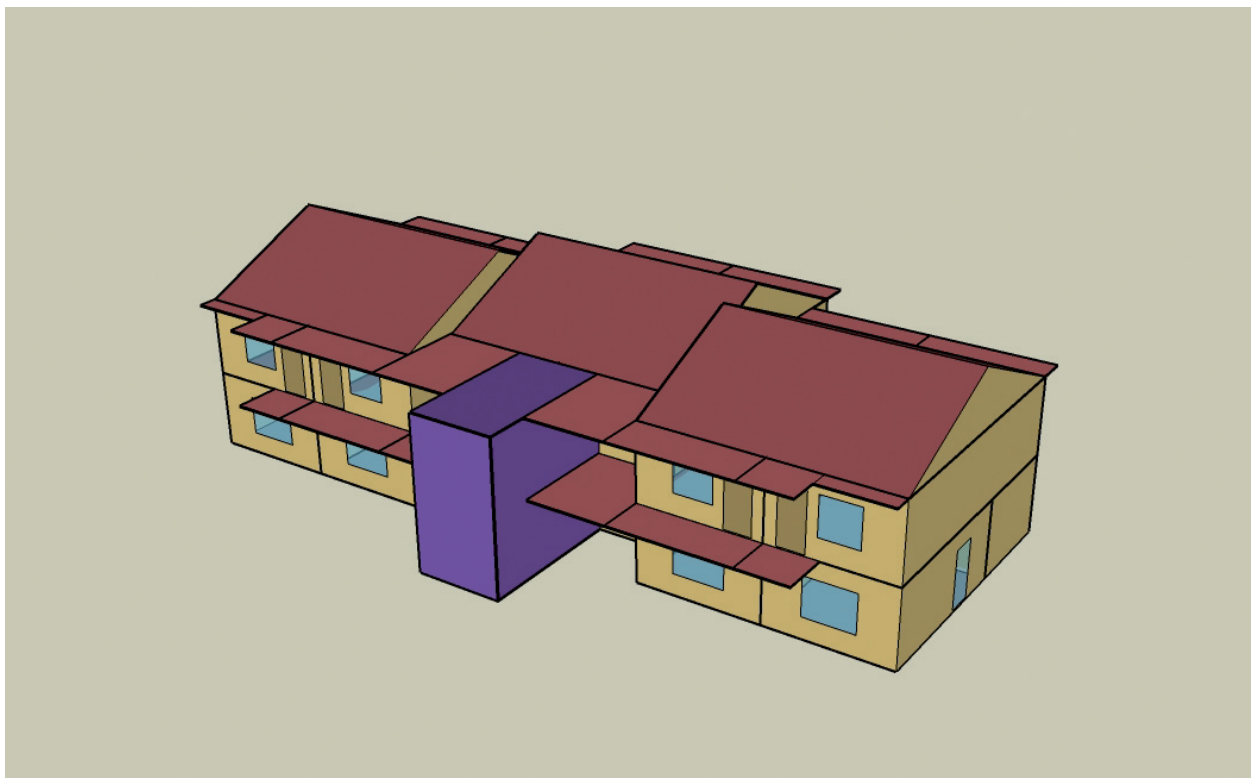
natural gravitation, no pump or controller unit required), are only a few benefits which guarantee the continual spread of this kind of solar application. For the specific demands in the kindergarten, a medium device with 3m² of collector-area and a 200 L boiler on the top was selected as the appropriate solution to cover the daily demands of dhw.

Study about common building topologies

The aim of the analysis was to define the optimum building envelope configuration for building typologies common in the Municipality of Cacak. Parametric studies were performed for typical buildings, testing different configurations of roof and external wall insulation. The annual building heating and cooling loads of

each configuration were estimated through dynamic thermal simulations. A simple economic analysis was then performed, based on current prices and tariffs,

comparing the energy requirements of each scenario with the cost of the respective insulation configuration, so as to identify the most cost-effective solution.



