
Russian-held areas
Area held by Russia-backed separatists since 2014
BELARUS
RUSSIA
Chernihiv
POL.
Kyiv
Kharkiv
Lviv
UKRAINE
Slovyansk
Dnipro
Donbas
MOL.
Mykolaiv
Mariupol
Kherson
ROMANIA
CRIMEA
Odessa
Annexed by Russia in 2014
200 MILES
Black Sea

Contents

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SOLAR WORKFORCE DEVELOPMENT IN UKRAINE
Building Resilience in Chernihiv, a Hero City*

Executive Summary

The purpose of this grant is to:

1. Harden critical infrastructure in the City of Chernihiv by supporting a demonstration project to install solar on two hospitals and two schools/shelters. Our two Rotary Clubs are working with the Net Zero World Initiative, (NZW), a flagship international initiative of the U.S. Department of Energy (DOE), implemented by DOE's national laboratories, led by the National Renewable Energy Laboratory (NREL). NZW works closely with the Ministry of Energy of Ukraine; the distributed energy line of work is co-funded by NZW and USAID.
2. Increase career pathways for Ukrainians–especially veterans– by promoting training and certification in a broad array of solar job categories in cooperation with several Ukrainian polytechnic institutes, solar installation businesses and private training academies.
3. Promote technology transfer to other municipalities by publicizing NREL's citywide engineering analysis of solar viability for all critical infrastructure buildings in Chernihiv. This supports the Ukraine Government's goal to transition to 25% renewable energy by 2030.

Because the project involving both solar installation and solar workforce development, it will be completed in three phases:

1. Solar for Chernihiv City Hospital #2 (600-bed hospital) plus launch of Kharkiv/Chernihiv Polytechnic Institutes Workforce Development Program
2. Solar for Chernihiv Maternity House KNP (200-bed) and expansion of the Workforce Development Program to include additional polytechnic institutes (Poltava Polytechnic).
3. Solar for two schools (#11 and #4) and continued expansion of the Workforce Program to additional educational institutions (Chernivtsi Polytechnic).

COST ESTIMATE
A high-level cost estimate as of Q1 2024 is as follows:
120-trainee job training program: $315,000
Solar on 4 municipal buildings: $1.0M

WHY INSTALL SOLAR DURING A WAR?

Any Community Assessment for solar installation during a war must begin by asking, "Does this make sense?" Solar industry thought leaders have given a great deal of thought to this question and a growing body of war-zone evidence supports their views. To wit:

"Solar systems can provide a reliable energy source during emergencies such as power outages caused by natural disasters or conflicts. But more importantly, they can be used for a long-term energy supply," says Bartosz Majewski, CEO at PV distributor Menlo Electric.

"The essential advantage of solar systems during the targeted attacks on energy infrastructure in a centralized energy system is their decentralized nature. Solar systems, especially hybrid or off-grid ones, provide a stable energy supply that can operate independently of the primary grid and are more resilient against missile attacks. The most telling example for me was how household solar stations saved the lives of residents of surrounded Mariupol, allowing them to cook

food. I wish it would not be an exception, and more people could survive because they had access to electricity," said Majewski.

**** Hero City of Ukraine is a Ukrainian honorary title awarded for outstanding heroism during the 2022 Russian invasion of Ukraine.[1] It was awarded to ten cities in March 2022.***

Recent Attacks Make Renewable Energy More Necessary Than Ever

Solar panels are a necessity in Ukraine, since the invaders aim not just to conquer the country, but also to deprive its population of normal livelihoods and electricity, water and heat. Today, ordinary Ukrainians are forced to buy expensive generators that run on petrol and require funds to maintain. During this conflict, there are hundreds of stories of families in Ukraine's energy system suffering significantly due to continuous missile and drone attacks on the energy infrastructure. This Rotary project will be a model for future public and private adoption of solar.

On the night of 22 March, 2024, Russia launched the largest-scale attack on the energy sector in recent memory - the enemy launched more than 60 "Shaheds" and almost 90 missiles of various types at Ukraine.

The explosions were heard in Kharkiv, Zaporizhzhia, Kryvyi Rih, Dnipro, Kropyvnytskyi, Khmelnytskyi, Vinnytsia, Sumy, Ivano-Frankivsk and Lviv regions. The Zaporizhzhya Nuclear Power Plant was once again on the verge of blackout, and Dnipro HPP, thermal power plants and main substations were attacked. Emergency power cuts were introduced in a number of regions.

Energy Minister Herman Galushchenko described what happened on the night of 22 March as "the largest attack on the Ukrainian energy sector in recent times". Judging by the scale of the attack, which was later announced, the Russians were trying to cause a large-scale blackout in the power grid.

"The morning attack on the power system by Russians was the largest ever, characterized by the use of combined weapons," said Ukrenergo CEO Volodymyr Kudrytskyi. The consequences of the latest attack are very large-scale. Though the power grid has not lost its integrity, in many regions the damage to generation and distribution facilities is very serious," he said.

A representative of one of the state-owned energy companies said that during the attack, the Russians shut down about 2,000 MW of generation, of which 1,500 MW is covered by emergency aid.

COMMUNITY OVERVIEW

Describe the characteristics (such as geographic information, main sources of income, population size, and access to education and health services) of the specific community where this project will take place.

Located in the north of Ukraine near the Belarus and Russian borders, Chernihiv is the administrative, industrial and cultural center of Chernihiv Oblast (region), situated on the banks of the Desna River. In March, 2022, after the Russian full-scale invasion began, Chernihiv suffered a tragic loss of life and infrastructure and was awarded the title Hero-City of Ukraine for heroism and resilience. Since 2022, more than 1,000 buildings have been destroyed. Sporadic attacks on people and infrastructure have continued.

As of January 1, 2022, the population of the city was 267,361 people. The city of Chernihiv is 150 km from Kyiv, the nation's capital, and from the international airports Boryspil and Kyiv (Zhulyani), as well as next to the international highway, E-95 Europe-Asia.

