REQUEST FOR PROPOSALS

Installation of three solar power plants (SPP) in Mykolaiv city

Country: Ukraine

Selection of a PIU Support Consultant for the MFA-DK funded Project "Installation of three solar power plants (SPP) in Mykolaiv city"

Client: NEFCO

May 2025

Section 1 – Letter of Invitation

Helsinki, 27 May 2025

Dear Sir/Madam,

Funds of up to EUR 250,000 are expected to be allocated from the Ministry of Foreign Affairs of Denmark for consulting services under the Project "Installation of three solar power plants (SPP) in Mykolaiv city" ("Project"). The Project is coordinated and monitored by the Nordic Environmental Finance Corporation ("NEFCO"). This amount includes a 10% provision for contingencies, which shall be reserved in the budget of the Assignment.

The Project is aimed to provide financing to the city of Mykolaiv in Ukraine for rehabilitation of district heating infrastructure.

NEFCO now invites proposals to provide the following consulting services: **Project Implementation ("PIU") support for the Project "Installation of three solar power plants (SPP) in Mykolaiv city"**. The details of the required services are provided in the attached Terms of Reference (**"ToR"**).

Nefco intends to sign a contract with awarded consultant for PIU support (hereinafter - "**the Consultant**") as soon as tender evaluation and contracts negotiations are completed.

By submitting the proposal, the Consultant agrees to provide services for within the Project.

This Request for Proposals ("RfP") has been published on Nefco's webpage.

Indication of Interest

Please inform NEFCO by e-mail to: *procurement@nefco.int* with a copy to *bo.nyhus@nefco.int* and *iryna.fedorenko@nefco.int* no later than **6 June 2025** if you intend to submit a proposal.

Any questions on the Terms of Reference or the other documentation in the RfP shall be provided in writing to NEFCO by e-mail: *procurement@nefco.int* with a copy to *bo.nyhus@nefco.int* and *iryna.fedorenko@nefco.int* no later than **13 June 2025** after which all questions will be compiled by NEFCO without any editing in the form they are sent to NEFCO. Answers to the questions are submitted by e-mail to all Consultants that have confirmed their intent to prepare a proposal.

Submission of Proposals

Proposals must be submitted to NEFCO no later than at **12:00 hrs local time in Helsinki on 11 July 2025** (submission date). You are recommended not to wait till last minute with submission, since the deadline is 100% strict and relates to NEFCO's reception of the proposal, which may occur several minutes after your submission to the system. One minute late is too late. NEFCO may at its discretion extend the deadline for submission of proposals. Belated proposals will be rejected and returned unopened.

The proposal shall be divided into two parts: a technical proposal and a financial proposal.

The requirements for the proposals are described in detail in Section 2 – Instructions to Consultants. The attached standard forms are to be used for the purpose.

Proposals shall be submitted in English and must remain valid for 90 days. Consultants willing to prepare and submit a proposal are responsible for all associated costs.

The proposal shall be submitted to NEFCO using secure encrypted e-mails, in two separate emails:

Email A: Technical Proposal

The Technical Proposal shall be sent to NEFCO to email address *procurement@nefco.int* by using this link *https://www.securedmail.eu/message/procurement@nefco.int*. Please indicate as title in the subject field: **"Installation of three solar power plants (SPP) in Mykolaiv city. Technical Proposal"**. In the message field please indicate at least the sender's name and company.

For further information, please see the enclosed document in Annex 3.

Email B: Financial Proposal

The Financial Proposal shall be sent to NEFCO to email address *nelly.eriksson@nefco.int* by using this link *https://www.securedmail.eu/message/nelly.eriksson@nefco.int*. Please indicate as title in the subject field: **"Installation of three solar power plants (SPP) in Mykolaiv city. Financial Proposal"**. In the message field please indicate at least the sender's name and company.

For further information, please see the enclosed document in Annex 3.

In case there are problems with the securedmail system, please contact *procurement@nefco.int* or *nelly.eriksson@nefco.int* for further assistance.

A Consultant will be selected under quality and cost-based selection method and procedures described in this RfP, in accordance with NEFCO's Procurement Policy and Procedures available at *www.nefco.int* under Procurement.

This RfP includes the following documents:

Section 1 - Letter of Invitation
Section 2 - Instructions to Consultants
Section 3 - Technical Proposal - Standard Forms
Section 4 - Financial Proposal - Standard Forms

Annex 1: General Conditions of Contract for Consultant's Services
Annex 2: Terms of Reference
Annex 3: Securedmail manuals

Yours sincerely,

Ulf Bojö
Vice President
Nordic Environment Finance Corporation

Bo Nyhus
Investment Director
Nordic Environment Finance Corporation

Section 2 – Instructions to Consultants

1. Rules concerning nationality of consultants

The funds used for this consultancy assignment are made available from the Ministry of Foreign Affairs of Denmark through NEFCO. According to the terms and conditions on the operation of the potential funds, there are no limitations on the nationality of the firm or the subconsultants.

2. Preparation and Submission of Proposals

2.1. Consultants submitting proposals are expected to examine carefully and respect all instructions, forms, General Terms and Conditions, Terms of Reference and specifications contained in this Request for Proposals. Failure to submit a proposal containing all the required information and documentation within the deadline specified in the Letter of Invitation may result in rejection of the proposal. The standard forms in Sections 3 and 4 of this Request for Proposals shall be used as applicable.

2.2. Consultants shall submit technical and financial proposals in separate emails marked **"Technical Proposal"** and **"Financial Proposal"**, as appropriate. No financial data of any sort shall be included in the technical proposal. Only emails containing technical proposals shall be opened at the time of submission of proposals. The financial proposals will be kept unopened and in safe custody until the technical evaluation is completed.

2.3. **Technical Proposal** (not exceeding 10 pages, excluding curricula vitae (CVs). CVs maximum 3 pages each). If documents are longer only the first 10 and 2 pages respectively will be considered. Font size minimum 11 for both Technical Proposal and CV).

(a) Consultant's technical proposal shall demonstrate the firm's knowledge of the requirements of the assignment and its understanding of the requisite tasks set forth in the scope of work of the Terms of Reference. Information must be provided about the firm and, in the case of a joint venture (JV) or any other form of association, about all member-firms associated with the assignment. Provision of the requested information, in full, must be presented as follows: A brief description of the firm, an outline of the firm's recent experience of assignments of a similar nature and specifically the firm's previous work, especially in the project country. Information on the current workload of the firm in the relevant areas of this assignment shall also be presented.

(b) Comments or suggestions, if any, on the Terms of Reference designed to improve performance in carrying out the assignment.

(c) Comments and elaborations on general approach and methodology.

(d) Composition of the team which the firm proposes to provide in the field and in the home office, together with CV of each individual team member and the specific task(s) to which each team member would be assigned. The team leader and the key experts listed in the evaluation criteria table (section 3.6 of the Instructions to Consultants) shall be specifically identified. Members of the team shall have requisite experience outside their own country, preferably under conditions similar to those prevailing in the project country. A good working knowledge of English is essential for the staff. Proficiency in Ukrainian or Russian is an additional merit. The language conditions for the assignment are stated in the Terms of Reference. If the firm proposes to have a member of the consultant's home office responsible for the supervision of the team in the field, similar details shall be given with the CV of that member.

(e) Work programme including a bar chart and a staffing schedule. The bar chart shall indicate estimates of the duration and total staff-weeks that would be provided for each task. The staffing schedule shall indicate clearly the estimated duration (in both the home office and in the field)[1] and the probable timing of the assignment of each professional (both foreign and local).

(f) The Consultant shall demonstrate that they have access to office space, a vehicle, necessary equipment, local counterpart support, and other relevant resources, required in the field for carrying out the proposed services.

2.4. **Financial Proposal**

(a) The firm's financial proposal shall be denominated in EUR. The costs shown shall include a detailed breakdown of *(i) remuneration* for the number of weeks of each team member to be assigned and the related unit rates, *(ii) direct expenses* in respect of subsistence costs and housing allowances, *(iii) all other reimbursable expenses*, *(iv) 10% of total financial proposal shall be reserved as contingency.*

(b) Financial proposals as submitted by the firm will be considered in the evaluation and selection of consultants. However, each element of the financial proposal of the selected firm will be reviewed during contract negotiations for determining the final contract price.

(c) **Audit.** NEFCO retains the right to audit, both during and after the assignment, the selected firm's accounts and time and cost records relevant to the services provided, including such accounts and records as will enable verification of the costs related to the assignment.

(d) **Funds.** The amount of funds allocated for this assignment is stated in the Letter of Invitation, exclusive of VAT. The financial proposal shall cover all foreign and local costs of services for this assignment including costs of staff in the field and in the home office. The financial proposal shall be based on a minimum of home office contribution during the assignment. It shall also cover international travel (economy class or equivalent), preparation of final reports, equipment, insurance, office supplies, subsistence, local transport, facilities, equipment, and all related expenses. The consultant shall be responsible for all direct and indirect tax liabilities (if any) arising out of or connected to the performance of the services wherever they arise.

The rates and prices shall be fixed for the duration of the assignment, and no currency fluctuation or other adjustments will be made.

(e) **Contract.** A lump-sum contract will be concluded for the assignment. The payment milestones for the lump-sum contract are defined under section 3.9 below.

3. Evaluation of Proposals

3.1. Evaluation of the proposals will be carried out by an evaluation committee appointed by NEFCO.

3.2. A two-stage procedure is adopted for evaluating the proposals. The technical proposals will be evaluated first and merit points awarded, and the proposals ranked in order of their respective merit points, prior to the

[1] **Home Office**: Tasks and activities performed at the Consultant's main office.
Field: On-site activities carried out at the project location.

opening and evaluation of financial proposals. Quality of the technical proposal, particularly that of the staff proposed, shall be the principal criterion for evaluation of proposals and selection of consultants.

3.3. ***Technical proposals*** shall be evaluated and merit points awarded based on the following factors:

(a) The firm's experience in the disciplines forming part of the total assignment, with the resent (last 12 years) specific reference to experience in the countries of Eastern Europe and/or Central Asia that are at institutional transformations stage. Experience working in the conflict-affected countries will be considered as an advantage.

(b) The approach to the assignment, the suggested work programme and organisation and composition of the proposed team of experts, plus comments, if any, on the methodology in response to the Terms of Reference; and

(c) The qualifications, experience and competence of the experts proposed for the assignment.

See further the scoring table below. All evaluations will be made relating to the Required Qualifications in the Terms of Reference.

3.4. A technical proposal may be treated as non-responsive if information with respect to any of the factors (a), (b) or (c) as requested above in section 3.3 is omitted. The workload of the experts in other ongoing assignments and their availability to undertake the assignment in case of an award, will be examined after the preliminary winner has been determined. If the conclusion of such examination is that an expert evaluated is not likely to have the availability indicated in the proposal, a reassessment of the scoring will be made, with possible influence on the ranking of firm..

Only firms (i) awarded a minimum of 70 technical proposal merit points and (ii) having technical merit points within 15 points of the highest technical score will be considered for the second stage (financial evaluation). If no firm scores the required minimum of technical points, NEFCO reserves the right to negotiate with the firm scoring the highest technical points, or to reject all proposals.

3.5. A firm will be excluded from the evaluation if, at the discretion of NEFCO, the firm has been, or might be placed, in a conflict of interest position in the procurement process or the performance of the contract. Firms, which believe such a situation may exist, shall seek guidance from NEFCO prior to preparing the technical proposal.