Picture 2: 3-D model used for simulation
Slika 2: 3-D model korišćen za simulaciju

Methodology

The Municipality of Cacak proposed fifteen buildings representative of its existing building stock. Technical questionnaires, prepared by CRES, were used to collect data and form the energy profile of each building. After processing the questionnaires, four buildings, representing a significant part of the Community's building stock were selected for further analysis. Specifically the buildings selected are:

- The residential complex for the Roma population in Atenica.
- The residential complex in Obrez.

- The old kindergarten building and the "Branislav Petrovic" primary school in Slatina.

The climate of Cacak was studied based on data, created by the weather file generator Meteonorm v. 6.0. Due to the cold winters and cool summers, reducing the heating loads of the buildings should be a priority in building design, while overheating during the summer months is unlikely to occur. This study therefore focused on reducing the heat losses through the buildings' shell through the optimum addition of thermal insulation. Dynamic thermal simulations were performed testing and comparing different widths and materials of insulation on the opaque elements of each building's outer envelope.

O Grčkoj pomoći

Generalni Direktor za međunarodnu saradnju u oblasti razvoja (Grčka pomoć) je osnovan 1999 od strane Direktorata Ministarstva Inostranih poslova Grčke (**MFA**). To je poslednji osnovani direktorat Ministarstva Inostranih poslova Grčke. Grčka pomoć je uglavnom odgovorna za superviziju, koordinaciju, monitoring i promociju humanitarne pomoći ugroženima, pomoći u hrani i razvojnim aktivnostima, kao i za pomoć u reorganizaciji ili ponovnom uspostavljanju infrastrukture, kojim rukovode institucije koje ih implementiraju, kao što su ministarstva univerziteta, NVO-e i drugi subjekti iz zemalja u razvoju, u zemljama u razvoju.

Grčka pomoć je kompetentno odeljenje Ministarstva Spoljnih poslova Grčke koje koordinira i vrši monitoring programa humanitarne pomoći ili programa razvoja.

Grčka politika razvoja

Grčka aktivno učestvuje u međunarodnoj alijansi protiv siromaštva i bede i, od 2000. godine na dalje, izrasta u bilateralno, donatorsku zemlju.

Ministarstva Spoljnih poslova Grčke, kroz politiku saradnje i pomoći u međunarodnom razvoju preuzima inicijative i aktivnosti koje služe **Milenijumskim Ciljevima Razvoja** i u potpunosti su kompatibilni **sa Komitetom za pomoć u razvoju** (nalogodavno telo preko koga Organizacija za evropsku saradnju i razvoj (OECD) rešava pitanja vezana za saradnju sa zemljama u razvoju) i prioritetima EU kao i nacionalnim politikama.

Unutar konteksta nove strategije Ministarstva, Inostranih poslova orijentisanih prema izvršenju Milenijumskih ciljeva razvoja, Grčka pomoć promovise:

- Humanitarne programme i programe pomoći u hrani
- Programe razvoja, materijalizovane od strane NVO-a, usmerene prema ekonomskom i socijalnom poboljšanju životnih uslova stanovništva u zemljama u razvoju
- Voluntarizam i uspostavljanje novih NVO-a za razvoj
- među nacionalnim NVO-a i pojedinim organizacijama koje preduzimaju aktivnosti u zemljama u razvoju.

Grčka izdvaja 0,17% Bruto nacionalnog dohotka zvaničnoj pomoći u razvoju u zemljama u razvoju, sa ciljem da se dostigne cilj EU 2010. godine od 0,51%.

Za više informacija molimo da posetite veb stranicu Ministarstva Spoljnih poslova Grčke: <http://www.mfa.gr>

O Centru za izvore obnovljive energije (CRES)

CRES je osnovan u Septembru 1987. dekretom Predsednika. To je državno telo koga nadgleda Ministarstvo Razvoja i Generalni Sekretar za Istraživanje i Tehnologiju, finansijski i administrativno nezavisan. Njegov glavni cilj je istraživanje i promocija Obnovljivih izvora energije (RES), Racionalna upotreba energije (RUS) i ušteda energije (ES) i njihova primena na nacionalnom i internacionalnom nivou, kao i podrška određenim aktivnostima koje uzimaju u obzir principe održivog razvoja.

