LIFE4GREENBROADBAND

The LIFE4GREENBROADBAND project

FOND ZA ZAŠTITU OKOLIŠA I ENERGETSKU UČINKOVITOST

Layman's report

Introduction

A1 Croatia is one of the largest telecom operators in the Croatian market, employs around 2,000 people and takes care of the needs of more than 2 million users every day.

The company has always been the first to introduce innovative products and services to the Croatian market, but also in caring for the environment. A1's goal is for users to surf on a completely green network by 2030.

A1 Croatia is implementing the project LIFE4GREENBROADBAND - Reducing CO_2 emissions of the electronic communications network by implementing free cooling and solar power solutions. The project is co-financed and implemented as part of the LIFE

program, the European Union's funding instrument for the environment and climate action.

This directly contributes to the implementation of the Croatian Integrated National Energy and Climate Plan, which sets the target of at least a 7% reduction in GHG emissions from the non-ETS sector by 2030, pursuant to the Effort Sharing Regulation, as well as the objectives to increase the share of RES in energy consumption by 36.4%, in electricity consumption by 63.8% by 2030.

Implementation of LIFE4GREENBROADBAND project actions resulted in the implementation of solar plants on 155 telecom base stations (BTS) locations and indoor free cooling solutions on 200 BTS locations resulting in the expected annual reduction of 1,721,560 kWh of non-renewable energy and accompanying CO_2 emission of 404 tCO_2. The development and integration of own smart metering and remote energy management system for distributed locations, accompanied by a energy management mobile application not only optimized energy use of many distributed locations but also introduced a novel, data-driven approach to management and monitoring of energy generation and use, as well as emissions reduction.

The project also aims to improve the knowledge base and propose measures to relevant public authorities for the development and implementation of effective climate change mitigation actions in the telecommunication sector as well as to improve the policies and measures for implementation of energy efficiency, renewable energy and GHG reductions in the telecommunication.

Situation at the start of the project

Climate change and digitalization are the key challenges of the 21st century.

While high-performance and future-proof infrastructure is the foundation of digitalization, information and communication technology can also contribute to combating climate change. A1 Group is committed to protecting the climate and actively align their business activities accordingly.

Besides reducing the emissions to net zero by 2030, i.e. to cause no emissions from our own activities (Scope 1 & 2) and to achieve a 60% reduction of the emissions along the supply chain (Scope 3) by 2030 the company is focused on generation and use of electricity from renewable energy and implementation of own projects with the aim of decreasing GHG emissions.

Overall objective of the LIFE4GREENBROADBAND project was to contribute to the sustainable transition towards a climate neutral economy by 2050 and to reach the EU emission reduction target for 2030 by reducing GHG emissions from the telecommunications industry (non-ETS sector). Specific objective of the project is increasing energy efficiency and renewable energy use of the electronic communications network in Croatia in order to reduce GHG emissions. The project also aims to contribute to the improvement of the knowledge base for development and implementation of effective climate change mitigation actions in the telecommunications sector and to the implementation of best practice renewable energy and energy efficiency solutions that are suitable for being replicated, transferred and mainstreamed.

Up until 2020, A1 Croatia operated 44 base stations powered by renewable energy sources, primarily solar panels, with an average of up to 15% of their energy needs being supplied by backup generators. The global average for base stations powered by renewable energy sources is around 24% of energy coming from generators. A1 Croatia is the leader in the A1 Group when it comes to the number of base stations relying on renewable energy.

At the company's headquarters in Zagreb, a 30kW solar power plant has been installed, generating approximately 35,000 kWh of electricity annually, which is fed back into the grid. For comparison, a medium-sized family farm (OPG) typically consumes around 19,000 kWh of electricity annually.