3.6. The specific evaluation criteria are listed below:

	PRINCIPAL FACTORS IN EVALUATION	**Maximum points**
1	**Experience of Consulting firm**	
	a) Demonstrated experience in at least two (2) completed contracts in project preparations, management, design, procurement, and supervision of municipal projects funded by international organisations (IFI), during the last twelve (12) years in the countries of Eastern Europe and/or Central Asia that are at the institutional transformations stage. Experience working in the conflict-affected countries will be considered as an advantage.	10
	b) Demonstrate one (1) experience from similar PIU assignments in municipal sector projects: design, construction and operation of solar power plants, during the last twelve (12) years.	10

	PRINCIPAL FACTORS IN EVALUATION	Maximum points
	Subtotal 1	**20**
2	**Approach and Methodology**	
	a) The proposed methodology should clearly demonstrate an understanding of the assignment and the issues to be addressed, present a comprehensive approach to delivering the scope of work and tasks outlined in the Terms of Reference, and highlight alignment of those methodologies with the overall proposed approach.	5
	b) Suggested work programme hall be consistent with the overall approach and methodology, aligned with the deliverables schedule, and demonstrate logically phased activities, timelines, milestones, and report delivery dates.	5
	c) Proposed Staffing plans shall adequately outline clear responsibilities among different staff positions, coordination between team leader and other Professional and Support staff members.	5
	Subtotal 2	**15**
3	**Qualifications and competence of key experts**[1)]	
	1) Team Leader ▪ Master's degree in engineering, municipal infrastructure, economics, or a related field. ▪ At least 10 years of professional experience in relevant sectors. ▪ Minimum 7 years of experience in projects financed by international organisations, including both preparation and implementation. ▪ At least 5 years of experience managing public infrastructure projects of comparable scale as a Team Leader. ▪ Proven experience in managing at least one internationally funded project, with demonstrated responsibility for project planning, organisation, and team leadership. ▪ Proficiency in internationally accepted procurement rules and procedures. ▪ Proven excellence in written and verbal communication in English, demonstrated through education, international project experience, or roles in English-speaking environments. Working knowledge of Ukrainian and/or Russian is an asset.	10
	2) Deputy Team Leader, Project Coordinator ▪ Master's degree in engineering, municipal infrastructure, economics, or a related field. ▪ At least 7 years of professional experience in relevant sectors. ▪ Minimum 5 years of experience in contract administration for infrastructure projects in Ukraine, including those financed by IFIs.	9

	PRINCIPAL FACTORS IN EVALUATION	Maximum points
	▪ At least one completed assignment demonstrating applied knowledge of project cycle management in an IFI-funded project, with experience in applying Ukrainian contracting rules in infrastructure implementation, and involvement in financial management, administration, reporting, and stakeholder communication. Coordination experience in IFI and/or NEFCO-financed projects is an asset. ▪ Proven written and verbal communication skills in English, demonstrated through education, international project experience, or roles in English-speaking environments. Fluency in Ukrainian and/or Russian is essential.	
	3) Solar power plant experts (international/local) (2 experts) ▪ Master's degree in engineering, preferably in power production. ▪ Minimum seven (7) years of professional experience in relevant fields. ▪ Minimum five (5) years of experience in implementing solar power plant (SPP) projects of similar nature and scope. ▪ Minimum 3 years of experience in preparation, design, optimisation, evaluation, and monitoring of solar power plant (SPP) projects in Ukraine, with proven knowledge of Ukrainian and international standards and best practices for off-grid and grid-connected SPPs with demonstrated experience in drafting technical specifications, design documents, and Employer's Requirements, as well as familiarity with internationally accepted procurement procedures. ▪ Proven written and verbal communication skills in English, demonstrated through education, international project experience, or roles in English-speaking environments. Fluency in Ukrainian and/or Russian is essential. ▪ Proven written and verbal communication skills in English (for international experts) and Ukrainian (for local experts), demonstrated through education, professional roles requiring regular communication in the respective language, authorship of reports or publications, participation in international projects, or relevant language certifications.	10
	4) Electric engineer ▪ Master's degree in civil engineering (power generation/distribution), municipal infrastructure, or a related field. ▪ Minimum seven (7) years of professional experience in relevant fields. ▪ Minimum five (5) years of experience in implementing water and wastewater infrastructure projects of similar nature and scope. ▪ At least five (5) years of experience working on projects funded by international financial institutions (IFIs). ▪ Minimum 5 years of experience in the preparation, design, optimisation, evaluation, and monitoring of water/wastewater systems in Ukraine, with proven knowledge of Ukrainian and international standards for power supply systems. Demonstrated ability to draft technical specifications, design documents, and Employer's Requirements, and familiarity with internationally accepted procurement procedures.	6

	PRINCIPAL FACTORS IN EVALUATION	Maximum points
	▪ Proven written and verbal communication skills in Ukrainian and/or Russian, demonstrated through education, project roles, reporting responsibilities, or authorship of technical documentation.	
	5) Technical supervision engineers (2 engineers) ▪ Master's degree in engineering, municipal infrastructure, or a related field. ▪ Minimum seven (7) years of professional experience. ▪ At least five (5) years of experience in construction supervision of infrastructure projects. ▪ Minimum three (3) years of experience in projects funded by international organisations. ▪ Demonstrated experience in at least three (3) assignments involving project cycle management and construction supervision funded by Multilateral Development Banks and/or other international organizations. ▪ Proven knowledge of internationally accepted procurement rules and procedures. ▪ Proven written and verbal communication skills in English, demonstrated through education, project roles, reporting responsibilities, or authorship of technical documentation (advantageous). ▪ Proven at least one (1) experience in the field of sustainable energy is considered an asset. ▪ Possession of a valid Ukrainian technical supervision qualification certificate authorising the expert to supervise construction works; reference must be included in the CV and a copy of the certificate attached.	6
	6) Procurement expert ▪ Master's degree in Law, Public Administration, Economics, Engineering, or a related field. ▪ Minimum seven (7) years of professional experience in procurement, including at least five (5) years in projects financed by international financial institutions (e.g., World Bank, EBRD, EIB, NEFCO).; ▪ Proven at least five (5) experiences in conducting procurement processes for all categories of complex procurements in accordance with IFI procedures, including preparation of tender documents, bid evaluation reports, and contract administration and/or management. ▪ Demonstrated in-depth knowledge of Ukrainian procurement laws and regulations, with demonstrated at least (1) experience applying them in public sector infrastructure projects. ▪ Strong written and verbal communication skills in Ukrainian and English is required, demonstrated through professional roles, documentation, participation in international projects or education	7
	7) Financial and Disbursement expert	5

	PRINCIPAL FACTORS IN EVALUATION	Maximum points
	▪ Master's degree in finance, economics, or a related field; in the absence of a Master's degree, at least five (5) years of relevant professional experience. ▪ Minimum five (5) years of experience in financial management, accounting, or economic analysis. ▪ At least three (3) years of experience working with the financing rules and disbursement procedures of International Financial Institutions (loans and grants), and with municipal financial budgeting and reporting systems in Ukraine. ▪ Demonstrated knowledge and understanding of IFI financial procedures and relevant Ukrainian municipal financial regulations and reporting standards. ▪ Strong written and verbal communication skills in both Ukrainian and English, as demonstrated through previous roles, documentation, reporting responsibilities or education.	
	8) Legal expert ▪ Master's degree in Law, Economics, or a related field; or, in the absence of a Master's degree, a minimum of five (5) years of relevant professional experience. ▪ At least five (5) years of experience in legal practice, with a focus on municipal sector activities and public institutions. ▪ Minimum three (3) years of experience working with legal frameworks and procedures of International Financial Institutions (loans and grants), as well as municipal legal regulations and compliance procedures in Ukraine. ▪ Proven knowledge of municipal law, public sector legal procedures in Ukraine, and understanding of IFI requirements related to legal compliance. ▪ Strong written and verbal communication skills in both Ukrainian and English, demonstrated through legal drafting, official correspondence, or professional roles involving interaction with authorities or international stakeholders.	5
	9) Environmental and Social expert (international/local) ▪ Master's degree in environmental science, environmental management, or a related field. ▪ Minimum seven (7) years of professional experience in environmental and social assessments, studies, or monitoring. ▪ At least five (5) years of experience in implementing environmental and social assignments in infrastructure projects of similar nature and scope. ▪ Minimum three (3) years of experience in monitoring compliance with environmental and safety regulations during the construction or reconstruction of municipal facilities. ▪ Proven knowledge of Ukrainian and EU environmental, social, health, and safety legislation, regulations, and standards relevant to buildings and water infrastructure. ▪ At least three (3) years of experience working on projects financed by International Financial Institutions (e.g., EIB, EBRD, World Bank).	5

	PRINCIPAL FACTORS IN EVALUATION	Maximum points
	▪ Strong written and verbal communication skills in both Ukrainian and English, demonstrated through reporting, stakeholder engagement, or international project roles.	
	10) Communication expert ▪ Bachelor's Degree in Communications, Public Relations, Journalism, or a related field. ▪ Minimum five (5) years of work experience in communication activities, public awareness, or media engagement, including at least three (3) years of relevant experience within Ukraine or Ukrainian organisations. ▪ Demonstrated experience in content creation, social media management, and public relations, particularly in contexts related to public or development projects. ▪ Experience working with public sector institutions in Ukraine and familiarity with procedures or collaboration involving International Financial Institutions (IFIs), Multilateral Financial Institutions (MFIs), or international organisations. ▪ Strong written and verbal communication skills in English, with fluency in Ukrainian essential for stakeholder engagement and public communication.	2
	Sub-total 3	**65**
	TOTAL	**100**

[1)] For those positions where the ToR indicates the need for more than one key expert for each position, Nefco reserves the right to base the evaluation on the number of experts deemed relevant.

3.7. **The financial proposals** will be opened and evaluated only after the technical evaluation has been completed and merit points awarded to each proposal. The financial proposals emails of only those firms that have qualified for the second stage of the evaluation in accordance with section 3.4 above will be opened for financial evaluation. The financial proposals of the remaining firms will remain unopened.

3.8. **Correction of Errors**. Activities and items described in the technical proposal but not priced in the financial proposal shall be assumed to be included in the prices of other activities or items, and no corrections are made to the financial proposal.

3.9. **Lump-sum contract.** Lump-sum contract. The consultant is deemed to have included all prices in the financial proposal, so neither arithmetical corrections nor price adjustments will be made. The total price, net of VAT, specified in the financial proposal (Form FIN-1) will be considered as the offered price.

3.10. The financial proposal representing the lowest evaluated price will be given the score 100; others are rated as follows:

Financial score of firm A = lowest evaluated price / price of firm A x 100;

If the financial proposal exceeds the indicated available funds it may be rejected at the discretion of NEFCO. Financial proposals including cost components in other currencies than EUR shall be converted to EUR according to the exchange rates published by the European Central Bank on the submission date of the proposal.

3.11. In the final evaluation combining the adjusted technical and financial scores, the adjusted technical merit score will be given a weight of **80 percent** and the financial score shall be given a weight of **20 percent**. The firm with the highest evaluated weighted score will be invited to contract negotiations.

4. Contract Negotiations and Award

4.1. NEFCO reserves the right to reject all proposals.

4.2. The consultancy services are expected to commence no later than within 14 days after the conclusion of the consultancy agreement. Contract negotiations will be carried out by representatives of NEFCO.

4.3. The costs of preparing a proposal and of negotiating and concluding a contract including the costs of travel to participate in possible pre-proposal meeting are not reimbursable as costs of the assignment.

4.4. NEFCO expects to conclude a contract on the basis of the experts named in the proposal and will require, in the contract negotiations, assurances that these experts can, in fact, be made available. NEFCO will, at its sole discretion, consider substitutions only in case the commencement of the assignment would otherwise be delayed, for reasons unrelated to selected consultant, or, exceptionally, because of incapacity of an expert for reasons of health. The desire of a firm to use an expert on another project will not be accepted as a reason for substitution of staff and may result in the rejection of the firm in question.

4.5. The firm (or the leading consultant, if there are several partners) that submitted the first-ranked proposal will be invited to discuss technical and financial details of the proposal and the terms of the contract without delay. Discussions will commence with a review of the technical proposal, the proposed approach and work plan, staffing and any suggestions the consultant may have made to improve the Terms of Reference. Agreements will be reached, first, on the final Terms of Reference, work plan, time schedule, the staff to be employed, their periods of work in the field and in the home office, frequency and timing of home travel, housing costs, budget to be allocated for the provision of office equipment, and next, on the facilities and services to be provided by local counterparts. Thereafter, financial negotiations will begin with discussions of the proposed fee rates for each team member, and of other costs as indicated by the consultants. In subsequent negotiations, the reasonableness of each item included in the Financial Proposal of the selected firm will be assessed. Consultants shall be prepared to disclose during negotiation data backing up the consultant fees and other costs and be aware and accept that the proposed rates and other costs will be subject to scrutiny and possible negotiation.

4.6. The representatives of the consulting firm invited for contract negotiations must be authorised (on behalf of all consultant partners) to discuss and agree on the technical and financial aspects of the proposal as well as the terms and conditions of contract and to conclude a binding agreement. Should the discussions with the first invited firm prove unproductive and/or unsatisfactory, the firm submitting the next-ranked proposal will be invited instead (and so on, if necessary, until an agreement is concluded). As soon as the contract is signed with the finally selected consulting firm (the "Consultant"), other short-listed firms will be informed accordingly.

4.7. Payments for PIU support services within **Project "Installation of three solar power plants (SPP) in Mykolaiv city"** will be made to the Consultant from the respective Technical Assistance budget. The Consultant will be paid only for work performed based on the payment schedule finalised at the contract negotiations. Payments will be made in 30 days after receiving the Consultant's invoice.