CRES ima dve glavne uloge: kao Istraživački i tehnološki centar za RES/RUS/ES i kao Nacionalni centar za energiju Grčke.

U okviru ove misije, CRES:

- je zvanični savetnik Vlade Grčke po pitanju RES/RUE/ES;
- izvodi primenjena istraživanja i razvija inovativne tehnologije koje su tehnički i ekonomski održive i neškodljive po okruženje;
- organizuje, nadgleda i vrši demonstraciju pilot projekata, u cilju promovisanja gore navedenih tehnologija, itd...

Tokom godina, CRES je učestvovao u preko 600 nacionalnih i internacionalnih projekata. Kroz ove projekte, CRES je razvio saradnju sa brojnim državnim i privatnim organizacijama na nacionalnom i internacionalnom nivou.

Za više informacija molimo vas posetite: <http://www.cres.gr>

O gradu Čačku

Grad Čačak se nalazi u središtu centralne Srbije, 145km jugo-zapadno od Beograda. Čačak je takođe ime opštinskog sedišta sa oko 75.000 stanovnika i to je najveći grad i administrativni centar Moravičkog regiona.

Čačak je jedan od najvažnijih ekonomskih centara Srbije. U njegovoj industriji dominira industrijska proizvodnja. Pre svega, prerada metala, proizvodnja papira i hemijska industrija. Poljoprivredni sektor je takođe veoma razvijen i uglavnom ga sačinjavaju individualni poljoprivredni proizvođači.

Grad Čačak je u mreži sa takozvanim bratskim gradovima. Jedan od njih je Grčki grad Katerini, koji se nalazi u centralnoj Makedoniji u Grčkoj.



Za više informacija o gradu Čačku molimo vas posetite:
www.cacak.org.yu

O partnerima

Stibetherm S.A., jedan od vodećih proizvođača solarne opreme u Grčkoj, zauzima mesto generalnog Izvođača Ugovora kao Nabavljač solarnih, termalnih uređaja za projekte. www.stibetherm.gr

Elsol, srpska građevinska firma koja je lokalni Podizvođač i odgovorna za ispravnu instalaciju projekata. www.elsol.co.yu

Econet S.A., grčka konsalting kompanija sa visokom ekspertizom u obezbeđivanju ekonomskih i finansijskih usluga, koja daje podršku za pitanja analiza i simulacija. www.econet-sa.gr

Ciljevi projekta

Dva glavna cilja projekta bila su razvoj saradnje u oblasti solarne energije i istraživanja u vezi dostupnih potencijala korišćenja RES u Srbiji. U okviru ovih ciljeva odigrala su se tri (3) dole opisana projekta.

Treći glavni cilj za CRES bio je, napraviti teoretsku analizu poboljšanja postojećih zgrada. Pozadina evaluiranih podataka bazira se na izboru javnih zgrada u gradu Čačku. U daljem tekstu sledi detaljno opisan postupak.

Posebni ciljevi predloženih programa bili su

- Smanjenje potrošnje energije u javnim zgradama grada Čačka koristeći maksimalno i koliko je to moguće solarnu energiju.
- Stvaranje uslova za dobrobit životnog okruženja kao i za društvenu i ekonomsku dobrobit ukupnog stanovništva a posebno za najsiromašnije društvene grupacije.

- Unapređenje poslovne kooperacije između Grčke i Srbije na polju RES tehnologija.
- Stvaranje mogućnosti za nove projekte primene solarne energije, velike vrednosti na zgradama i RES u regionu.
- Široka uverenost i prihvatanje primene RES Tehnologija.