A1 Croatia has long been applying innovative green solutions in its base stations. One example is the base stations that, in addition to solar and wind energy, also used hydrogen fuel cells. This was a truly unique solution, an excellent example of local intelligence and development, created in collaboration with company Končar, and it was the first such system in the world. The energy availability for the operation of the BTS in this system was 99.9%. For this innovative solution, A1 Croatia was awarded a global telecom innovation award in London in 2012. However, with the rise of new network technologies and overall traffic growth, the power requirements of our base stations increased, and the hydrogen fuel cells no longer had enough capacity to meet those needs. Additionally, organizing the transport of hydrogen proved to be logistically challenging, especially during the most demanding times of the year, such as when there is snow, rain, fog, mud, and other adverse weather conditions. At the end, the company decided to abandon the implementation of this solution due to all the mentioned reasons.

Main project measures

Project Objectives

The general objective of the proposed project is to contribute to the sustainable transition towards a climate-neutral economy by 2050 and to achieve EU goals for reducing greenhouse gas emissions by 2030 through the reduction of greenhouse gas emissions in the telecommunications industry (non-ETS sector).

The main specific objective of the project is to increase energy efficiency and the use of renewable energy sources in electronic communication networks in Croatia in order to reduce greenhouse gas emissions.

Quantified Main Results and Impacts by the end of the project

- Solar power plants implemented on 155 BTS locations
- “Free cooling” solution implemented at 200 BTS locations
- Annual energy savings of 1,210,000 kWh in the telecommunications network
- Annual production and use of energy from RES increase by 511,560 kWh in the telecommunications network
- Annual CO_2 emissions reduction of 404.24 tCO_2 in the telecommunications network

Start Date: 05/07/2021
End Date: 31/12/2024
Total Eligible Budget: 2,168,772 €
EU Contribution: 1,192,824 €
EPEEF contribution: 200.000 EUR
Project Location: Croatia

Implementation of solar panels and free cooling systems

The LIFE4GREENBROADBAND project was structured around three key activities aimed at enhancing energy efficiency and reducing CO_2 emissions in telecom base stations (BTS).

The goal was to install 120 solar power systems on base stations and 200 free cooling systems. Initially, we planned to install 8 panels on 120 locations. However, it became clear that this was not feasible for most of the locations, so we adjusted our approach. Instead, we installed 6 panels on 155 locations, which allowed us to meet our goals

without exceeding the allocated budget. This adjustment not only ensured that the project remained within budget but also enabled us to install more solar power systems across a greater number of base stations. Additionally, all 200 free cooling systems were successfully installed.

Activity 1 and Activity 2 were closely connected as we selected the same contractor for both design and execution phases in the tender process, allowing these tasks to proceed simultaneously. Activity 1 involved preparing the technical documentation for the installation of 155 photovoltaic (PV) solar plants on BTS locations. Certified civil and electrical engineers drafted the designs in line with construction regulations, and a competitive procurement process ensured the selection of the best providers for design services. Once the designs were completed, the construction phase began, with strict adherence to technical and safety standards.

Activity 2 focused on the installation of the 155 solar plants, which is expected to reduce the use of electricity from non-renawable energy by 511.560 kWh and CO_2 emissions by 120,12 tons annually. Following a thorough procurement process for solar panels and related equipment, the construction of steel structures and electrical connections took place. After installation, the solar systems were configured, tested, and equipped with smart metering to track energy production and savings."

Activity 3 focused on implementing free cooling systems at 200 indoor BTS locations, using external ambient temperatures to reduce electricity consumption by 1.21 million kWh annually and cut CO_2 emissions by 284.12 tons. The process included site preparation, equipment selection, and integrating smart metering for optimal energy management. The implementation spanned different regions with varied climates and included locations where 5G rollouts were planned, ensuring the solutions are tested

under diverse conditions. Additionally, inefficient air conditioning units were replaced with energy-efficient models that enable their remote management and work alongside free cooling solutions. This project is scalable and demonstrates the feasibility of and energy efficiency solutions in telecom sector, supporting European climate objectives.