Section 3 – Technical Proposal

FORM TECH-1
TECHNICAL PROPOSAL SUBMISSION FORM

[*Location, Date*]

To: NEFCO

Dear Sirs,

We, the undersigned, offer to provide the consulting services for **PIU Support Consultant for the DSIF & NORAD funded Programme "Rehabilitation of wastewater services in four cities of Ukraine: Horishni Plavni, Lubny, Lutsk, Khmelnytskyi"** in accordance with your Request for Proposals dated [*insert date*] and our Proposal. We are hereby submitting our Proposal, which includes this Technical Proposal, and a Financial Proposal sent in a separate secured mail.

[We are submitting our Proposal in association with: [*insert a list with full name and address of each associated Consultant/member of Consortium*].]

We hereby declare that all the information and statements made in this Proposal are true and accept that any misinterpretation or misrepresentation contained in it may lead to our disqualification.

If negotiations are held during the period of validity of the Proposal as defined in the Letter of Invitation, we undertake to negotiate on the basis of the proposed staff. Our Proposal is binding upon us during this period, and subject to the modifications resulting from Contract negotiations.

We undertake, if our Proposal is accepted, to initiate the consulting services related to the assignment not later than the date indicated in Clause 4.2 of the Instructions to Consultants.

We understand that you are not bound to accept any proposal you receive.

We hereby accept the General Conditions of Contract for Consultant's Services attached as Annex 1 to your RfP.

Yours sincerely,

Authorized Signature [*In full and the original copy initialized*]:

Name and Title of Signatory:

Name of Firm:

Address:

FORM TECH-2
CONSULTANT'S ORGANISATION AND EXPERIENCE

A - Consultant's Organisation

Provide here a brief (max 2 pages) description of the background and organisation of your firm/entity [as well as of each subconsultant] for this assignment.

B - Consultant's Experience

Please provide information on each assignment, relevant for this assignment, for which your firm [and each joint venture/consortium or any other association partner/member was legally contracted either individually as a corporate entity or as one of the major companies within a consortium, for carrying out consulting services similar to the ones requested under this assignment (max 1 page per project and 5 pages in total) including information on contract value, contracting entity/client, project location/country, duration (months and years), expert months provided (if different from duration), main activities and objectives.

FORM TECH-3

COMMENTS AND SUGGESTIONS ON THE TERMS OF REFERENCE

A – Comments and Suggestions on the Terms of Reference

Present and justify here any modifications or improvement to the Terms of Reference you are proposing to improve performance in carrying out the assignment (such as deleting some activity you consider unnecessary, or adding another, or proposing a different phasing of the activities). Such suggestions shall be concise and to the point, and incorporated in your Proposal.

FORM TECH-4
DESCRIPTION OF APPROACH, METHODOLOGY AND WORK PLAN FOR PERFORMING THE ASSIGNMENT

Technical approach, methodology and work plan are key components of the Technical Proposal. You are suggested to present your Technical Proposal (max 8 pages, inclusive of charts and diagrams) divided into the following three chapters:

a) Technical Approach and Methodology,
b) Work Plan, and
c) Organisation and Staffing.

a) Technical Approach and Methodology. In this chapter you shall explain your understanding of the objectives of the assignment, approach to the services, methodology for carrying out the activities and obtaining the expected output, and the degree of detail of such output. You shall highlight the problems being addressed and their importance and explain the technical approach you would adopt to address them. You shall also explain the methodologies you propose to adopt and highlight the compatibility of those methodologies with the proposed approach.

b) Work Plan. In this chapter you shall propose the main activities of the assignment, their content and duration, phasing and interrelations, milestones, and delivery dates of the reports. The proposed work plan shall be consistent with the technical approach and methodology, showing understanding of the Terms of Reference and ability to translate them into feasible work plan. A list of the final documents, including reports, drawings, and tables to be delivered as final output, shall be included here. The work plan shall be consistent with the Work Schedule of Form TECH-8.

c) Organisation and Staffing. In this chapter you shall propose the structure and composition of your team (Professional (Foreign and Local) and Support). You shall list the main disciplines of the assignment, the key expert responsible, and proposed technical and support staff.

FORM TECH-5

TEAM COMPOSITION AND TASK ASSIGNMENTS

Professional staff				
Name of staff	**Firm**	**Area of Expertise**	**Position Assigned**	**Tasks Assigned**

Support staff[2]				
Name of staff	**Firm**	**Area of Expertise**	**Position Assigned**	**Tasks Assigned**

[2] Proposed Support staff are not subject of evaluation

FORM TECH-6

CURRICULUM VITAE (CV) FOR PROPOSED PROFESSIONAL STAFF[3]

CVs may be provided in any format you prefer, but shall as a minimum clarify the following issues for every member of the proposed professional staff:

1. Proposed Position [o*nly one candidate shall be nominated for each position*]:

2. Name of Firm [*insert name of firm proposing the staff*]:

3. Name of Staff:

4. Date of Birth:

5. Nationality:

6. Education:

7. Membership of Professional Associations:

8. Other Training:

9. Countries of Work Experience:

10. Languages [*for each language indicate proficiency: good, fair, or poor in speaking, reading, and writing*]:

11. Employment Record Relevant to the Assignment:

12. Adequacy for the Assignment: Detailed Tasks Assigned [*list all tasks to be performed under this assignment*] and Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks:

Expert's contact information: (e-mail ……., phone……)

Certification:

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes myself, my qualifications, and my experience, and I am available to undertake the assignment in case of an award. I understand that any misstatement or misrepresentation described herein may lead to my disqualification or dismissal by NEFCO, and/or sanctions by NEFCO.

{day/month/year}

Name of Expert | Signature | Date

{day/month/year}

Name of authorized Representative of the Consultant (the same who signs the Proposal) | Signature | Date

[3] CVs only Professional Staff requested by the ToR shall be provided. CVs shall be signed by the proposed candidate and authorised person.

FORM TECH-7

STAFFING SCHEDULE

For professional staff the input shall be indicated individually; for support staff it shall be indicated by category. **Weeks** are counted from the start of the assignment. Indicate home and field work separately - *field work means work carried out at a place other than in the home office.* The time format used in the schedule shall be explicitly calculated and provided in "**staff-weeks**".

No	Name of Staff	Staff input (in the form of a bar chart)														Total staff-week input		
		1	2	3	4	5	6	7	8	9	10	11	12	…	n	**Home**	**Field**	**Total**
PROFESSIONAL STAFF																		
Foreign																		
1		*(Home)*																
		(Field)																
2		*(Home)*																
		(Field)																
n		*(Home)*																
		(Field)																
										Subtotal for Foreigh								
Local																		
1		*(Home)*																
		(Field)																
2		*(Home)*																
		(Field)																
n		*(Home)*																
		(Field)																
										Subtotal for Local								
										Total for Professional Staff								

No	Name of Staff	Staff input (in the form of a bar chart)														Total staff-week input		
		1	2	3	4	5	6	7	8	9	10	11	12	…	n	**Home**	**Field**	**Total**
SUPPORT STAFF																		
Foreign																		
1		*(Home)*																
		(Field)																
2																		
n																		
									Subtotal for Foreign									
Local																		
1		*(Home)*																
		(Field)																
2																		
n																		
									Subtotal for Local									
									Total for Support Staff									
									Grand Total for Professional and Support Staff									

FORM TECH-8

WORK SCHEDULE

No.	**Activity**	**Weeks**												
		1	2	3	4	5	6	7	8	9	10	11	12	n
1														
2														
3														
4														
5														
n														

Indicate all main activities of the assignment, including delivery of report (e.g inception, interim, and final reports) and other relevant benchmarks. Duration of activities shall be indicated in the form of a bar chart and shall be aligned with the approach and methodology proposed.

FORM TECH-9

COVENANT OF INTEGRITY

to the Client - NEFCO
from a Consultant – [name]
to be attached to its tender
(or to the contract in the case of a negotiated procedure)

"We declare and covenant that neither we nor anyone, including any of our directors, employees, agents, joint venture partners or sub-contractors ("the **Parties**"), where these exist, acting on our behalf with due authority or with our knowledge or consent, or facilitated by us, has engaged, or will engage, in any Prohibited Practices (as defined below) in connection with the tendering process or in the execution or supply of any works, goods or services for [*specify the contract or tender invitation*] (the "**Contract**") and covenant to so inform you if any instance of any such Prohibited Practices shall come to the attention of any person in our organisation having responsibility for ensuring compliance with this Covenant.

We shall, for the duration of the tender process and, if we are successful in our tender, for the duration of the Contract, appoint and maintain in office an officer, to whom you shall have full and immediate access, having the duty, and the necessary powers, to ensure compliance with this Covenant.

If any of the Parties, where these exist and as applicable, (i) have been convicted in any court of any offence involving Prohibited Practices in connection with any tendering process or provision of works, goods or services during the five (5) years immediately preceding the date of this Covenant, or (ii) have been dismissed or resigned from any employment on the grounds of being implicated in any Prohibited Practices, or (iii) have been excluded from participation in a tendering procedure by Nordic Environment Finance Corporation (NEFCO) or by any national or EU Institutions or any international financial institution or other sanctions authority, which NEFCO deems relevant, or (iv) is under any investigation in relation to Prohibited Practice, we shall give details of any event in (i)-(iv) above together with details of the measures that we have taken, or shall take, to ensure that no Party will commit any Prohibited Practices in connection with the Contract [*give details if necessary*].

In the event that we are awarded the Contract, we grant the Purchaser/Client/Employer/NEFCO and auditors appointed by either of them, as well as any authority or body having competence under relevant legislation, the right of inspection of our records and those of all our sub-contractors under the Contract. We accept to preserve these records generally in accordance with applicable law but in any case for at least six (6) years from the date of performance of the Contract."

For the purpose of this Covenant, "Prohibited Practices" includes:

- **Abuse** meaning theft, misappropriation, waste or improper use of property or assets related to the Contract, either committed intentionally or through reckless disregard.
- **Coercion** meaning impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party for the purpose of improperly influencing the actions of a party.
- **Collusion** meaning an arrangement between two or more parties designed to achieve an improper purpose, including for the purpose of improperly influencing the actions of another party.
- **Corruption** meaning the promise, offering, giving, receiving, or soliciting, directly or indirectly, anything of value or any undue advantage, or any act or omission that involves the abuse of authority or functions, for

the purpose of influencing or causing to influence improperly the actions of another party, or for the purpose of obtaining an undue advantage for oneself or for another party.

- **Fraud** meaning any act or omission, including misrepresentation or concealing a material fact, that knowingly or recklessly misleads, or attempts to mislead, a party for the purpose of obtaining a financial or other benefit or undue advantage for oneself or for a third party, or to avoid an obligation.
- **Obstruction** meaning
  (i) deliberately destroying, falsifying, altering or concealing evidence material to an investigation;

  (ii) making false statements to investigators in order to materially impede an investigation;

  (iii) failing to comply with requests to provide information, documents or records in connection with an investigation;

  (iv) threatening, harassing, or intimidating any party to prevent it from disclosing its knowledge of matters relevant to a NEFCO investigation or from pursuing an investigation; or

  (v) materially impeding NEFCO's contractual rights of audit or access to information; and

- **Money laundering** meaning

  (i) the conversion or transfer of property, knowing that such property is derived from criminal activity, to conceal and disguise the illicit origin of the property, or assisting any person who is involved in the commission of such activity to evade the legal consequences of this action;

  (ii) the concealment or disguise of the true nature, source, location, disposition, movement, rights with respect to, or ownership of property, knowing such property is derived from criminal activity;

  (iii) the acquisition, possession or use of property knowing, at the time of receipt, that such property was derived from criminal activity; or

  (iv) participation or assistance in any of the activities above; and

- **Financing of terrorism** meaning the provision or collection of funds, by any means, directly or indirectly, with the intention that they should be used or in the knowledge that they are to be used, in full or in part, in order to carry out terrorist activities (the "terrorist activities" shall have the same meaning as set out in Article 2 of the International Convention for the Suppression of the Financing of Terrorism).