Rezultati Programa će dati svoj doprinos u mnogim sektorima društvenog i ekonomskog života ljudi Srbije, kao što su:

- Ušteda energije i smanjenje uvoza energije (nafta i gasa na primer), što će posledično doneti Srbiji manje zavisnu poziciju od zemalja izvoznica energije.
- Smanjenje troškova grejanja tehničke vode u javnim zgradama.
- Veću uposlenost usled stvaranja novih poslova, naročito za mala i srednja preduzeća.
- Upotreba i pristupanje RES takođe i za privatna domaćinstva.
- Zaštita životne sredine i poboljšanje kvaliteta života koji je vezan za gore navedene aktivnosti.

Budući ciljevi za nastavak, u nezavisnom projektnom okruženju su:

- Stvoriti novi potencijal dugotrajne tehnološke i ekonomske kooperacije između Grčke i Srbije.
- Doprineti transferu iskustava i know how po pitanju solarne energije uopšte, i novih primena - bezopasnih po okruženje sa direktnim rezultatima i finansijskom koristi.
- Podrška širokoj upotrebi različitih oblika RES u različitim ekonomskim sektorima, kao što su tercijarni sektor, u industriji, u javnoj administraciji, u stambenom i poljoprivrednom sektoru itd...

1. Aktivnost	Instalacija i funkcionisanje solarnog sistema za zagrevanje vode
2. Aktivnost	Seminar o transferu specijalnog tehničkog know-how za upotrebu solarne energije u zgradama
3. Aktivnost	Pronalaženje novih radova u vezi solarne energije, velikog obima u gradu Čačku.
4. Aktivnost	Evaluacija, mesečni izveštaji o progresu za nadzor

Tabela1: Aktivnosti

Tehnički opis solarnih projekata

Prva instalacija realizovana je u srednjoj školi (Prehrambeno Ugostiteljska Skola). 40m² visoko selektivnih ravnih kolektora koji zagrevaju do 2m³ tehničke vode. Ovaj sistem je takozvani zatvoreni sistem. Solarno zagrevana voda se transportuje od kolektora (proizvođač) do kotlova (skladištenje vode) pumpom. Solarno pre-zagrejana tehnička voda u kotlovima, može se upotrebiti za potrošnju, na primer za kupatila i toalete. Na ovaj način se znatno smanjuju troškovi energije, posebno zbog prethodnog načina na koji se zagrevala tehnička voda (dhw) električnim uređajima. Ovi električni uređaji

su sačuvani kao podrška, za zagrevanje dhw u slučaju perioda bez sunca. Dalje, instaliran je mali Fotonaponski - uređaj koji snabdeva malu sijalicu, uglavnom u obrazovne svrhe

Druga instalacija bila je u vrtiću Bambi Primena solarnih uređaja i tehničke okolnosti su slične sistemu u srednjoj školi koji je već opisan. Jedina razlika je ta što će solarni paneli u vrtiću smanjiti troškove energije u formi uštede nafte umesto električne energije, kao što je to bio slučaj u školi. Neto ušteda energije obe instalacije je veoma slična i procenjena je na 45.000 kwh/a što je ekvivalentno 5.000 L tečnog goriva.



Picture 3: Collector installation

Slika 3: Instalacija kolektora



Treća 3rd instalacija - vrtić Sunce – postojeće okolnosti dovele su do instalacije takozvanog solarnog Termosifon-sistema. Ova tehnologija je dugo vremena testirana i uspešno se upotrebljava širom sveta za zagrevanje tehničke vode sunčevom energijom. Jednostavnost instalacije, efikasan način rada i prosta tehnika (radi po principu prirodne gravitacije, nema potrebe za pumpom ili kontrolnom jedinicom), su samo nekoliko prednosti koje garantuju kontinuirano širenje ove vrste primene solarnih uređaja. Za specifične zahteve u vrtiću Sunce, srednji uređaj sa 3m² površine kolektora i kotlom od 200 L na vrhu, izabran je da zadovolji dnevne potrebe za dhv.

i hlađenje zgrada različitih konfiguracija su procenjivani kroz dinamičke termo simulacije. Tada su izvođene jednostavne ekonomske analize, bazirane na trenutnim cenama i tarifama, upoređujući zahteve za energijom u svakom scenariju sa cenom odgovarajuće konfiguracije izolacije, tako da se identifikuje naj efikasnije rešenje po pitanju troškova.