The special value of the Chernihiv urban environment is the presence of a significant number of historical Middle Ages and cultural monuments, unique architectural treasures that are inextricably linked with the landscape, which gives the city uniqueness and originality.

Prior to the full-scale invasion, the city was characterized by a high level of attractiveness for investment, according to Moody's credit rating service (Last data available 2021-2022).

As of today, the City of Chernihiv operates 52 kindergartens, 31 schools; three hospitals, two clinics and a maternity hospital. Every community resident has free access to the city's medical and educational services.

The nation generated 11 percent of its electricity from renewable sources in 2020, according to the International Renewable Energy Agency, although more than half of its electricity came from nuclear power plants, which have a low carbon footprint. The country's goal is to build capacity for 30 gigawatts' worth of clean electricity by 2030, which would cover about half of Ukraine's needs.

NOTE: The proposed solar installations are in Chernihiv, but the workforce training program will start there and branch out to other communities through the nation's excellent polytechnic institutes at its universities.

COLLECTING COMMUNITY ASSESSMENT DATA

When you conducted the assessment, who in the community did you speak to? At least two different community representatives and beneficiaries who are not involved in Rotary (such as teachers, doctors, or community leaders) should be included in the discussions.

In order to prepare this Community Assessment, the City of Chernihiv and the Rotary Club of Babcock Ranch have had more than a dozen discussions via zoom since October 19, 2023, with representatives from local government, the utility company, NGOs, medical and education experts, the solar industry and the polytechnic institutes of the national university system. The City representatives have included the Head of International Relations and Investment, City Councilwoman Nataliia Kholchenkova, City Energy Manager Roman Movchan, and representatives from the local heating and hot water utility, Oblteplocomunenergo (OTKE).

Since January 12, 2024, Rotary Club of Kyiv-Capital has hosted a weekly meeting so that Babcock Ranch Rotarians could gain additional information from solar industry experts, veterans, investors, and others. The Babcock Ranch Rotary also meets weekly with a group of Rotarians from Wichita KS, Denmark and the UK, in a meeting specially designed to discuss Global Grants in Ukraine. Babcock Ranch Rotarians also participate in monthly calls organized by Rotary Club of Denver to discuss current issues with Ukrainian Rotarians, teachers and NGO representatives.

When in the last year did the discussions occur?
The last discussion was held April 5, 2024.

What methods did you use to collect information from community members (such as community meetings, interviews, or focus groups)?
To collect information we used two different methods: community meetings via zoom between Rotary and representatives of NGOs, local municipal representatives and from educational and medical spheres. Also focus groups with residents of the city of Chernihiv were organized.

TARGET POPULATION

Who will benefit directly from the project? List the groups that will benefit (such as schools, hospitals, vocational training centers, cooperatives, or villages).

Residents of the city of Chernihiv who use medical services; medical workers; teachers; parents; children at school; and the city's departments of education and medicine. Also, we will be offering training in solar industry skills that will be aimed at municipal building maintenance workers, veterans, and internally displaced persons (IDPs) in need of jobs and training.

Describe how the beneficiaries were identified.
For the solar installation: The City's Energy Manager Roman Movchan, in consultation with the City Council and the Mayor's Office, chose four strategic buildings that it seeks to make resilient in the face of Russian attacks: Chernihiv City Hospital No. 2, the City Maternity Hospital, Public School No. 11, Preschool Educational Institution No. 4.

For the solar training: Consultations were held with the Ukraine Solar Energy Industry Association, Atmosfera, EcoClub, National Technical University "Kharkiv Polytechnic Institute", National University "Yuri Kondratyuk Poltava Polytechnic" , National Technical University "Chernihiv Polytechnic institute," and solar project developer Myroslav Tabaharnyuk of MT-Invest Mergers & Acquisitions.

Chernihiv City Hospital is the largest hospital in the region, with more than 16,000 patients annually. It is our Phase 1 project and is discussed later in this document.

Chernihiv Maternity House KNP is targeted for Phase 2. The hospital provides high-quality obstetric and gynecological care to women, pregnant women, women in labor, and newborns from the city of Chernihiv and other communities in the region. More than 1,000 children are born in the hospital every year. The maternity hospital is a vital medical institution for the region, because in addition to maternity services, complex surgical operations are performed. On March 17, 2022, a rocket hit the hospital yard. No one was injured, but the blast caused a fire, broken windows, damage to the roof and facade of the main building, and destroyed critical medical spaces such as wards and delivery rooms. The hospital operated out of a bomb shelter until it could safely return patients to the building. Building repairs are completed and the hospital has had energy efficiency upgrades.

School No. 11 and Kindergarten No. 4 are among the largest educational institutions in the city of Chernihiv that have equipped bomb shelters. They are used 12 months of the year, including when the students are on vacation. A variety of community meetings take place in these buildings and in the warmer months, many tradespeople are in the school buildings every day, making repairs and doing renovations with power tools that rely on electricity.

City officials have said that it is critically important to harden these four facilities so that the hospitals, school and kindergarten can function autonomously during blackouts and during air raid alerts in shelters. These institutions provide a large share of the city's social services, both medical and educational. This project will increase the community's capacity for energy autonomy and will allow for a reduction in energy

At the Kindergarten No.4, children performed traditional Ukrainian dances as part of the opening ceremony.

consumption in these critical community facilities.

The four building locations are:
Kindergarten #4, 134 Pukhova Street, 2 stories
Secondary School #11, 137 Myr Avenue, 3 stories
City Hospital #2, 168 Mykhaila Hrushevskoho Ave., 9 stories
City Maternity Hospital, 172 Mykhaila Hrushevskoho Ave., 5 stories

BENEFITS OF THE SOLAR INSTALLATION

Though local in nature, this project will contribute to global CO2 emissions reduction. The U.S. National Renewable Energy Laboratory (NREL) is providing in-kind contribution, engineering and management staff time to this project.