Date:

Signature:
[Name and position]
for and on behalf of

[Name of the firm/individual or joint venture]
Note: When so required by NEFCO this Covenant must be sent to NEFCO together with a copy of the contract documents. In other cases, it must be kept by the Beneficiary and available upon request from NEFCO

Section 4 – Financial Proposal – Standard Form

FORM FIN-1
FINANCIAL PROPOSAL SUBMISSION FORM

[*Location, Date*]

To: NEFCO

Dear Sirs:

We, the undersigned, offer to provide the consulting services for **PIU Support Consultant for the Project "Installation of three solar power plants (SPP) in Mykolaiv city"** in accordance with your Request for Proposals dated [*insert date*] and our Technical Proposal. Our attached Financial Proposal is for the **Total Cost of [*insert amount(s) in EUR in words and figure*]**. This amount is exclusive of the applicable VAT.

Our Financial Proposal shall be binding upon us subject to the modifications resulting from the contract negotiations, up to expiration of the validity period of the Proposal as defined in the Letter of Invitation. We understand that any final rates and prices resulting from the contract negotiations will remain fixed until the end of the assignment.

Commissions and gratuities paid or to be paid by us to agents relating to this Proposal and execution of contract, if we are awarded the contract, are listed below:

Name and Address, Amount and Purpose of Commission of Agents, Currency or Gratuity

[*If no payments are made or promised, add the following statement: "No commissions or gratuities have been or are to be paid by us to agents or any third party relating to this Proposal and Contract execution."*]

We understand you are not bound to accept any Proposal you receive.

We remain,

Yours sincerely,

Authorized Signature [*in full and the original copy initialized*]:
Name and Title of Signatory:
Name of Firm:
Address:

FORM FIN-2
SUMMARY OF COSTS

Type of cost	Costs, EUR
Remuneration	
Reimbursable Expenses	
Total	
10% contingency calculated on the aggregate of Remuneration and Reimbursable Expenses),	
Grand Total,EUR	

- The relevant Grand Total must coincide with the Total Costs of the Financial Proposal given in Form FIN-1.
- Respectively, Remuneration and Reimbursable Expenses must coincide with the relevant Total Costs indicated in Forms FIN-3, and FIN-4.
- The 10% contingency must be calculated based on the total amount of Remuneration and Reimbursable Expenses.
- The Grand Total must be calculated based on the total amount of Remuneration, Reimbursable Expenses and 10% contingecy.

FORM FIN-3

BREAKDOWN OF REMUNERATION

When used for lump-sum contract assignment, information to be provided in this form shall only be used to demonstrate the basis for the calculation of the contract's ceiling amount and, if needed, to establish payments to the Consultant for possible additional services requested by NEFCO. This form shall not be used as a basis for payments under lump-sum contracts.

A. Remuneration _____				
No.	**Name**	**Position (as in TECH-6)**	**Person-month Remuneration Rate**	**Time Input in Person/Month** (from TECH-6)
	Professional Staff			
	Foreign			
K-1			[*Home*]	
			[*Field*]	
K-2			[Home]	
			[Field]	
	Local			
K-3				
K-4				
Sub-total for Professional Staff				
	Support Staff			
N-1			[*Home*]	
			[*Field*]	
N-2				
Sub-total for Support Staff				
				Total Costs, EUR

FORM FIN-4

BREAKDOWN OF REIMBURSABLE EXPENSES

When used for lump-sum contract assignment, information to be provided in this form shall only be used to demonstrate the basis for calculation of the contract ceiling amount and, if needed, to establish payments to the Consultant for possible additional services requested by NEFCO. This form shall not be used as a basis for payments under lump-sum contracts.

B. [*Reimbursable]* _____				
N°	**Type of [*Reimbursable Expenses]***	**Unit**	**Unit Cost**	**Quantity**
	*{e.g., subsistence costs**}*	{Day}		
	{e.g., International flights}	{Ticket}		
	{e.g., In/out airport transportation}	{Trip}		
	{e.g., Communication costs between Insert place and Insert place}			
	{ e.g., Reproduction of reports}			
	{e.g., Office rent}			
	.....			
	{Training of the project owner's personnel – if required in TOR}			
				Total Costs, EUR

NEFCO

NEFCO'S GENERAL TERMS AND CONDITIONS FOR CONSULTANCY SERVICES

1 RESPONSIBILITY, PROFESSIONAL PRACTICE, INTEGRITY, IMPARTIALITY AND INDEPENDENCE

1.1 The Consultant shall be fully responsible for the Services and perform them in an objective and professional manner in compliance with best industry practice for similar services.

1.2 While providing the Services, the Consultant shall protect NEFCO's interests and act dutifully and transparently towards NEFCO.

1.3 The Consultant shall not receive or request instructions for the performance of the Services from any other party than NEFCO (unless otherwise explicitly instructed by NEFCO).

1.4 The Consultant shall during the Assignment remain financially and otherwise independent of other consultants, manufacturers, suppliers, contractors and other actors and/or factors that may prejudice the Consultant's objectivity. In particular the Consultant shall not accept any referral fee or other compensation from other consultants, manufacturers, suppliers, or contractors recommended by the Consultant.

1.5 The Consultant shall promptly inform NEFCO of any assignment or relation with a third party which might affect or be seen to affect the Consultant's impartiality or create a potential conflict of interest in relation to the Assignment.

1.6 The Parties are independent parties and the Parties agree that the Agreement shall not be deemed as an employment agreement and that the Consultant is not, nor any other person performing services under this Agreement, engaged by NEFCO as an employee but as an independent consultant and that relevant provisions of the Swedish Employment Protections Act (1982:80) shall not be applicable on the Parties' arrangement under this Agreement.

2 TIME SCHEDULE, INFORMATION, ASSIGNED PERSONNEL AND COOPERATION WITH THIRD PARTIES

2.1 The Services shall be provided in accordance with the time schedule in the Special Terms and Conditions and as possibly described in more detail in the annexes. The Consultant shall ensure that the agreed time schedule is adhered to.

2.2 The Parties shall keep each other timely informed about events or matters relevant for the performance of the Services. The Consultant shall without delay inform NEFCO Responsible person of any events which have had or are likely to have an adverse impact on the Consultant's provision of the Services within the agreed time schedule and/or otherwise negatively impact the Consultant's performance and/or fulfilment of the Services. Any delay or other underperformance in carrying out the Services shall be subject to the remedies set out in Sections 4, 5 and 17.

2.3 The Services shall be carried out personally by the Consultant or the personnel of the Consultant as set out in Section 1 of the Special Terms and Conditions and as possibly described in more detail in the annexes (the "**Assigned Personnel**"). If the Consultant should wish to engage a subcontractor to perform a certain part of the Services, the matter shall be discussed with NEFCO, including its possible effects on the Consultant's remuneration, and can only be done subject to NEFCO's prior written approval. Notwithstanding such approval, the Consultant shall remain fully responsible and liable for the performance of the Services, including any Services provided by its subcontractors as if they had been carried out by the Consultant.

2.4 The Consultant shall, without unreasonable delay and at no cost to NEFCO, be obliged to replace any Assigned Personnel performing the Services, who NEFCO reasonably considers is lacking the necessary competence, whom NEFCO finds it manifestly difficult to collaborate with or whose conduct is inconsistent with what NEFCO reasonably expects. The

identity of such replacing personnel as well as any other changes of the Assigned Personnel and any possible effects on the Consultant's remuneration, shall be subject to NEFCO's prior written approval (except if triggered by a *force majeure* situation). If approved by NEFCO, the replacing personnel shall become Assigned Personnel. Any changes in the Assigned Personnel shall not affect the agreed time schedule, in the absence of NEFCO's prior written consent.

2.5 If and to the extent relevant, the Consultant shall while providing the Services co-operate with other parties as may be determined by NEFCO.

3 CHANGE REQUEST

3.1 NEFCO and/or the Consultant may request the other Party to make changes to the Services to be provided.

3.2 In such case, the requesting Party shall submit a written request (the "**Change Request**"). The Change Request shall contain a description of the content of the proposed change as well as the reasons for the change and the effect the change is deemed to have on the Services.

3.3 The receiving Party shall within reasonable time review the Change Request in terms of its possible impact on the agreed Total Fee, time schedule and/or other agreed terms and conditions, and each Party shall be entitled to either approve or reject the Change Request.

3.4 If the Change Request is accepted by the other Party, the change shall be formalized through both Parties approving it in writing and the change shall thereafter be considered as an amendment to the Agreement.

3.5 The Parties agree and acknowledge that comments to form or substance, revision, adjustment, correction and/or supplemental requirements to bring the Services to a final and acceptable/agreed form (including all reasonable incidental work related thereto, such as meetings, telephone calls, correspondence etc.) shall not be considered as changes to the Services in terms of Sections 3.1 to 3.4 above.

4 ERRORS, OMISSIONS AND DELAY

4.1 The Consultant shall, at no cost to NEFCO, assume responsibility for correcting any errors and/or omissions in the performance of the Services.

4.2 In the event that the Consultant is delayed in performing the Services or a material error, defect and/or non-conformity occurs in the Services, and the situation upon NEFCO's request is not remedied or corrected within 30 (thirty) days to NEFCO's satisfaction, NEFCO shall (without prejudice to NEFCO's other rights under the Agreement, including, without limitation, the right to liquidated damages in accordance with Section 5) have the right to:

(i) accept the Services in their then current form at a reduced price which corresponds to the value of the actually delivered part; or alternatively;

(ii) complete itself or appoint a third party to complete the Services at the Consultant's sole cost and expense; or alternatively;

(iii) terminate the Agreement in whole or in part with immediate effect, while reserving all other rights available to it under the Agreement and applicable law; and in addition to (i) - (iii)

(iv) seek damages from the Consultant.

5 LIQUIDATED DAMAGES IN CASE OF DELAY

5.1 If the Consultant is not able to provide the Services within the agreed time schedule and this is not caused by *force majeure* or circumstances related to NEFCO, then the Consultant shall pay liquidated damages to NEFCO in compensation for the delay.

5.2 The liquidated damages shall amount to 0.2 percent of the agreed Total Fee excluding VAT, for each working day the Services are delayed, but in any circumstances limited to a maximum of 50 (fifty) working days. NEFCO shall be entitled to deduct such liquidated damages from any amounts owed by NEFCO to the Consultant under the Agreement.

5.3 If only parts of the agreed Services are delayed, the Consultant may request NEFCO to reduce the liquidated damages in such way that the compensation is proportional to the ability of NEFCO to utilise those parts of the Services that have been performed and delivered to NEFCO.

5.4 Any claims for liquidated damages shall be presented by NEFCO in writing to the Consultant at the latest 90 (ninety) days from the day on which the Assignment was completed or the Agreement was terminated. If NEFCO should not present a claim to the Consultant within this time limit, NEFCO's right to liquidated damages shall be deemed forfeited.

6 REMUNERATION

6.1 The remuneration to be paid by NEFCO to the Consultant in return for the Services shall consist of the fee agreed in the Special Terms and Conditions.

6.2 The Total Fee can be either fixed or variable. Variable fees shall be based on performance on a time and material basis.

6.3 If agreed in the Special Terms and Conditions, NEFCO shall, against receipts or written clarification, in addition to the Total Fee, pay compensation for the costs listed below:

(i) reasonable travel costs in economy class including airport transfers;

(ii) reasonable accommodation costs in a standard hotel room including breakfast only; and

(iii) other expenditures required for providing the Services.

6.4 Notwithstanding Section 6.3, NEFCO will not reimburse (i) travel time, or (ii) travel costs within the Helsinki metropolitan area (meaning a range of sixty (60) kilometres measured from the centre of Helsinki).

6.5 NEFCO will not pay any daily allowances to the Consultant.

7 TERMS OF PAYMENT

7.1 Payment(s) will be made by NEFCO in accordance with the payment schedule agreed in the Special Terms and Conditions. If no payment schedule is agreed, the Consultant shall invoice NEFCO monthly in arrears after the Services have been performed by the Consultant and accepted by NEFCO.

7.2 According to Article 9 of the Agreement concerning NEFCO[1], NEFCO is in the Nordic countries exempted from taxation, including VAT, in relation to its official activities. Also, as an international organization, NEFCO is exempted from VAT within the European Union[2].

7.3 Invoices specifying the nature and extent of the Services performed will be paid by NEFCO within 30 (thirty) days from the date of receipt, subject to NEFCO's acceptance of the Services as satisfactory. Should an invoice or a part thereof be disputed by NEFCO, NEFCO will up-front pay the undisputed part.

7.4 The Consultant shall submit a written confirmation issued by the account-holding bank confirming that the Consultant is the legal owner of the bank account to which the payment is requested to be made.