A1 Hrvatska successfully implemented the LIFE4GREENBROADBAND project over a period of 3,5 years, including a full year of monitoring the achieved energy and GHG savings and extensive efforts to encourage replication of project solutions in other telecom operators. The goal was to install 120 solar power systems on base stations and 200 free cooling systems. Through careful planning and dedication, A1 Hrvatska not only met but exceeded these goals by installing 155 solar power systems and all 200 free cooling systems within the allocated budget.

The project faced several challenges from the outset. The European Union funding for the project was secured in 2021, but the initial phases of implementation were affected by significant external factors. In 2021, as the team was working on gathering the necessary documentation, the COVID-19 pandemic emerged, creating delays and disruptions. This was further compounded by a global surge in inflation, which had a notable impact on procurement and pricing. Furthermore, the design of the technical solution was challenging due to the windy zones, but we successfully overcame this by implementing an innovative solution to place solar panels on telecom towers in wind zones over 25 m/s wind speed.

Despite these hurdles, the project made significant progress and carefully managed the allocated funds. By the end of 2022, A1 Hrvatska had successfully implemented 100 free cooling systems and 30 solar power systems within its network. The dedicated efforts of the team, along with effective problem-solving strategies, allowed the company to accelerate its work in 2023. As a result, by the end of 2023, A1 Hrvatska completed the core activities of the project, having installed 155 solar power systems and all 200 free cooling units.

This accomplishment marks a significant milestone in A1 Hrvatska's commitment to sustainability and energy efficiency, contributing to the company's broader goal of reducing its environmental impact and advancing green technologies within its infrastructure. The LIFE4GREENBROADBAND project not only improved the energy efficiency of A1's network but also demonstrated the company's resilience and ability to adapt to unforeseen challenges while achieving its ambitious sustainability targets.

Participation

Free cooling system

It is a common practice to cool the rooms of base stations with air conditioning units of a certain capacity, sufficient to cool the specific spaces with the equipment to the desired temperature, ensuring a longer and more reliable lifespan for the equipment and batteries.

Analysis has shown that there are many periods when the desired room temperature is above the external temperature, and that external air, which is cooler than the indoor

air, could be brought into the room using fans. It was determined that the energy required to operate the fan is significantly lower than the energy needed to run the air conditioning unit and to cool the network equipment.

Free Cooling (FC) is a device consisting of a fan, control panel, and sensors. Using the fan and airflow through the base station room, it cools and keeps the temperature within the specified limits. If the outside temperature is significantly higher than the expected indoor temperature, the air conditioning unit is activated. Calculations and field indicators suggest that, on average, the air conditioning unit is needed only 12% of the time for the operation of the base station, while Free Cooling operates 60% of the time. The remaining time is used for inactive periods and heating (with heating accounting for less than 1%).

This approach leads to significant savings in electricity, extends the lifespan of the air conditioning unit, and provides a backup in case one of the systems fails. It also helps extend the operation of the base station by preventing overheating and the failure of the base station due to high temperatures.

Photovoltaic Solar Panels

Telecommunications operators manage a large number of base stations and have a significant demand for electrical energy.

One way to reduce GHG emissions is by generating power from renewable sources, in this case, solar panels. The initial idea was to utilize the roofs production and use of power from renewable sources of existing telecom containers at BTS, where the telecommunications equipment is housed. This approach addressed the lack of available clean ground space for mounting floor structures and minimized the amount of steel required for installation.

Given the restraints of container locations and constructural demands during the project

phase, we opted for a configuration with six solar panels, each with a capacity of 455 Wp, connected in a single series string. One of the conditions for installing solar panels on base stations was ensuring that the total consumption was greater than the total production from the solar panels to compensate for production losses. For the inverters, we chose a solution that maintained the direct current (DC) voltage, as the base station was also connected to a DC system. This way, we avoided unnecessary conversion from DC to alternating current (AC) and back to DC. Since we selected locations where consumption exceeded solar production, there was no need to connect to the grid operator.