NREL will help Rotary Club and the City of Chernihiv to review proposals from local solar installers to ensure that the highest safety and technical standards are met. NREL's engineers will advise the city council on the optimal configuration of solar modules and batteries to achieve both resiliency and the greatest energy savings.

A benefit of this project is that it will serve as a model for private investors who have slowed their projects in Ukraine due to the war. The people who are living and working in Chernihiv and elsewhere in Ukraine very much want to get on with their lives and build a better future for themselves and their families. This project is a beacon of hope for these families, and demonstrates that Ukraine's supporters see a bright future for them.

In a sense, this project will help to "de-risk" solar investment in Ukraine, because it will serve as a model of public-private partnership that can be emulated in other parts of the country.

INSTALLATION DETAIL
Chernihiv City Hospital #2 was the subject of an NREL draft pre-feasibility study (using NREL's RE-Opt software) and shared with our Rotary Club on May 2, 2024. (Related: See NREL's latest study of solar feasibility in Ukraine.) We have uploaded in the Other Documents section a Google Earth image of this hospital; it has several buildings but we are going to put solar only on the S shaped main building.

Study results:
The roof has 2,640 sq meters of available space.
Est. PV capacity (kW-DC) for this project is 284kW (100% utilization of available space)
Current electric bill is US$292,361
Util bill avoided costs, Year 1 = US$52,120
Simple payback (years) = 4.3
CAPEX (Capital Expenditure) = US$241,536

No BESS (battery energy storage system) has been estimated at this time; however, the hospital would like a BESS and so that additional feasibility study is ongoing.

This information will be used to inform the bid ("tender") document that the City of Chernihiv will create, with NREL's help. We will use a NREL template for the bid document and will distribute the tender to the approximately 10 to 15 solar installation companies in Ukraine that have the capacity for this job.

BENEFITS OF SOLAR INDUSTRY WORKFORCE DEVELOPMENT PROGRAM

Rotary International has advised the applicants that Global Grant applications for solar installations are stronger when accompanied by training programs. We could not agree more and the accompanying budget shows a training program for an initial 100 people. To that end, the applicants have held in-depth discussions with the City of Chernihiv, several polytechnic institutions and solar companies to ensure that job opportunities result from this project by means of a solar training program. This application includes a Memorandum of Understanding with the National Technical University "Kharkiv Polytechnic Institute", and Atmosfera Academy, which are the likely organizations to coordinate the public/private job training, pending Rotary approval.

The target workforce development audience will be threefold:

- **Veterans.** Ukraine's active duty military is an estimated 2.2 million people and another 1.2 million are in the reserves. Upwards of 30,000 women serve in the military, in all roles including combat.
- **Municipal building managers** Ukraine has 461 cities, 27,190 villages and 24 oblasts (states), all of which employ municipal building and maintenance staff who can benefit from learning how to maintain solar energy systems. This sector typically will be concerned with fire safety, utility interconnection, and maintaining and repairing the systems in the wake of any damage.
- **Internally Displaced Persons (IDPs)**. There are an estimated 3.7 million IDPs in Ukraine at this time, creating a great need for job opportunities.

Describe any challenges and gaps in the community's behaviors, skills, and knowledge.

Some municipal stakeholders have expressed concern about a personnel shortage for building management, including those who will maintain the solar energy systems. The ongoing war is taking a toll on the economy at the local, regional and national levels. This underscores the need for the solar workforce development program, to bring new workers into the industry, including women.

As a result of the war, the unstable power grid and the possibility of blackouts remain as top concerns. (In a small way, Rotary Club of Babcock Ranch offered assistance when it sent 27 solar cell phone chargers to Chernihiv, to help keep cell phones charged during blackouts.)

Another challenge is that the widespread use of diesel generators, which are necessary to provide power in the case of power outages, leads to an increased risk of fire, since the fuel for the generators is stored indoors. The solar installation will be accompanied by a battery system that will be an alternative to diesel generators, and will be sized to provide backup emergency power for 48 hours.

Another challenge is the air pollution caused by the existing Combined Heat and Power (CHP) fossil fuel plants, as well the war-related increase in the number of vehicles in the city, which increases emissions of harmful pollutants.

As a result of the Russian invasion, there are areas where the soil is contaminated with land mines and other explosive objects. Despite the fact that the city operates a demining program, the risk remains.

What issues will the project address, and how does the community currently address those issues?

The solar installation project will help solve several important issues, including an improvement in energy security during the war, increasing the sense of day-to-day security among city residents, as well as among employees of medical and educational institutions, while also reducing energy consumption. The community currently is in a constant state of anxiety about its unstable power supply, with its attendant pollution and fire risks posed by diesel generators. The air is polluted also by the increasing number of vehicles in the city, which increases emissions of harmful gasses.

The solar training program will help Ukrainians prepare for a brighter future. The Government of Ukraine is committed to adopting renewable energy, and the initiative will not succeed without enough trained solar industry workers.

A key innovative aspect of this project is that there are not at this time widespread public/private partnerships to grow the solar energy industry. They have much to offer one another.

Describe the long-term plan for the project (such as oversight, financial responsibilities, and expected behavior change) after Rotary's involvement ends.

Oversight

Installation Project: After the end of Rotary's involvement in the project, the City of Chernihiv will maintain the solar energy systems. In addition, the City will share its experience in implementing and using solar energy with other communities in Ukraine. The City maintains an active social media presence and will publicize the project extensively by working with Rotary to host a series of solar implementation workshops for municipalities, to promote technology transfer.

Workforce Development Project**:** By involving the solar industry from the start, the training programs are intended to "outgrow" Rotary's involvement. Employers consistently demonstrate a willingness to pay for employee training when they are certain the added expense will solve a labor issue they are experiencing and accrue to their bottom line.