7.5 At the latest within 90 (ninety) days after completion of the Assignment, the Consultant shall submit a final invoice specifying any outstanding payments with respect to the Services provided under the Assignment. NEFCO's payment of the final invoice will only take place once NEFCO has agreed to that the Assignment has been completed. Any subsequent claim for payment shall entail no more than the right of set-off of any payments owed by NEFCO to the Consultant, unless the Consultant, within the specified time, gives written notification to the effect that an outstanding payment, unknown to him at that time, may lead to a further claim, or can show that the claim is based on the outstanding sum that was unknown to him at the time.

7.6 If NEFCO should not make an undisputed payment on time, the Consultant shall be entitled to request interest on the overdue amount if the claim is presented within reasonable time not exceeding 45 (forty-five) days after the overdue date, at an annual interest rate of 9% p.a. (nine per cent per annum) from and including the due date to but excluding the date of actual payment.

8 LIABILITY AND LIMITATION OF LIABILITY

8.1 The Consultant shall, subject to the limitations specified below in this Section 8 and any additional provisions agreed in the Special Terms and Conditions, be liable for any damage that the Consultant, its subcontractors or any other party engaged by the Consultant for the performance of the Services, may cause NEFCO to incur as a consequence of the Consultant's wilful misconduct, negligence or breach of the Agreement.

8.2 NEFCO's acceptance of the Services shall not release the Consultant from liability.

8.3 The total aggregate liability of both Parties under or in relation to the Agreement shall be limited to the higher of (i) 50,000 euro; or (ii) the value of the Total Fee and possible costs compensation paid or payable by NEFCO to the Consultant under the Agreement.

8.4 The limitation of liability set out in this Section 8 shall not apply in case of gross negligence, fraud, wilful misconduct, death or personal injury, material breach of the Agreement or breach of the Agreement in relation to the intellectual property rights or indemnification provisions set out in Section 9 or in relation to the confidentiality provision in Section 12. Further, the limitation of liability set out in this Section 8 shall not apply in case the Consultant is liable for payments to any third party in accordance with Section 4.2.

[1]Agreement between Denmark, Finland, Iceland, Norway and Sweden concerning the Nordic Environment Finance Corporation, available at NEFCO's website www.nefco.int.

[2] On the basis of Article 151(1), point b, of Directive 2006/112/EC on the common system of value added tax (as amended by 2009/162/EC) and Article 12(1), point b, of Directive 2008/118/EC concerning the general arrangements for excise duty.

9 RIGHTS OF OWNERSHIP, INTELLECTUAL PROPERTY RIGHTS AND INDEMNIFICATION

9.1 All rights, title, interest and all intellectual property rights in and to any pre-existing material, information, data, programs, models, methods and/or work created by a Party outside the scope of this Agreement or prior to the execution of this Agreement, shall vest in and remain the sole and exclusive property of that Party.

9.2 All rights, title, interest and all intellectual property rights in or relating to the Services shall vest exclusively in NEFCO. The Consultant may retain copies of documents and data, but shall not be entitled to use this material for purposes unrelated to the Services without NEFCO's prior written consent.

9.3 Equipment, vehicles and materials made available to the Consultant by NEFCO, or purchased by the Consultant wholly or partly with funds supplied or reimbursed by NEFCO under this Agreement shall be the property of NEFCO and shall be marked as such. Upon completion of the Services or termination of the Agreement, the Consultant shall make available to NEFCO an inventory of such equipment, vehicles and materials and shall dispose of same equipment, vehicles and materials in accordance with NEFCO's instructions.

9.4 For the avoidance of doubt, nothing in this Agreement shall limit a Party's right to use the general professional skills, experience and know-how acquired and/or applied by it under or in relation to this Agreement for the benefit of itself or a third party.

9.5 The Consultant shall indemnify, defend and hold NEFCO harmless from any and all claims, suits, actions or demands asserted against NEFCO world-wide, and against all liabilities, damages, losses, costs and expenses (including but not limited to attorney's fees) which NEFCO may incur when arising directly or indirectly from any infringement or alleged infringement of any patent, trademark, copyright or design or any other intellectual property right of a third party, if such claim, demand, suit or action may be attributable to the Consultant's provision of the Services. Should an intellectual property claim, or threat for such claim, arise, the Parties shall seek to agree on appropriate measures to address the matter. The cost for the defence against any such claim shall be entirely borne and covered by the Consultant as set out above.

9.6 No limitation(s) of liability set out in the Agreement or otherwise shall apply to the indemnification undertaking to hold NEFCO harmless as set out in Section 9.5 above.

10 INSURANCE

10.1 The Consultant shall maintain adequate insurance for any liability under this Agreement, including for safeguarding of the documents and other property of NEFCO, which may be in the Consultant's possession during the Assignment.

10.2 Unless otherwise agreed between the Parties, the Consultant shall maintain adequate professional liability insurance throughout the entire period of the Assignment.

10.3 The Consultant shall be responsible for insuring its Assigned Personnel, and for ensuring that any subcontractor(s) is similarly insured, against death, injury, loss of property and illness. The Consultant shall also be responsible for ensuring that adequate travel insurance is in place.

10.4 Upon NEFCO's request, the Consultant shall provide evidence demonstrating that sufficient insurance is in place.

11 LEGAL STATUS OF NEFCO

11.1 The Consultant expressly acknowledges NEFCO's legal status as an international organisation, vested with certain immunities and privileges, and the impact this special legal status has on NEFCO's contractual obligations as follows:

(i) NEFCO is a legal person under international law and is governed solely by and operates under its constituent documents;

(ii) NEFCO enjoys immunity from jurisdiction, which means that the chosen dispute resolution mechanism shall be arbitration and only a final arbitral award is binding upon NEFCO;

(iii) NEFCO itself, its property and assets (wherever located and by whomsoever held) are immune from search, requisition, confiscation and expropriation by executive and legislative actions (including any interim court orders, injunctive reliefs etc.);

(iv) NEFCO's premises, archives, and all documents belonging to NEFCO or held by NEFCO are inviolable and the communications of NEFCO are protected by bank secrecy and are confidential;

(v) NEFCO has its own established governing and supervisory bodies and, therefore, NEFCO is exempted from audit inspections and disclosure requirements under national laws or as otherwise may be imposed on a party through a contractual relationship; and

(vi) NEFCO is not bound by any national or EU legislation on protection of personal data. NEFCO's Global Privacy Policy (available at NEFCO's website) provides information on why and how personal data is processed at NEFCO.

11.2 Nothing in this Agreement shall be construed as a waiver, renunciation or other modification of any immunities, privileges or exemptions accorded to NEFCO pursuant to the Agreement concerning NEFCO, any international convention or any applicable law. Notwithstanding the foregoing, NEFCO has made an express submission to arbitration under Section 16 and accordingly, and without prejudice to its other privileges and immunities (including, without limitation, the inviolability of its archives), it acknowledges that it does not have immunity from suit and legal process in respect of the enforcement of a final arbitral award duly made against it as a result of its express submission to arbitration pursuant to Section 16.

12 CONFIDENTIALITY

12.1 The Consultant understands and agrees that as part of the Assignment, the Consultant may get access to information (in hard copy, electronic format or verbally) that relates to NEFCO's or NEFCO's clients' and cooperation partners' past, present or future operations, businesses, research, development, finances, services and technical know-how or knowledge (the "**Confidential Information"**). Any information related to NEFCO and its activities is protected by bank secrecy and shall therefore be treated as Confidential Information and be subject to the confidentiality obligation set out in this Section 12. Furthermore, all information contained in this Agreement shall be deemed Confidential Information.

12.2 The Consultant undertakes to keep confidential any Confidential Information it may receive from NEFCO, a client of NEFCO or any third party under or in connection with this Agreement and, save as specifically permitted below, not to divulge this information to any third party without NEFCO's prior written consent. The Consultant undertakes to use the Confidential Information solely for the purposes of this Agreement.

12.3 Save as may follow from statutory obligations of confidentiality, the above shall not apply to any information that:

(i) is in the public domain at the time of disclosure or later becomes a part of the public domain through no breach of this Agreement;

(ii) is received by the Consultant in good faith from a third party who is under no obligation of confidentiality with respect thereto;

(iii) is known to the Consultant without any obligation of confidentiality prior to disclosure by NEFCO;

(iv) is independently developed by the Consultant without utilizing the Confidential Information as evidenced by the Consultant's written records;

(v) is expressly authorised to be disclosed by NEFCO in writing; or

(vi) is required to be disclosed by law or in accordance with the requirement of a supervisory or regulatory authority to which the Consultant is subject to. For the sake of clarity, the Consultant expressly acknowledges that NEFCO enjoys inviolability of its archives and communication, including any data, information and material, and therefore any disclosure in accordance with this subsection shall always be subject to NEFCO's prior written consent. Any such authorised disclosure shall only be made to the extent required.

12.4 The Consultant may give access to Confidential Information received from NEFCO to its Assigned Personnel and/or subcontractors (if any) only on a need-to-know basis, and provided that there is always a clear understanding of the confidential nature of the information as set out in this Section. The Consultant further represents and warrants that it will ensure that the Assigned Personnel and/or subcontractors (if any) will agree to be bound and adhere to the confidentiality obligations set out in this Section. The Consultant also accepts that all Assigned Personnel performing the Services shall, at NEFCO's request, be obliged to sign a separate confidentiality agreement.

12.5 The Consultant shall exercise its utmost care in safeguarding that the Confidential Information is appropriately processed, stored, handled and protected.

12.6 The rights and obligations set out in this Section shall survive the expiry or termination of this Agreement. Upon expiry or termination of the Agreement for any reason, the Consultant shall immediately cease using the Confidential Information and, upon NEFCO's request, destroy or promptly return all concerned material (and all copies thereof) to NEFCO and confirm to NEFCO, within 15 (fifteen) days after NEFCO's request, that all of the Confidential Information has been destroyed or returned.

13 PERSONAL DATA PROTECTION

13.1 The Consultant shall at all times comply with the applicable data protection laws in processing any personal data, including by procuring all requisite consents where necessary, including where explicit consent is required.

13.2 The Consultant

(i) has introduced and applies appropriate data protection policies and procedures concerning the collection, use, storage, retention, transfer and security of personal data;

(ii) has implemented regular staff training, using testing, audits or other documented mechanisms to ensure and monitor compliance with those policies and procedures;

(iii) has ensured that only authorised personnel has access to personal data and that such access has only been granted on a need to know basis; and

(iv) maintains complete, accurate and up to date records of all of its personal data processing activities as required by the applicable data protection laws.

14 AUDITING, ANTICORRUPTION AND ETHICAL CONDUCT

14.1 The Consultant shall (i) keep accurate and systematic accounts and records with respect to the Services provided under the Agreement, in accordance with internationally accepted accounting principles and in a form and detail which clearly identifies all relevant charges and costs, and their basis; and (ii) upon request up to two (2) years from the expiration or termination of the Agreement, permit NEFCO or its designated representative to inspect these accounts and records and to make copies thereof as well as to have them audited by auditors appointed by NEFCO.

14.2 The Consultant acknowledges and confirms that it is aware of and undertakes to comply with NEFCO's Policy on Anticorruption and Compliance, available at NEFCO's website (the "**Anticorruption Policy**"), which includes specifically an undertaking to (i) not engage directly or indirectly in any abuse, coercion, collusion, corruption, fraud, obstruction, money laundering or financing of terrorism as defined in the Anticorruption Policy (the "**Prohibited Practices**"), and (ii) promptly, upon becoming aware of any suspected or alleged Prohibited Practices in relation to the Services or the Agreement, notify NEFCO in writing.

14.3 The Consultant acknowledges and confirms that it is aware of and undertakes to comply with NEFCO's Policy on Prevention of Sexual Exploitation, Sexual Abuse and Sexual Harassment, available at NEFCO's website (the "**SEAH Policy**"), which includes specifically an undertaking to (i) refrain from directly or indirectly participating or engaging in any form of sexual abuse, sexual exploitation or sexual harassment as defined in the SEAH Policy, and (ii) promptly, upon becoming aware of any suspected or alleged SEAH in relation to the Services or the Agreement, notify NEFCO in writing.

14.4 The Consultant undertakes while performing the Services to observe the highest ethical standards and to follow all applicable laws, including but not limited to those relating to payment of taxes and/or social security contributions in accordance with the laws of the country in which the Consultant is domiciled, operates or where the Services are performed.

14.5 The Consultant shall provide NEFCO or any designated NEFCO representative its full and timely cooperation during any integrity due diligence process or investigation relating to an suspected or alleged breach of the Anticorruption Policy or the SEAH Policy, and shall require its agents, attorneys, accountants or other advisers, to cooperate as reasonably required during any due diligence, audits or investigations carried out by NEFCO. The Consultant shall also make relevant personnel available for a meeting with the NEFCO representative.