We utilized the existing DC system at the locations to connect the solar panels and use the produced energy. The solar inverter used in the system had a maximum power of 2 kW (+5% overload), which is slightly less than the 2.7 kWp that the solar panels could produce at maximum. In practice, it was confirmed that the peak sunlight hours were very brief, and the power output of the panels outside of peak sunlight hours compensated for the lack of maximum production.

The structure on the container was installed using a twist lock mechanism, utilizing holes meant for transport. This method eliminated the need for welding or drilling into the container structure, which could have led to corrosion, especially in coastal areas. During the initial installations, we discovered ways to further adapt the container structure to reduce the amount of steel used, leading to the development of the V2 structural solution for the second phase. The only visible difference was the orientation of the panels: on the V1 structure, they were installed in portrait mode, while on the V2 structure, they were installed in landscape mode.

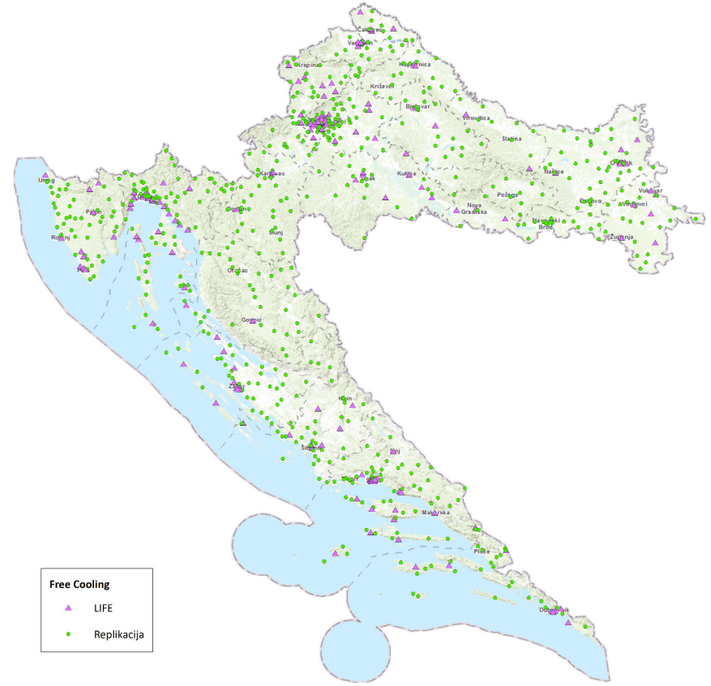
Container construction proved suitable in wind zones 1 and 2, up to 25 m/s wind speed. However, with wind speeds of over 25 m/s which is pretty common in Croatia, the container technical solutions proved inadequate to adhere to calculations of statics and wind stability. Therefore, new technical solution was designed to place solar panels on telecom towers in wind zones over 25 m/s wind speed that enabled the meeting of standards for statics and wind stability. Of the 155 installed solar systems, 44 were installed on tower structures (26 ATB and 18 ATS subvariants), and 111 were installed on container structures, with 71 using the V1 design and 40 using the V2 design.

Locations

The selection of free cooling locations was based on the type of installation.

The plan was to install free cooling systems in base station rooms located in buildings, factories, silos, etc. The locations were chosen in such a way that at least one wall was external, allowing easy access to fresh air and reducing costs associated with additional piping for bringing in outside air. Several locations were implemented in this manner to demonstrate the efficiency of such setups, but with increased investment in piping, the cost-effectiveness of these locations decreased.

Another condition was that the wall should not be made of reinforced concrete, as cutting through such walls is more expensive and may compromise the building's structural integrity. For these locations, a structural engineer was consulted before any work commenced. An additional requirement was that an opening for the hot air to exit could be made on the opposite side, as otherwise, heat pockets would form. In exceptional cases, extra pipes were installed inside the room to simulate the exit of hot air from the opposite end of the room, thereby creating air circulation.



Geographically, these locations were distributed across the entire territory of Croatia.