Financial Responsibilities

The Rotary Club of Kyiv-Capital will hold the purse strings. Rotary Club of Babcock Ranch's leadership team includes several individuals who have had extensive grant management experience. They will offer assistance as needed. RC of BR will have the primary reporting responsibility, working in tandem with the Kyiv Club to send timely reports to Rotary International.

Installation Project: Payment will be made to the installation company.

Workforce Development: Payment will be made to both the polytechnic institute and the industry partner, which will supply instructors. Additional polytechnic institutes wishing to join the program will be paid by the coordinating polytechnic.

List any cultural practices that are relevant to the project (such as agricultural techniques or traditions). Chernihiv already has experience in installing and maintaining solar energy systems. In the fall of 2023, solar panels were installed at two schools in the city by the Energy Act for Ukraine Foundation (EA4U). Its tender has since closed.

At present, academic/industry partnerships for solar education are not common. This program will be an opportunity to develop this practice so that the regional and national economy can move forward. The partners will publicize their collaboration to help others replicate the model in other regions.

What positive and negative environmental changes do you expect to result from the project?
We expect only positive changes, as the project will reduce the load on the CHP plant that produces electricity and, accordingly, reduce CO2 emissions. The project will contribute to the development of green energy and air purification. The community will serve as a role model to popularize the solution of environmental issues through the use of alternative energy sources.

COMMUNITY STRENGTHS, NEEDS, PRIORITIES, AND PROJECT DESIGN

Describe what members of the community said matters to them during the assessment.

The priority addressed by this grant, said Chernihiv City Councilwoman Nataliia Kholchenkova (center), "is the need for resilience so that the city can continue to provide medical and educational services. Due to the threat of shelling and blackouts, there is a very real possibility of disconnection from the central power grid, which leads to highly compromised medical services and can threaten health or life. The solar and battery backup system will give the City the means to continue providing critical services during periods of conflict."

Ms. Kholchenkova is the Head of International Relations and Investment for the City of Chernihiv and an extraordinarily talented coalition builder. She documents all the City's partnerships on social media and already has posted about this project.

Solar already has proved itself in many localities across Ukraine as a critically important component of medical and educational institutions during the Russian invasion. Energy Act for Ukraine Foundation (EA4U),

a Ukrainian NGO, already has installed solar on Chernihiv Schools No. 3 and No. 19 as well as a Children's Hospital in Chernihiv Oblast, completing those projects in 2023.

The City of Chernihiv Energy Manager spoke about the positive aspects of the project for school children.

"The absence of power or the threat of power outages in educational institutions entails stopping the education process, which negatively affects the quality of education," said Roman Movchan, at left. "A typical day might include one or more trips to the bomb shelter, where it is often unheated and students must try to concentrate while they try to stay warm. A separate issue that worries city residents is the impossibility of providing high-quality electricity to shelters during air alerts."

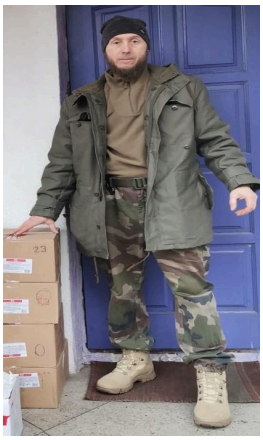
Feedback from the Ukraine Solar Industry

One of the founders of the Ukraine Solar Energy Association, Yevhen Babak, at left, told us that last summer his company, Atmosfera, had plenty of solar installation work but lacked workers. He and staff members have created Atmosfera Academy to teach solar installation to job seekers. They are seeking to expand their academy via grant funding to specifically target veterans and internally displaced persons (IDP).

For Andriy Martynyuk, at right, executive director of the Ukrainian NGO, EcoClub, the war has meant a hectic time for their organization. Their Solar Aid for Ukraine project focuses on solar for hospitals and water utilities.

"Our primary objective is to equip as many hospitals and water utilities with a reliable and sustainable source of energy and storage with solar power plants," says Martynuk. "This allows medical staff to continue to save lives and treat our civilian population during everyday power cuts." EcoClub has completed nearly a dozen projects in the Rivne region of Eastern Ukraine. They have provided a preliminary bid for inclusion in the project, subject to needed updates as project specifications become available from NREL.

Similarly, Myroslav Tabaharnyuk, of MT-Invest Mergers and Acquisitions, at left, whom we met through Rotary Club of Kyiv-Capital, told us of the difficulty of finding project managers. Mr. Tabaharnyuk has commissioned a well-developed proposal by Voltage Group for solar installation on a hospital and school near the frontline. However, he says foreign private investors are unwilling to look at it today, and he does not have the staff resources to make an application to USAID or other government programs.



Anatolii Mykhaylov, at left, a Chernihiv native now living in Irpin (near Kyiv), is a recently discharged veteran and has experience with solar installation. He has introduced our project team to Atmosfera, a founding organization of the Ukraine Solar Energy Association. Anatoli sees our proposed solar project as helpful to the City of Chernihiv, and can advise on how to recruit students who are veterans. In his experience, the training of rooftop solar installers is not a lengthy process per se, but he agrees that training project managers and small business owners in the industry's more complex functions is a challenging task, particularly with so many people being called into active military service. These functions include solar site assessment, system design, utility data collection and analysis, obtaining municipal permits, adhering to the city building code, large-scale project engineering, insurance, etc. He is optimistic that this project's engagement with Chernihiv Polytechnic and the other polytechnic institutes will yield positive results.

Wherever possible, Ukrainians are trying to use solar energy, which has undeniable advantages during the war. Chernihiv region is one of the leading regions of Ukraine in this regard, notes Ana Pavelieva, at left, External Communication Coordinator for Eurodoc; PhD, Associate Professor at the National University "Yuri Kondratyuk Poltava Polytechnic". (Professor Pavelieva was a Open World scholar who visited Babcock Ranch in January 2024 under the auspices of Rotary International.) Almost from the very first days of Russia's full-scale invasion of Ukraine, part of the Chernihiv region was cut off from the central power supply. For more than a month, local households in one of the communities in the Chernihiv region, have been receiving electricity for lighting, keeping fresh food in refrigerators, powering bomb shelters and charging mobile phones from the sun.