14.6 NEFCO shall, in its sole discretion, have the right to terminate the Agreement with immediate effect, should it become apparent in the reasonable opinion of NEFCO that the Consultant, the Assigned Personnel or any other parties involved in the provision of the Services have engaged in Prohibited Practices or in SEAH, and/or have not adhered to the obligations under this Section 14.

15 REFERENCE RIGHT

15.1 The Consultant shall be entitled to use NEFCO name as a reference for marketing or other purposes subject to NEFCO's prior written consent in each individual case.

16 GOVERNING LAW AND DISPUTE RESOLUTION

16.1 This Agreement shall be governed by and construed in accordance with the substantive laws of Sweden.

16.2 Any dispute, controversy or claim arising out of or in connection with this Agreement, or the breach, termination or invalidity thereof, which has not been settled amicably by mutual agreement of the Parties within 60 (sixty) days after the other Party's receipt of a written request for negotiations by either Party to such effect, shall be finally settled by arbitration administered by the SCC Arbitration Institute (the "**SCC**").

16.3 The Rules for Expedited Arbitrations of the SCC (the "**Expedited Rules**") shall apply where the amount in dispute does not exceed EUR 300,000. Where the amount in dispute exceeds EUR 300,000, the Arbitration Rules of the SCC (the "**Arbitration Rules**") shall apply. The arbitral tribunal shall be composed of a sole arbitrator appointed in accordance with the Expedited Rules or Arbitration Rules, as relevant. The amount in dispute shall be calculated as including the claims made in the request for arbitration and any counterclaims made in the answer to the request for arbitration. With reference to points 11.1 (ii) and 11.1 (iii) in Section 11 of this Agreement, Article 38 (Interim measures) of the Expedited Rules and Article 37 (Interim measures) of the Arbitration Rules shall not be applicable to NEFCO during the arbitral proceeding.

16.4 The legal seat and place of arbitration shall be Stockholm, Sweden. The arbitrator may, at /her discretion, hold hearings, meetings and deliberations at any other convenient geographical place in order to secure the efficient and cost-effective conduct of the proceedings.

16.5 The language to be used in the arbitral proceedings (including the documentation) shall be English.

16.6 The arbitral award shall be final and binding upon the Parties.

17 TERM AND TERMINATION

17.1 The Agreement shall become effective and binding upon signing by both Parties and shall remain effective until both Parties have fulfilled their respective obligations under the Agreement, unless terminated earlier in accordance with this Agreement.

17.2 NEFCO shall be entitled to terminate the Agreement with 30 (thirty) days prior written notice. In such case the Consultant shall be entitled to compensation, in accordance with this Agreement, (i) for the Services carried out until the notice of termination was made and (ii) for occurred verified necessary expenses which have not yet been reimbursed.

17.3 NEFCO shall be entitled to terminate the Agreement with immediate effect upon written notice, if the Consultant files for bankruptcy or is put into liquidation, receivership or becomes insolvent. In such case the Consultant shall be entitled to compensation, in accordance with this Agreement, (i) for the Services carried out until the notice of termination was made and (ii) for occurred verified necessary expenses which have not yet been reimbursed.

17.4 Either Party shall be entitled to terminate the Agreement with 30 (thirty) days prior written notice, if there is a *force majeure* event that continues for more than 30 (thirty) days or if the other Party is in material breach of its obligations under the Agreement and the breaching Party fails to remedy such breach within the notice period. Any unpaid fee that is disputed by NEFCO shall not constitute a material breach under this Section.

17.5 Upon termination, the results of work carried out shall immediately be handed over to NEFCO, unless otherwise agreed between the Parties.

18 AMENDMENTS TO THE AGREEMENT

18.1 Any amendments to the Agreement shall be made in writing and accepted and signed by the authorised representatives of both Parties.

19 TRANSFER OF THE AGREEMENT

19.1 The Consultant may not assign or transfer this Agreement or any of its rights or obligations under the Agreement without NEFCO's prior written consent.

20 NOTICES

20.1 Any notice to be given by one Party to the other shall be made in writing and deemed properly given or made when delivered to the recipient by hand, registered mail, courier or email during normal business hours to the address and contact person specified in Section 1 of the Special Terms and Conditions (or to such other address as may be notified in writing from time to time by either Party). If given by email, any notice shall promptly be confirmed by registered letter or courier.

21 SURVIVING TERMS

21.1 The following Sections of NEFCO's General Terms and Conditions for Consultancy Services shall survive any termination or expiry:

Section 8, Liability and Limitation of Liability;
Section 9, Rights of Ownership, Intellectual Property Rights and Indemnification;
Section 11, Legal Status of NEFCO;
Section 12, Confidentiality;
Section 13, Data Protection;
Section 14, Auditing, Anticorruption and Ethical Conduct;
Section 15, Reference Right; and
Section 16, Governing Law and Dispute Resolution.

NEFCO

The Nordic Green Bank

Green Recovery Programme for Ukraine

Installation of three solar power plants (SPP) in Mykolaiv city

PROJECT IMPLEMENTATION UNIT SUPPORT

Terms of Reference for consultancy services

May 2025

NEFCO

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List of abbreviations:

City, Municipality	Mykolaiv
MFA-DK	The Ministry of Foreign Affairs of Denmark, the donor
NEFCO	Nordic Environment Finance Corporation
DH company	Oblast Public Utility “Mykolaivoblteploenergo, 100% City-owned Municipal District Heating Enterprise
Water supply company	Municipal Communal Enterprise “Mykolaivvodokanal”
Employer	City and/or DH company
MVF	Mykolaivvodokanal Facilities, powered by the DH company
DWP	Drinking water points
SPP	Solar Power Plant

NEFCO

1. INTRODUCTION

Nordic Environment Finance Corporation (NEFCO) is an international financial institution established by the five Nordic countries. It finances climate related and other environmental investments and projects primarily in Eastern Europe. In 2017 NEFCO's geographical mandate was widened to a global one, with Eastern Europe still remaining as priority.

NEFCO strives to promote energy efficiency and renewable energy projects and initiatives through different programmes and facilities supported by technical assistance and investment grants from different international donors. Besides climate and environment issues, NEFCO is very supportive for social projects that make possible wider number of people to benefit from the municipal development projects. With some 200 municipal infrastructure and energy efficiency projects, Ukraine is the country where NEFCO has funded the largest number of projects. Projects in public buildings, district heating, water and wastewater sectors result in significant energy efficiency, cost savings, positive environmental and climate impacts, as well as social benefits.

Today's political and institutional framework conditions in Ukraine are marked by the Russian's unprovoked and unjustified invasion of Ukraine started on the 24 February 2022 and escalating war to Ukraine with repercussions not only in Ukraine, but throughout the World. The war has affected significant material damage on municipal, transport and residential infrastructure that led not only to billions of financial losses of Ukraine but also caused a large migration within Ukraine as well as over the Ukrainian boarders to neighbouring countries.

The Green Recovery Programme for Ukraine was approved by NEFCO's Board in June 2022. The aim of the programme is to provide financial and technical support to recovery projects in order to build a much-needed bridge between humanitarian crisis management and long-term sustainable development. The programme will support green economy and transition in the recovery process. The purpose is to enhance and finance projects focused on rebuilding infrastructure at the municipal level to ensure that Ukraine is built back greener and better.

It is expected that the Ukrainian city of Mykolaiv (hereinafter "**the City"**) will receive a grant funding provided by MFA-DK through NEFCO for the Project related to **installation of three solar power plants (SPPs) for reduction of energy expenditures in this city.**

These Terms of Reference (ToR) define the objectives, tasks and qualification requirements for projects implementation support to this Project.

The Project envisages procurement of Project Implementation Unit Support Consultant (hereinafter "**the PIU Consultant**" or "**the Consultant**"). The Project Implementation Unit (hereinafter "**the PIU**") will be formed by employees of the participating municipality and respective company.

The total grant amount to be provided by MFA-DK within the Programme is anticipated to be **up to EUR 7.2 million.**

2. BACKGROUND INFORMATION

The Consultant is requested to provide project implementation unit support services described in this ToR taking into account feasibility assessment developed for this project as attached in APPENDIX 1.

3. THE ASSIGNMENT

3.1. Objectives of the Assignment

NEFCO is now looking to engage a qualified Consultant to support the Project Implementation Unit to be established by the City for the purpose of Project implementation.

The support by the Consultant is essential to assist the City and DH company in preparing and implementing the project in a way that ensures the greatest possible positive impact and sustainability.

The overall objective is to establish new municipally owned power generating capacities for powering critical infrastructure of the city, strengthening resilience and build capacity of the City and DH company to respond to impacts generated by the war. The PIU Consultant shall provide technical assistance to City and DH Company during the project implementation phases, including but not limited to:

- management and capacity building support;

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- support in state registration of international assistance;
- support in design and preparation of technical specifications;
- procurement support;
- support for administration of contracts and works supervision;
- support in assuring compliance with financial documents and other agreements;
- communications.

4. SCOPE OF WORK

Technical assistance will include but is not limited to the below main tasks, further detail of which is provided under each relevant heading:

4.1. Task 1: Management and capacity building support to the City

The Consultant shall provide project management support to the City and its respective DH Company in order to establish the PIUs, and to co-ordinate, administer, manage, monitor and evaluate all aspects of the projects, including project implementation, contract and financial administration.

The Consultant shall organise kick-off meeting with the PIUs as soon as possible after signing the consultancy agreements with NEFCO. The kick-off meeting shall result in an initial plan of action, agreed with the PIUs including respective project implementation activities and respective timing, established lines of coordination with project stakeholders and as well as regular online meetings. The expectations of the City and DH Company should be heard and managed.

In addition, the following items should be covered:

(1) Information to the Municipality and DH Company regarding basic documents and guidelines to be followed, such as the Framework Agreement between NEFCO and Ukraine, NEFCO's Procurement Policy and Procedures, NEFCO's Practical Guide for Municipal Investment Projects, Anticorruption Policy and Integrity Due Diligence Policy etc; (2) roles of the PIU, the PIU Support Consultant and NEFCO; (3) lines of communication; and (4) procedures for decision making.

Furthermore, the Consultant shall identify training needs for the PIUs staff, to effectively implement the projects. It is envisaged that training may be required in the following areas:

- Procurement procedures;
- Compliance procedures;
- Control and reporting, including financiers and other stakeholders;
- Administration of contracts (technical design, testing, supervision and inspection);
- Accounting and disbursement processing (to ensure their compliance with financier's requirements);
- Environmental and Social management.

It is envisaged that training will include both formal training workshops and informal on the job training. The Consultant is expected to support the PIUs and ensure smooth project implementation according to NEFCO's policies described above.

The PIUs should be of a size and structure appropriate to the complexity of the respective project. The PIU teams are expected to consist at least of the following experts:

- Head of PIU/project director;
- District heating expert (technical expertise);
- Electric engineer (technical expertise);
- Procurement expert and financial expert;
- Compliance expert;
- Communication expert.

The Consultant will develop job descriptions, including key qualifications required, for the PIUs staff. Municipality will identify and appoint staff members with the requisite skills. Responsibilities and communications between the parties should be clearly defined.

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The Consultant will assist the Municipality and DH Company to establish the operating systems and procedures required to manage the Project, including drafting of brief PIU Operations Manuals including, *inter alia*:

- A Project Procedures System, setting out the responsibilities and authorities of the parties involved in design and construction, together with all necessary procedures for communications, meetings, reporting, change control, quality control, etc. as are necessary for the efficient implementation and control of the Project.
- A Financial Management System, including: (i) project accounting and budget management systems; (ii) procedures for payments for services, goods and works; (iii) management of project accounts and preparation of the documentation as required by NEFCO; (iv) systems for financial reporting to NEFCO meeting reporting requirements specified in grant agreements.
- A Project Management System, by which all relevant parties are made aware and reminded regularly of the existence and timing of important milestones and events. This should include a Project Decision Matrix for all project stakeholders, showing dates for decisions and approvals over the forthcoming six months.

The Consultant, in consultation with the Municipality and DH Company, shall develop respective well-structured Project Implementation Plan (PIP) including Procurement Strategy and Procurement Plan with well identified scopes of work, investment measures and associated costs.

The PIP shall cover all aspects of the project implementation including inter alia:

- Project Programme – a detailed programme of implementation of the whole project showing all activities and key events for design, approvals, permits and agreements, construction, commissioning, completion, payments, etc.
- Project Budget – a detailed cost budget as well as cash flow forecast.
- Procurement Plan – a detailed procurement approach of the Project.