Solar Locations

The solar locations were chosen based on the following criteria:

- The tower should not fully block the roof of the container
- Access to the location should be possible without heavy machinery
- The wind zone should be suitable for installation
- The base station's energy consumption must exceed the solar production
- Surrounding vegetation should not block the panels, both now and in the coming years
- The container must be properly anchored to the foundation
- The legal status of the location must be finalized, allowing for the construction notification to be submitted and processed.

The solar locations were chosen based on their normal accessibility. We avoided complex locations such as island locations (due to ferry connections), locations with difficult access such as mountainous areas (dirt roads), and locations where delivery vehicles could not easily reach. The map illustrates the solar locations, categorized by the type of structure used, for those locations financed through the LIFE project and those installed using the company's own resources through project continuation activities.

Key Communication and Replication Activities Throughout the Project

Extensive communication and dissemination activities:

- Press conference for the promotion of the project (14 media representatives and 14 expert and public stakeholders)
- LIFE4GREENBROADBAND website developed with a blog designed to inform on project activities and results
- More than 20 published media articles
- 2 articles on the project published on company website
- 2 videos on the project published on online media
- 10 posts published on social media (around 5,000 views)
- Meetings with other A1 Group Members
- Meeting with Austrian Chamber of Commerce, Croatian Chamber of Commerce, Austrian Ambassador to Croatia, Representative of Austrian investors and the Advisor for EU funds of the Croatian Government, Ministry of Environmental Protection and Green Transition

- Project presented in article in daily newspaper Jutarnji list in special print edition Best EU projects in Croatia
- Conference on green energy organized in Osijek resulted with 44 media articles in total (3 print, 3 radio, 2 TV, 36 online)
- More than 170,000 individuals/entities made aware of the project and the need for GHG emission reductions in the telecom sector.

Continuation, transfer and replication:

- Meeting held with A1 members with the purpose of replicating project activities in all A1 TAG members.
- Meeting held with Austrian Chamber of Commerce, Croatian Chamber of Commerce, Austrian Ambassador to Croatia, Representative of Austrian investors and the Advisor for EU funds of the Croatian Government with the aim to enable support for increasing energy efficiency and renewable energy use in the telecommunication sector
- Participation in the Good Energy Festival in Zagreb where the project was promoted
- Participation in the Green Future Conference 2022 in Split where the project was promoted
- Project presented to representatives of all members of the Telekom Austria Group in Vienna

- Conference on green energy organized in Osijek to promote replication of project solutions with esteemed speakers from the public, academia and private sector

Effects on climate and energy efficiency

The purpose of the **LIFE4GREENBROADBAND** project – Reducing CO_2 Emissions in the Telecommunications Network through the Implementation of Free Cooling and Solar Energy Solutions – was to increase energy efficiency and the use of renewable energy sources in the telecommunications network in order to reduce greenhouse gas emissions in the telecom sector.

The activities of this project focused on applying best practices in energy efficiency and the use of renewable energy sources (RES), specifically through the cooling of base stations using highly efficient refrigeration systems that employ the free cooling method, and the installation of solar power systems at telecommunications base station sites.

The project demonstrated the technical feasibility of these solutions, as well as the energy savings and reductions in greenhouse gas emissions that can be achieved through investments in free cooling systems and solar power plants in telecommunications networks and other distributed networks that operate on or off the grid..

In addition to the strictly economic impacts in the context of competitiveness and the reduction of the carbon footprint of society, the LIFE4GREENBROADBAND project has multiple impacts on both the economic and social outcomes in the Republic of Croatia. This is reflected in:

i. **Contribution to local development** through the creation of sustainable telecommunications infrastructure,

ii. **Contribution to the goals of key strategic documents** in the field of energy and climate change mitigation on both the European Union and Croatian levels, and

iii. **Contribution to the goals of national and local development strategies.**

The implementation of this project and its continuation activities within A1 Hrvatska could result in annual energy savings of 5.96 GWh according to the prepared business plan for large-scale implementation of project solutions within the company, which would result in a reduction of the annual energy cost by EUR 923,589 for the company. This would also contribute to a reduction in greenhouse gas emissions by 1,399.15 tCO_2/year.

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