That is why it is important to start thinking about the sustainable reconstruction of the country now, says Ms. Pavelieva. In the course of reconstruction, it will be necessary to diversify electricity sources as much as possible and reduce the distance from the place of energy generation to the consumer, she and others have contended. This approach will help ensure stable access to electricity during the temporary occupation. Only an increase in the share of renewable energy sources in the energy balance, as well as energy saving measures, will increase the energy independence of communities and meet the goals of overcoming the climate crisis, she notes.

Describe the community's strengths and resources.

1. History. The city of Chernihiv has a 1,200-year history, and as such is one of the most ancient cities in Eastern Europe. City officials are dedicated to preservation of its antiquities, despite the hardships.
2. Environmental stewardship. The city is actively working on energy efficiency and renewable energy.
3. Recreational opportunities. The city has many parks, trees and verdant areas.

4. Industrial potential. Dominated by small and medium-sized businesses and processing enterprises, the city seeks to develop its industrial potential. Infrastructure potential exists in the availability of workshops and warehouses that can be renovated for new industries.
5. Bravery and optimism in the face of daily threats posed by war.

Project design

Provide the specific design details of the installation and workforce development projects and how they will solve issues in the community.

As noted, three phases will be required for the solar installation and workforce development projects. At a high level, the phases are as follows.

PHASE 1

Q3 2024 through Q2 2025

SOLAR INSTALLATION ON CITY HOSPITAL #2 + LAUNCH OF SOLAR WORKFORCE DEVELOPMENT PROGRAM

1. Design of the Solar Installation Project

The installation of solar power systems will reduce the consumption of centralized electricity by up to 35% in the chosen buildings. It will decrease pollution and will replace dirty fossil fuel generators. The solar systems' backup power will allow for critical life saving functions to continue at the two hospitals in the event of a power outage. And it will allow for full community use of the bomb shelters that are underneath the school and hospital buildings, for extended periods of time.

Our partner NREL is performing a techno-economic analysis (pre-feasibility study) for the projects, and this will save funds that otherwise would have to be spent on engineering for the projects.

Installation Detail: Chernihiv City Hospital #2 was the subject of an NREL draft pre-feasibility study (using NREL's RE-Opt software) and shared with us yesterday. (Related: See NREL's latest study of solar feasibility in Ukraine.) I have attached a Google Earth image of this hospital; it has several buildings but we are going to put solar only on the S shaped main building.

Results:

The roof has 2,640 sq meters of available space.

Est. PV capacity (kW-DC) for this project is 284kW (100% utilization of available space)

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Utility bill avoided costs, Year 1 = US$52,120

Simple payback (years) = 4.3

CAPEX (Capital Expenditure) = US$241,536

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This information will be used to inform the bid ("tender") document that the City of Chernihiv will create, with NREL's help. We will use a NREL template for the bid document and will distribute the tender to the approximately 10 to 15 solar installation companies in Ukraine that have the capacity for this job.

Regarding the later phases: according to a survey in PV Tech, a typical configuration of Ukrainian hospital and school solar projects is shown in the table below. The chart describes system size as measured by kilowatts. NREL is still completing its analysis of the four Chernihiv buildings.

Equipment	School	Hospital
Solar modules	15-20kWdc	50-80kWdc
Hybrid three-phase inverters	10-30kW	20-35kW
Battery storage	20-50kWh	60-96kWh

Solar Installation on Critical Infrastructure
Background on the Phase 1 building appears below.

Chernihiv City Hospital #2

Photo from Hospital #2 website

Chernihiv City Hospital #2 is the largest medical institution in the city. The 24/7 hospital was built in 1992. In the early days of the full scale Russian invasion, the hospital was hit by artillery, destroying the emergency room, and windows were blown out on all nine floors. Work is underway to repair the destruction.

During 2022 and 2023, the hospital had an unstable power supply for periods of time. Power outages have been chaotic due to the intensity and degree of damage to the energy grid by missile and combat shells.

The General Director is Vladyslav Kukhar. Dr. Kukhar has more than four years of experience in the hospital and total work experience of almost 30 years.

“A solar system is a most necessary element for ensuring the secure operation of the institution: both as an alternative source of energy and as a means to save energy,” says Dr. Kukhar.

Since 2016, work has been carried out to install energy-efficient window and door structures, LED interior lighting has been installed, the heating unit has been modernized, and pipeline insulation measures have been undertaken. Replacement windows and insulated new facades have been installed, and roof repairs have been made.

Chernihiv City Hospital #2 is a medical institution of the highest accreditation category. The institution is equipped with modern diagnostic equipment: X-ray, computer tomography, ultrasound, endoscopy, colposcopy, ECG, etc. The hospital has its own laboratory. Additional equipment includes two angiographs, MRI, and endoscopic equipment, clinical, bacteriological, pathological and cytological laboratories.

The hospital's emergency room has an average of more than 20,000 visits per year from residents of the city and region. The institution has almost 600 beds and the total number of employees of the institution is almost 1,700 people. The total number of visitors to the institution in 2022 was almost 200,000 and in 2023, nearly 230,000.

Among the main medical services are adult and pediatric surgery, medical rehabilitation of adults and children from 3 years old with damage to the nervous system, with damage to the musculoskeletal system, inpatient palliative care for adults and children, treatment of heart attack, stroke, and diagnosis of cancer. The Surgery Department has 15 operating rooms and a modern cardiac surgery department, where open-heart surgeries are performed.

Critical electrical equipment in the hospital includes operating room equipment, laboratory equipment, tomograph, angiograph, MRI, ultrasound, ventilators, EKG, dry heat cabinets, defibrillators, sterilizers, fluorograph, X-ray unit, autoclaves, gastroscopes, etc. Among other important functions requiring electricity are the ventilation and heating system, and the lighting system of the medical unit.