The Procurement Plan shall be developed, approved by the Municipality and DH Company and submitted for NEFCO's no-objection. Following approval of the PIP by the Municipality/DH Company and NEFCO, the Consultant will closely monitor progress against the PIP. Where the Consultant identify the need to change any aspect of the PIP and/or Procurement Plan, a request for approval, accompanied by a clear outline of the need for such a change, will, with the support of the Consultant, be submitted by the City/DH Company to NEFCO.

4.2. Task 2: Support in state registration of international assistance

Ukrainian legislation requires all technical assistance projects to be registered with the Cabinet of Ministers of Ukraine. This registration is also required for obtaining the right for VAT exemption for contractors to be awarded in result of procurement.

The registration package includes the Procurement Plan for all procurements of goods, works and services planned in the projects as well as a number of other documents signed by NEFCO, the City, the DH Company and respective Regional Administrations (as needed) as well as contractors and sub-contractors.

The Consultant shall assist the City/ DH Company in registration of the projects required for tax exemption, through preparation of respective documentation and ensuring continuous communication with the City and DH Company for the purpose of prompt preparation and signing of the necessary documents.

4.3. Task 3: Support in design and preparation of technical specifications

4.3.1. Assist with preparation and review of design documentation

Depending on the procurement strategy to be developed, the Consultant shall assist the City/DH Company with swift initiation and preparation of technical designs (including the review of design specifications, if not finalised prior to the engagement of the Consultant), and once prepared by local design institutes, review and verify the designs with regard to the contracts to be implemented within the Project to ensure the design documentation is suitable for preparation of technical requirements and specifications for the plant & works. In case of turn-key procurement strategy, the Consultant shall review and verify designs developed by awarded contractor(s) during the Project implementation.

4.3.2. Preparation of the Solar Power Plant Operational Model Report

The Consultant shall:

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- Develop operational models of 3 Solar Power Plants (SPP) with expected total installed power capacity of 9.9 $MW_{El.}$ and analysis of the power consumption for all key facilities related to the DH Company and Mykolaivvodokanal (MVF) including 79 drinking water points (DWP) that will be used for confirmation/correction of the initial data used for power generation and its use as described in APPENDIX 1. The result of this work shall clarify requirements for technical parameters and operating regimes of SPPs preferably in automatic mode and used for preparation of the tender documentation, procurement and implementation within the Assignment.

- The next land plots were allocated for construction and commissioning of 3 (three) SPPson. The Consultant shall consider potential connection points and suggest optimal ones:
    - SPP-1 at 42 Samoilovycha Street of the city is adjacent to the existing boiler house of the DH Company. Potential connection to the existing 6 kV reserve cell of the distribution substation No.96.
    - SPP-2 at 44 Samoilovycha Street of the city is also adjacent to the same boiler house of the DH Company. Potential connection options:
        1. to 35/6 kV Teplychna substation.
        2. to same substation as SPP-1 i.e., substation No.96.
    - SPP-3 at 36 Vodopiina Street of the city. Potential connection to the 6 kV busbars of the Promzona substation.
- Develop the optimal connection scheme from three new SPPs to key power consumers and the grid with clear outlining of “power” flows and “payment” flows between utilities and agreed with key Project stakeholders. The scheme shall be prepared before the procurement start.

- Consider the use of power accumulation batteries for covering minimum required blackout hours and inclusion of this measure into the Project scope shall correspond to the DH company needs, including in post-war period and properly justified. The final technical solution should be in line with available Project budget.

- Develop a financial model of transactions between the parties of power distribution scheme created within the Project, i.e. DH company and MVF. It is expected that during heating season produced electricity will be used for own needs of the DH Company facilities and 79 DWPs. During the non-heating period produced electricity will be used mainly by MVF’s facilities including 79 DWPs.

NOTE: The Consultant is eligible to sub-contract necessary design services, measuring equipment etc and other necessary equipment and services in connection with the tasks to be performed as described in this paragraph. In case of sub-contracting, the Consultant shall estimate and envisage respective budget for such services and include them into its price proposal.

4.3.3. Development of Employer’s requirements

The Consultant shall be responsible for preparing the required technical requirements and specifications for the plant & works in the detail sufficient for inclusion in tender documents. All technical specifications shall meet the requirements of Ukrainian Law and international standards. The Consultant shall also be responsible for preparing draft contracts.

4.4. Task 4: Legal support

The Consultant shall support the City/DH Utility with legal aspects related to preparation of sites, general permitting documents required for starting the construction, construction and operation of solar power plants and correct legal set up for further power distribution between municipal consumers (Mykolaiv city utilities). To this end, the Consultant will, inter alia:

- Legal support during the development of operational model for solar power plants including development of legal list of necessary permits, licences and approvals to be received all project parties;
- Drafting and filling respective documents for obtaining necessary permits, licences and approvals from relevant authorities, city council;
- Overall legal support with prioject related matters.

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4.5. Task 5: Procurement support

4.5.1. Monitoring of procurement

The Consultant will oversee all procurement activities and ensure that procurement is carried out in accordance with NEFCO's Procurement Policy and Procedures.

4.5.2. Advice on procurement strategy

The Consultant will provide advice to the City and DH Company with respect to all aspects of the procurement strategy.

4.5.3. Support in preparation of Procurement Documentation

The Consultant will prepare the procurement documentation for approval by the City and DH Company for obtaining required "No-objections" from NEFCO. To this end, the Consultant will, inter alia:

- Draft tender documents based on NEFCO's Recommended Tender Documents (available from NEFCO) and, where appropriate, other internationally accepted standard tender documents;
- Develop appropriate tender evaluation and qualification criteria;
- Advise on the possibilities for alternatives, cost savings and value engineering opportunities etc. and the treatment of these in the Tender documents;
- Ensure that all applicable environmental procedures required by NEFCO are addressed by the tender documents.

4.5.4. Support during the procurement process

The Consultant will support the City and DH Company throughout the procurement process. To this end, the Consultant will, inter alia:

- Ensure that all approvals and No-objections are applied for in a timely manner;
- Ensure that tenders opening to be carried out in online format and consultant is capable to act as procurement agent;
- Carry out the administration of the tender process, ensure that appropriate records are kept, documentation is properly stored, recorded and managed, and confidentiality is maintained;
- Prepare draft responses to Tender inquiries, arrange for approval and issue and record the same;
- Assist in arranging any site meetings, information meetings or other pre-tender events, and record the same; and
- Assist in arranging procurement in electronic format, public tender opening and prepare minutes.

The Consultant shall take into consideration that projects needs may require procurement of several lots, each requiring preparation of separate package of tender documentation, tender procedure, evaluation report and all related assistance to the municipality in connection with this. It should be also noted that in case of unsuccessful tenders, re-tenders may take place.

4.5.5. Support during the evaluation process

The Municipality and DH Company are responsible for procurement and acting as the Employer in procurement. The Consultant will take the lead in organising and managing the evaluation process. To this end, the Consultant will, inter alia:

- Give guidance on the composition of the Evaluation Committee and to the Committee as required. Assist the Committee with initial examination and detailed evaluation of submitted tender proposals;
- Provide draft detailed technical evaluation report for consideration by the Committee. Compile the evaluation report in a standard format, including all technical and financial analyses and clarifications requested and received;
- Arrange for meetings of the Evaluation Committee, attend as an advisor and keep record of these meetings, presenting the minutes for approval by the Evaluation Committee;
- Document the Evaluation Committee's deliberations in relation to the evaluation report and compile the agreements reached into the report prior to seeking all approvals;

NEFCO

- Ensure that all queries and complaints are promptly attended to as appropriate and copy such inquiries as appropriate to donors.

4.5.6. Integrity checks of the successful tenderers

Integrity assessment of the winning tenderers according to the NEFCO's Policy on Integrity Due Diligence (IDD) shall be carried out to mitigate the risk of fraud and the reputational risk of the City and donors. The integrity checks shall basically confirm the identity, management and financial position of the contractor, confirm that the company is not ineligible or under sanctions, as defined by NEFCO's Procurement Policy and Procedures. This examination should include, but should not be limited to, the following activities:

- Verifying that the tender is not in a conflict-of-interest situation;
- Verifying whether the evaluated tenderer had any integrity and/or corruption issues.

Furthermore, the Consultant shall upon request continuously monitor integrity issues in case of pending criminal cases, litigations etc.

4.5.7. Support during contract finalisation

The Consultant will provide support to the City and DH Company during contracts finalization. To this end, the Consultant will, inter alia:

- Prepare a brief for municipality and DH Company indicating all the items to be resolved as pre-contract clarifications, if any.
- Prepare a draft contract incorporating all understandings between the parties and ensure compliance with the requirements of the tender documents.
- Attend pre-contract discussions, if any, and document the discussions, updating the contract documents as necessary and seeking all necessary approvals.
- Advise on the validity of performance and other contract-related securities.
- Oversee that unsuccessful tenderers are informed; ensure that all queries and complaints are promptly attended to as appropriate and report correspondingly to NEFCO.

4.6. Task 5: Support for administration of contracts and works supervision

The Consultant will support the Employer's Project Manager(s) (PM) or equivalent to implement PM's duties as specified and/or implied by respective contract, in compliance with Ukrainian laws, technical standards, construction norms and rules. In order to do so, the Consultant will inter alia:

- Review the working drawings prepared by the Contractor, for approval by the Project Manager or equivalent;
- Support the Project Manager in administering the works and approving all materials, construction techniques and workmanship in accordance with the contract(s);
- Provide expert advice on all aspects of the works undertaken, especially regarding project management, measurement, contracts monitoring and quality control;
- Ensure the proper programming, recording, measurement and accounting of the works by means of contemporary management and measurement techniques;
- Carry out monitoring of the project progress and promptly report to PM the details of any aspect that may jeopardize the progress of the works, as well as any implications such aspects may have on the original time of completion or cost of the works, and the measures being (or to be) adopted to mitigate these risks;
- Provide regular information on the status of the contracts implementation to the head of the PIU and to NEFCO;

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- Participate in regular progress meetings with the PIU and contractors on the progress of contracts implementation and issues to be addressed. The Consultant will also recommend to the municipality the measures to be undertaken to address the implementation issues identified; and
- Coordinate with technical supervisors engaged by the municipality on proper supervision and reflection of problems and defects during the project implementation according to the Ukrainian law.

The Consultant shall assist the Employer with seeking prior required “no objection(s)” before:

- Issuing any Variation Order/Change Order/Amendment to Contract with financial or time implications, except in an emergency situation when the approval of the Project Manager shall be issued as soon as practicable;
- Sanctioning additional items, sums or costs;
- Approving the sub-contracting of any part of the works; and
- Approving any extension for the time(s) for completion.

The Consultant will coordinate the work of all other parties involved in the projects. To this end, the Consultant will assist the municipality to:

- Ensure that other parties involved in the implementation of the projects are provided with necessary documentation and any other assistance;
- Prepare an integrated time schedule for progress meetings with the various parties;
- Attend meetings together with the municipality to support the Contractor's overall programme as a whole, seek response to reports, and discuss project issues on a regular basis with key stakeholders;
- Prepare and circulate minutes of the meetings, including follow-up actions required to ensure progress.

The Consultant shall also identify and advise the City and DH Company to initiate the procedures for all necessary local or sector licenses, permits or other approvals, including but not limited to licenses related to site access, building permits for permanent and temporary works as appropriate.

4.7. Task 6: Support in assuring compliance with Financial Documents and other agreements

- Arrangement of timely disbursement under the contracts
- To ensure timely disbursements under the contracts, the Consultant shall, inter alia:
  - Prepare cash flow forecast for contracts and respective sub-projects as a whole;
  - Assist with financial planning;
  - Verify the invoices and payment documents for all contracts; and
  - Assist with preparing of disbursement requests according to the requirements of the financing agreements.

4.7.1. Conditions Precedent

The Consultant will advise the City and DH Company on actions required to discharge the Conditions Precedent/effectiveness to the availability of funds according to Grant Agreement between NEFCO and the respective City/DH Company. The Consultant shall advice and support the City and DH Company to apply qualified electronic signature for signing documents as required in the Conditions Precedent in order to streamline disbursements.

4.7.2. Environmental and Social Matters

The Consultant will ensure that all applicable environmental procedures required by NEFCO are being adhered to and that the City and DH Company are duly informed about the procedures. The Consultant will develop Environmental Social Action Plan as well as the Results framework document (according to the template in APPENDIX 2) and support its update during project implementation.