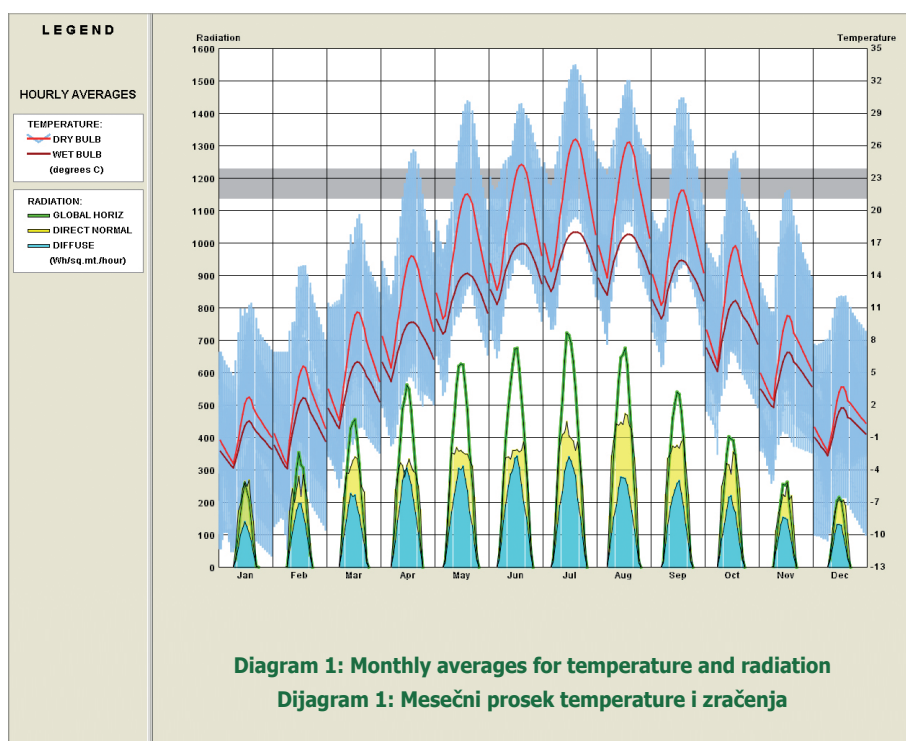
Metodologija

Grad Čačak, predložio je petnaest reprezentativnih zgrada od svih postojećih. Tehnički upitnici, pripremljeni od strane CRES-a, bili su upotrebljeni da bi se prikupili podaci i formirao energetska profil svake zgrade. Po obradi upitnika četiri zgrade, koje su predstavljale značajan deo sveukupnog broja zgrada u gradu izabrane su za dalju analizu. Posebno izdvojene zgrade su:

- Stambeni kompleks romske populacije u Atenici.
- Stambeni kompleks Obrež.
- Stara zgrada vrtića i osnovna škola "Branislav Petrović" u Slatini.

Klima Čačka izučavana je na bazi podataka dobijenim uz pomoć Meteoroma v. 6.0. Zbog hladnih zima i svežih leta, smanjenje utroška energije potrebne za zagrevanje zgrada trebalo bi da bude prioritet pri

konstrukciji zgrada, jer je prilično nemoguće da dođe do preteranog zagrevanja tokom leta. Ova studija se zbog toga fokusira na umanjenje gubitaka toplote kroz spoljne zidove zgrade, optimalnim dodavanjem termo izolacije. Izvedene su dinamičke termo simulacije testirajući i upoređujući različite širine materijala i različite izolacione materijale na građevinskim elementima od opeke, poput onih u spoljnim zidovima zgrada.



Studija uobičajene tipologije zgrada

Cilj ove analize bio je da definiše optimalnu spoljašnju konfiguraciju zgrada za tipologiju zgrada uobičajenu za grad Čačak. Izvedene su studije parametara za tipične zgrade, testirajući različite konfiguracije krovova i izolaciju spoljnih zidova. Godišnji troškovi za zagrevanje



Editorial

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