The hospital’s backup power system relies on gasoline and diesel electric generators. The facility stores enough fuel to power the critical load of the hospital for up to seven days.

The required capacity for the satisfactory functioning of Hospital No. 2 is 400 kW.
The minimum required capacity to ensure the operation of the institution at a critical level is 150 kW.

The first of the four buildings will be City Hospital #2. NREL’s Ukraine Team is working with the City’s energy manager to obtain utility data that will allow them to recommend the optimal system size and configuration of the solar system.

“The solar system will increase the energy autonomy of the institution, which is most necessary during the war, and will make it possible to improve the stability of the provision of medical services, which will create a feeling of security and confidence in the quality of medical services in patients and create a generally positive effect in the community,” said General Director Vasyl Ivanovych Husak. Dr. Husak has more than 15 years of work experience in the hospital and 31 years of total work experience.

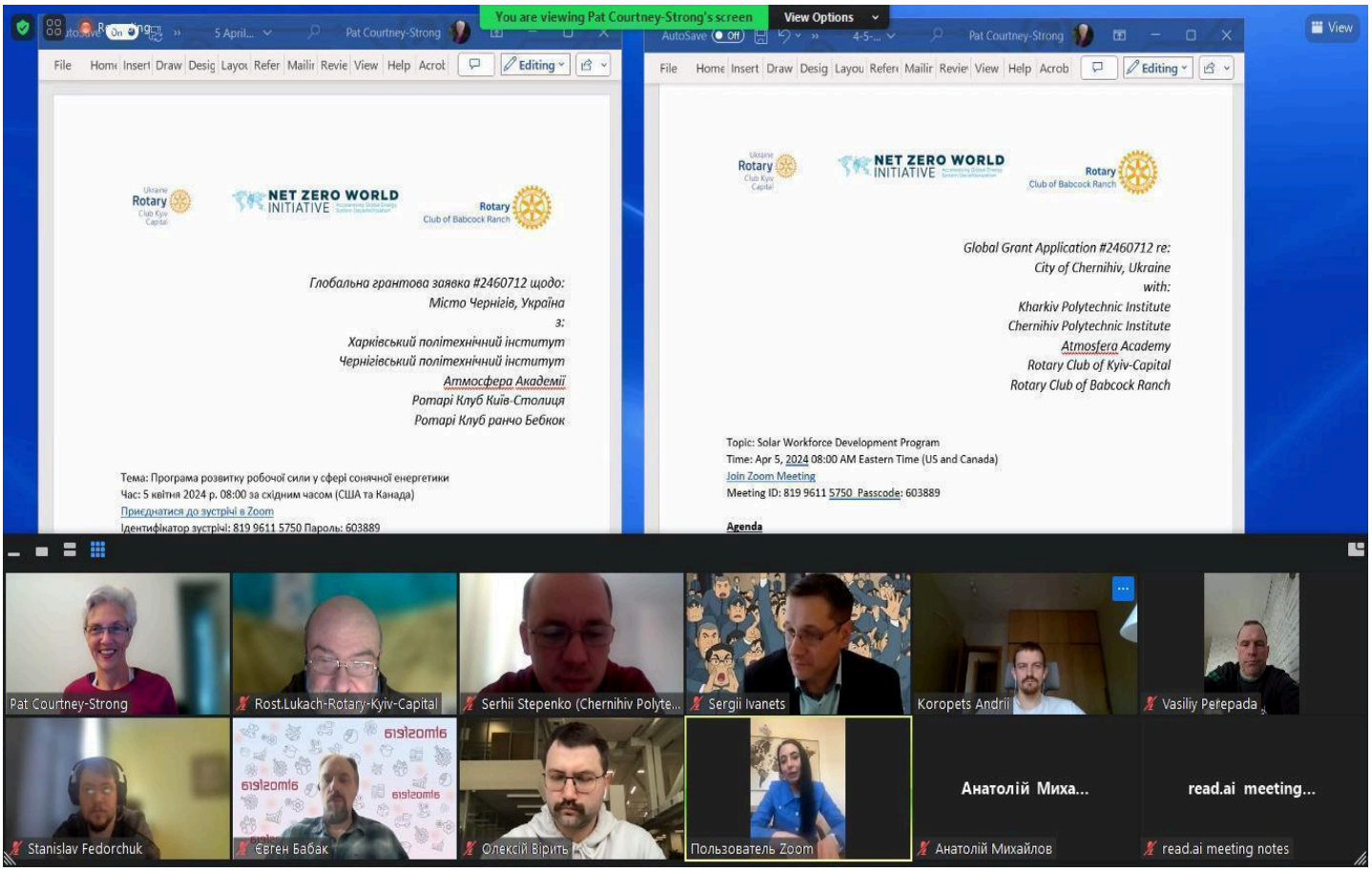
City’s Tender (Bid) Process
Once the analysis is complete, the City will issue a Request for Proposals, informed by templates such as those used by the U.S. Department of Energy to assist municipalities in purchasing solar systems. NREL’s Ukraine Group identified more than a dozen Ukraine solar energy companies to whom the RFP could be directed. The review committee will be composed of our solar experts plus a similar group in Ukraine who can provide assurances that they have no involvement with the bidding parties. Our team members who are qualified to review bids include:

Mark Wilkerson
Jay Warmke
Rich Stromberg
Jessica Barry

The RFP will ask for proposals for solar installations. The RFP will also include a request for pricing on a BESS so that these critical facilities can function through a microgrid in the event of a power outage, and remain operational for a minimum of 48 hours. The final configurations in the solicitations will be informed by analyses and consultations with experts and local stakeholders.

The RFP also will ask proposers to detail their plans to support the workforce development program that will be developed by a consortium of Ukrainian polytechnic institutes under this funding proposal.
Any trainees who are invited to observe or participate in the solar installations will be supervised by the installer's safety-certified team members, will be required to use appropriate Personal Protection Equipment (PPE) and must be covered under the insurance policy of either their university or employer.

Design of the Solar Workforce Development Program
The program will be jointly run by a Ukrainian polytechnic institute and a Ukrainian solar industry partner. Administration will be primarily handled by the institute, and the industry partner will supply curriculum, instructors, and when appropriate, venues. Below: a recent bilingual meeting of the polytechnic institutes of Kharkiv and Chernihiv with Rotary Clubs of Kyiv and Babcock Ranch along with solar industry representatives.



Leaders from City of Chernihiv, Chernihiv and Kharkiv Polytechnic institutes and solar company Atmosfera discuss with Rotary Club the creation of a workforce development program focused on veterans.

NOTE: While the solar installation RFP will go to a wide group of solar companies, we note that the polytechnic institutes have specialized knowledge and standing in the Ukraine academic community. Thus they are the presumptive workforce development grantees, and as such will be required to submit a full Scope of Work. Kharkiv Polytechnic Institute is the presumptive lead institution because of their previous experience with building academic consortia and their solar energy experience. Chernihiv Polytechnic also is eager to participate and will function as a subcontractor to Kharkiv Polytechnic Institute.

We have attached Memoranda of Understanding that include the City of Chernihiv, Kharkiv Polytechnic Institute, Chernihiv Polytechnic Institute, Atmosfera Academy and the Kyiv-Capital Rotary Club. Kharkiv will be charged with recruiting and coordinating additional polytechnic institutions, as appropriate.

Below is the preliminary plan.

The target audiences from which to draw students will be municipal building managers, veterans and IDPs. Here is the approximate timeline we are using and the steps to the program setup.

1. **October, 2023-April, 2024 -** Research was conducted among universities, the Ukraine solar industry, and the City of Chernihiv to determine the stakeholders' views and wishes.

2. **March 20, 2024** - An informal Rotary International Global Grants review was conducted March 20, 2024, at which time the Ukraine Grants Officer gave a preliminary, non-binding **positive** review.
3. **Spring 2024** - The Global Grant application will be submitted, pending required signatures by Rotary Club leadership in Florida and Kyiv.
    a. Rotary International will formally review the Global Grant and issue a decision (8 weeks)
4. **Summer/Fall 2024** - If approved, the polytechnic institutes will prepare their Scope of Work.
    a. The providers will be an industry organization paired with one of Ukraine's renowned polytechnic institutions, to ensure that the curriculum is "industry driven" and a wide audience is reached.
        i. "Wide audience" includes entry-level learners, university students, and specialized groups such as municipal building maintenance workers and IDPs.
        ii. The industry/academic team will be chosen based on the strength of their written plan to collaborate.
    b. The academic and industry providers will sign a Memorandum of Understanding or Letter of Intent outlining their roles and responsibilities.
    c. The polytechnic institute will provide the following services:
        i. **Analysis**: A brief analysis of existing solar education curriculum (in UA, EU and US), to identify best offerings for the target audiences.
        ii. **Logistics**: classroom locations, scheduling, and any needed alignment of this program with related studies at the institute
        iii. **Recruitment** of students through social media and other marketing channels
        iv. **Recruitmen**t as appropriate, of additional polytechnic institutes, which will be paid as subcontractors.
        v. **Exam** preparation and proctoring
        vi. **Certificate Issuance**
        vii. **Payment** of instructors and venues (if applicable)

    d. The solar industry organization will provide the following services:
        i. **Curriculum:** Instructors will share its proprietary curriculum with relevant university department administrators and instructors, retaining ownership of that material.
        ii. **Analysis:** Industry instructors will analyze existing curriculum offerings (UA, EU, US), to determine which are the best offerings.
        iii. **Industry instructors** will provide classes at polytechnic institutes and at industry locations, as decided collaboratively by the industry and academic partners.
        iv. **Certificates:** Industry will work with polytechnic institutes to combine their certifications, if need be, or jointly issue them.

5. **Fall/Winter 2024** - The provider will develop a set of certificate-granting courses based on Ukrainian and international safety and technical standards.
    a. The curriculum developers will investigate whether it is economically and technically feasible to blend NABCEP (North American Board of Certified Energy Practitioners), the U.S. industry gold standard for solar education, with training specific to the Ukrainian market.
    b. One benefit of NABCEP, which is taught in more than 90 countries, is that it sends a message to future global investors that Ukrainian solar projects meet and exceed international safety and quality standards.

6. The providers will submit monthly invoices to the Rotary Club of Kyiv-Capital for jointly delivering training at the institutes and other sites (e.g. in municipal meeting rooms, community centers, etc.) as warranted by enrollee demographics.

7. **Winter 2025** - Measurement and Evaluation will commence. The training budget will include a sum equal to or less than 10% funding for a third party program evaluator, who will be charged with making recommendations as to needed program updates and improvements.

    a. A "succession plan" will be developed by the providers that outlines how they will continue to fund the training program after Rotary funding has ended.

PHASE 2

SOLAR INSTALLATION ON HOSPITAL + EXPANSION OF SOLAR WORKFORCE DEVELOPMENT PROGRAM TO POLTAVA POLYTECHNIC INSTITUTE

During the first months of the full-scale war against Ukraine, 143 children were born in Chernihiv maternity hospital. Some of them had to be delivered in a bomb shelter.
© European Union, 2023 (photographer: Oleksandr Ratushnyak)

Maternity Hospital KNP
Estimated cost of solar installation: $200,000. Estimated timeframe: Q4 2025

KNP Maternity House began to operate in 1963. The main building was built in 1984. In 2019, energy-efficient renovations were implemented.
In 2022, during the early months of the war, the facility suffered damage to the first floor. The work to fix the destruction has been completed.

With nearly 400 employees, the Maternity Hospital is a medical institution of the highest accreditation category. It provides qualified obstetric and gynecological care to pregnant women, women in labor, and newborns in the city of Chernihiv and in the region. The maternity hospital has 210 beds. Of them, 100 are obstetric and 50 are pathology, 60 are gynecological (including 15 beds for pediatric and adolescent gynecology). In 2022-2023, the total number of visitors to the facility exceeded 30,000 users from the city of Chernihiv and the regions of the region.

The maternity hospital provides:
• Primary resuscitation of newborns;
• Support for the expanded initiative, "The hospital is friendly to the child"
• Training of ultrasound doctors on issues of prenatal diagnosis
• Family planning and sexual education of teenagers.
• Premarital counseling.
• School for responsible parenting.
• Prevention of HIV transmission
• Latest perinatal technologies

- Involvement of the family before the birth of the child
- Individual delivery rooms
- Mother and child staying together
- Family planning after childbirth
- Consulting on healthy lifestyle issues

Gasoline and diesel electric generators have been used as an alternative source of energy during periods of attack and grid instability. Using a pollution-causing power source, which also poses a fire hazard, in a place of healing is an unsatisfactory situation that requires correction as soon as possible.

The electric power required for the satisfactory operation of the maternity facility is 150 kW.
The minimum required power to ensure the operation of the facility at a critical level is 50 kW.
Critical electrical equipment requiring electricity includes: operating room equipment, incubators, X-ray equipment, surgical knives, breathing apparatus, including ventilators, sterilizers, ultrasound machines, laboratory equipment, refrigeration equipment for blood and plasma preservation, etc. Also, the ventilation, heating and lighting systems require electricity.

Solar Workforce Development Program Expansion at Poltava Polytechnic Institute

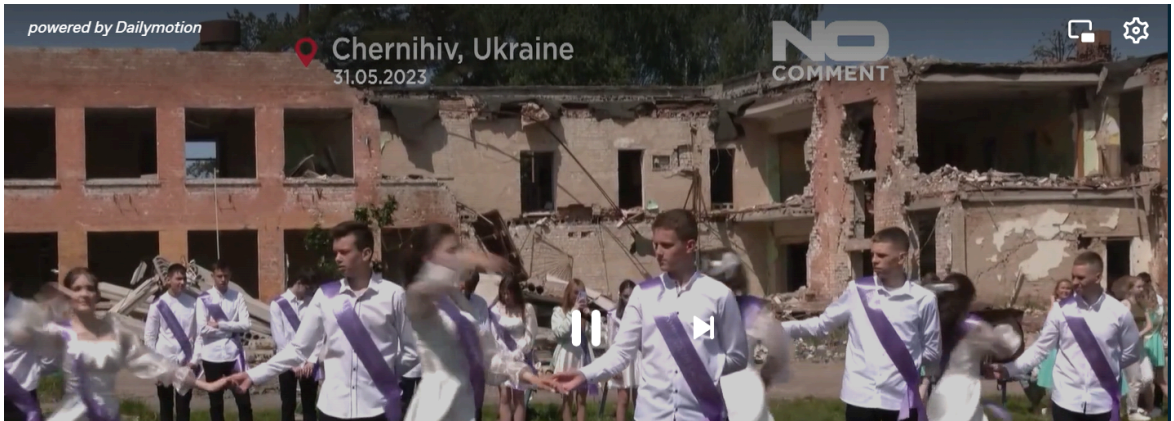
Estimated workforce development program expansion to Poltava Polytechnic cost: $100,000
Poltava Polytechnic Institute is part of National University Yuri Kondratyuk.

The Polytechnic institutes have a track record of working together across the nation to share policy and curriculum and this solar workforce development program will follow in that tradition. As with the workforce development program in Chernihiv and Kharkiv, the program will be jointly run by the polytechnic institute and a solar industry partner such as Atmosfera or EcoClub (participation by both companies is also possible). Administration will be primarily handled by the institute, and the industry partner will supply curriculum, instructors, and when appropriate, venues. Poltava will function as a subcontractor to Kharkiv Polytechnic.

As previously noted, although the solar installation RFP will go to a wide group of solar companies, the polytechnic institutes have specialized knowledge and elevated standing in the Ukraine academic community. Thus they are the presumptive grantees, and as such will be required to submit a Scope of Work. Kharkiv Polytechnic Institute is the presumptive lead institution because of their previous experience with building academic consortiums and their solar energy experience.

PHASE 3

SOLAR INSTALLATION ON CHERNIHIV SCHOOLS #11 and #4 + FURTHER EXPANSION OF SOLAR WORKFORCE DEVELOPMENT PROGRAM TO CHERNIVTSI POLYTECHNIC INSTITUTE



Students dance on the site of their former school in Chernihiv.

Estimated solar installation cost: $250,000. Estimated timeframe: Q1 2026
The schools selected for solar installations are located at:
Kindergarten #4, 134 Pukhova Street, 2 stories
Secondary School #11, 137 Myr Avenue, 3 stories

Estimated workforce development program expansion to Chernivitsi Polytechnic cost: $100,000
Chernivtsi Polytechnic Institute is part of Yuriy Fedkovych National University (https://www.chnu.edu.ua/en/)

Chernivtsi is in Western Ukraine and has an active Rotary Club headed by George Zvirid (which is part of an active Rotary ICC club) that is eager to work with our team. The Polytechnic universities have a track record of working together to share ideas and curriculum and this solar workforce development program will follow in that tradition. Chernivtsi will function as a subcontractor to Kharkiv Polytechnic. More details will be provided as we move into later phases of this project.

SUMMARY

High-Level Budget Estimates as of April 6, 2024:
Solar on 4 municipal buildings: $1.0M
Solar Workforce Development Program at 4 Polytechnic Institutes for 100 veterans: $315,000

The Rotary Clubs of Kyiv-Capital and Babcock Ranch wish to thank Chernihiv City Councilwoman Nataliia Kholchenkova and the medical teams at Chernihiv City Hospital No. 2 and the Chernihiv Maternity Hospital for their invaluable written contributions to this report.