NEFCO

4.7.3. Health and Safety Matters (H&S)

The Consultant shall develop general H&S guidelines to be applied in all projects and take care that the Contractors develop and execute the project and site-specific H&S plans.

The Consultant shall work closely with the contractors and their responsible H&S specialists to ensure that safety on site is adhered to. Regular H&S oriented site visits and/or monitoring visits should be carried out in addition to the works supervision visits.

The Consultant shall train / conduct a capacity building session to respective PIUs members in terms of key H&S requirements.

The Consultant will take supervise that all workers and people on-site are instructed and trained accordingly on H&S management. All relevant H&S aspects should be adhered to already at the stage of development of the procurement documentation and reflected in contractual documents.

4.8. Task 7: Communications

The Consultant will be responsible for communications activities related to the Programme such as awareness raising, content creation, capacity building and dissemination of results of the project(s), and work in close cooperation with NEFCO and/or NEFCO's authorized partner taking into consideration respective security safeguards:

4.8.1. Awareness raising

- Ensure donors' and NEFCOs' visibility in all communications activities related to the Programme.
- Ensure key messages are coherently used in all communications.
- Convey easily understandable messages about the benefits of implementing green and sustainable technologies and solutions, which would help target audiences see the benefits of not only rebuilding but rebuilding in a sustainable way.

4.8.2. Content creation

Provide content, photography and video materials from the project sites, which can also be used by NEFCO and the donors in various communication activities.

Create social media postings about Programme progress and milestones achieved, including relevant hashtags, and share these with NEFCO and the donors.

4.8.3. Capacity building

Support the PIUs and the Beneficiaries' communication:

Provide support and review messages, social media postings, press releases and other articles by the city;

participate in communications trainings for the PIU carried out by NEFCO or NEFCO's authorised partner; and

make sure press releases get adequate approval from NEFCO or NEFCO's authorised partner.

4.8.4. Dissemination of results

Regular status report meetings (mainly online) as regards communications activities with NEFCO and/or NEFCO's authorised partner.

After project completion, create relevant reports, see 5.5. Reporting requirements

4.8.5. Other

- Assist NEFCO or NEFCO's authorised partner with media relations on local level by:

(i) providing contacts, when needed, for journalist briefings, pitches and news articles distribution;
(ii) informing about inquiries from media outlets/journalists, NGOs and/or general public; and
(iii) alert on possible critical topics and (negative) media coverage that may require prompt actions.

NEFCO

5. IMPLEMENTATION ARRANGEMENTS AND REPORTING REQUIREMENTS

5.1. Logistics, timing and arrangements

The intended start date is July 2025 and the period of implementation of the contract will be 30 months from this date. In average, each of the projects implementation is expected to be completed within 30 months from the commencement date.

The Consultant is responsible for the office space for his experts. The possibility to work in the City premises shall be agreed by the Consultant with the City and/or DH Company. It is expected that the experts may work remotely when feasible as long as they could deliver their services in the expected quality. The Consultant must ensure that its experts have all the necessary computer hardware and the software required to deliver the services, as well as the necessary office equipment. The Consultant is responsible for the residential accommodation for their specialists, whenever necessary, as well as for local and international transportation, office consumables, communications, internet and other required costs. The Consultant will be responsible for all salaries, fees, allowances, insurance, leave pay and taxes for the staff involved in the Assignment.

5.2. Cooperation with the City

Participating City will designate:

- A senior official (deputy mayor or similar) to be the primary contact person with specific responsibility for overall cooperation with the Consultant;
- A coordinator(s) (head of respective City' department/DH Company or similar) to be responsible for daily management and coordinating PIU activities relating to the projects;
- A PIU to be responsible for projects implementation.

The City will share all relevant project's information, such as records, plans, background reports, technical designs, archives and other documents, but it will be the responsibility of the Consultant to translate these documents, as necessary. Access to construction sites, objects and operational facilities are to be provided to the Consultant's experts as well.

All documentation related to the works will remain the property of the relevant participated City after completion of the Assignment. The Consultant shall not publish, use or dispose of this documentation without the written consent of the City.

5.3. Management of the Programme

The Team Leader appointed by the Consultant will be responsible for running the assignment and delivering the outputs on time and at a good quality level.

The Programme is managed by NEFCO. The Consultant will provide NEFCO with all relevant CVs of experts, reports, minutes of meetings, draft documents that are to be published/disseminated, proposals for the use of the budget for incidental expenditure, etc. relating to each activity to be implemented under the Programme. Before the activities can be carried out, some of these materials will need prior review and NEFCO's no-objection, as defined in NEFCO's Procurement Policy and Procedures.

Throughout the duration of the projects, particular attention will be paid to keeping a low carbon footprint, in particular, it is encouraged to hold project and coordination meetings via video conferencing or conference call.

Women's participation in the projects will be encouraged and documented, be it as hired experts or participants in the project's activities. The use of disaggregated gender data is encouraged. Furthermore, the projects will be expected to apply a gender analysis in the preparation of the work plans and specific activities. This analytical work should be clearly reported in the relevant project documents. The Consultant will explain in its Organisation and Methodology to what extent gender is relevant to climate action in Ukraine, and what activities can be proposed to bring a positive contribution to addressing gender issues.

5.4. Action Plan

An Action Plan for each Project in the City shall be prepared, once a Grant Agreement is signed between NEFCO and the City and contain the following steps:

1. Preparation of tender dossiers by the City with assistance of the PIU Consultant according to agreed procurement rules.

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2. Issuing of NEFCO's no-objection to the tender dossiers.
3. Publication of tenders in webpages of each relevant City, DH Company, NEFCO, Prozorro and other relevant portals.
4. Pre-tender meetings, clarifications to requests of the tenderers with assistance of the PIU Consultant.
5. Tender Evaluation by the tender evaluation committee of the City and DH Company with assistance of the Consultant.
6. Issuing of NEFCO's no-objection to the Tender Evaluation Report prepared for the City/DH Company.
7. Preparation of contracts by the Municipality with assistance of the Consultant.
8. Issuing of NEFCO's no-objection to the draft contracts.
9. Contracts signing.
10. Issuing of NEFCO's no-objection for any additional agreements to the contracts.
11. Tenders can be annulled and financing stopped in case of breach of procedures.

5.5. Reporting requirements

Name of report	Content	Time of submission
Inception report	Analysis of existing situation and project implementation plan (including training and communication plan)	No later than 3 weeks after mobilisation of the Consultant.
Regular brief reports according to the agreed format	Short and concise updates to inform about the progress in project implementation	Every two weeks
Solar Power Plant Operational Model Report	Special report on operational model of 3 solar power plants, including energy distribution and financial flows as as specified in 4.3.2	1 month after Consultants' mobilisation
ESAP	Environmental and Social Action Plan according to the project specifics	1 month after Consultants' mobilisation
Results framework document	List of key project indicators to be identified and achieved during project implementation	1 month after Consultants' mobilisation
Biannual Programme progress reports	Short description of progress (technical and financial) including problems encountered; planned work for the next 6 months. Any difficulties encountered or expected in the implementation of the project will be stipulated. Maximum 15 pages (excluding the annexes).	Not later than 1 month after the end of each 6-months implementation period.
Draft final report	Description of achievements including problems encountered and recommendations. Maximum 50 pages (excluding annexes).	Not later than 1 month before the end of the implementation period.
Final report	Description of achievements including problems encountered, mitigating measures and recommendations.	Within 2 weeks after receipt of comments on the draft final report from NEFCO.
Communication Plan	Plan for each project considering security situation and requirements of NEFCO describing the main target groups, communications responsibilities, goals and main communications activities and materials to be developed.	As part of PIP in the inception report, 2 weeks after the start of the assignment.
Projects reports		
Tender Evaluation Reports	Description of receipt and opening of tenders; Preliminary examination of tenders; Evaluation and comparison of tenders and Award recommendation.	On completion of Tender evaluation stage
Project Progress Reports	Description of projects progress, including the percentage completion achieved; Update on project costs,	On each disbursement within 2 weeks of receiving the

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	identified risks of cost overruns, if any; Recommendations on implementation risks' mitigation; Conclusion on City's readiness for tranche disbursement	disbursement documentation
Site-visits reports	Work progress, construction deviations, if any, photos.	Within 2 days of visit

Interim Reports shall include an "executive summary", highlighting the key developments, conclusions and recommendations. Wherever possible the Consultant shall make use of graphs, diagrams or tables, as an illustration of the text.

The reports shall be submitted in the following way:

- Inception and Interim Reports shall be submitted to NEFCO electronically in English language;
- Draft Final and Final Reports shall be submitted to NEFCO electronically in English and Ukrainian languages.

The Consultant is also obliged to prepare and submit the ad-hoc reports and/or short project status reports on various aspects of the assignment, if/when and as requested by donors.

6. CONSULTANT'S PROFILE

The Consultant will be responsible for the overall projects support and monitoring including compliance with international practices.

The Consultant shall mobilise highly qualified staff, who has experience in consultancy role in providing PIU support, for implementation of the Programme, with relevant expertise and hands-on experience of NEFCO's procedures and the ability to assist in drafting highly-qualified project descriptions, financing plans and other crucial decision-making documents and plans in accordance with NEFCO's requirements. In addition, the Consultant shall have practical experience in project implementation with the ability to drive projects forward under time pressure.

The Consultant is expected to involve a group of professional and support staff (international and/or local) to make sure that all required expertise and resources are available. Such experts may include, e g electric engineer, structural engineer, installation and construction supervisors, expert(s) of environmental and social issues, expert(s) of legal/regulatory issues and requirements, as well as the local support staff to ensure proper implementation of its responsibilities under the assignment.

The consultancy company presenting a proposal should, either in its own capacity or through a partnership with another consultancies, be able to present significant experience both related to international procurement procedures, work with IFIs and grant organizations, as well as be able to prove an extensive knowledge regarding implementation of projects within the municipal infrastructure sector in the Former Soviet-Union countries and in Ukraine in particular and work with administrative bodies on all levels (local, regional, Ministries) and local utility companies.

It is envisaged that the Consultant is an international consulting company with strong local representation in Ukraine, with the capacity to engage local experts in the project municipality.

6.1. Required experts

The Consultant's team is expected to consist of lead and senior experts who will perform the bulk of the work, assisted by short-term non-key experts in specific areas as necessary.

Information related to work of experts is indicated in the table below:

No	PIU experts	Minimum number of experts
	Professional Staff	**12**
1	Team Leader	1
2	Deputy Team leader, Project coordinator	1
3	Solar power plant experts (international / local)	2
4	Electric engineer	1
5	Technical supervision engineers	2
6	Procurement expert	1
7	Financial and Disbursement expert	1

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8	Legal expert	1
9	Environmental, Social expert, H&S expert (international/local)	1
10	Communication expert	1
11	Support staff (as necessary)	

The Team Leader will develop close collaborative links with NEFCO to ensure permanent coordination of Project management with the project beneficiaries and stakeholder's institutions at all levels. Experience in project management and knowledge of international procedures and rules are required for all experts.

Position, number of experts, time allocation	Qualifications and skills	Professional experience
Team Leader	▪ Master's degree in engineering, municipal infrastructure, economics or similar; ▪ Strong knowledge of project management, in particular for projects financed by international organisations; ▪ Proficiency with internationally accepted procurement rules and procedures. ▪ Excellent written and communication skills in English. Working knowledge of Ukrainian and/or Russian languages is advantageous; ▪ Strong planning and organisational skills, including team management.	▪ Minimum 10 years of professional experience in relevant fields; ▪ At least 7 years of experience in projects financed by international organisations (including project preparation and implementation); ▪ At least 5 years of experience in managing public infrastructure projects of similar size as a team leader.
Deputy Team leader, Project coordinator	▪ Master's degree in engineering, municipal infrastructure, economics or similar; ▪ Strong knowledge of project cycle management, in particular for projects financed by IFIs; ▪ Strong knowledge of contracting practices, rules and legislation in Ukraine**;** ▪ Good written and communication skills in English. Fluency in Ukrainian and/or Russian is essential.	▪ Minimum 7 years of professional experience in relevant fields; ▪ At least 5 years of experience with contract administration in infrastructure projects in Ukraine, including IFIs funded projects; ▪ Experience of financial, administration and organisational matters, reporting, communication with stakeholders; ▪ Experience of coordinating IFIs and/or NEFCO projects is advantageous.
Solar plant experts	▪ Master's degree in engineering (power production) ▪ Knowledge of Ukrainian and international standards and rules, best international practices applicable for implementation of solar power off-grid and grid connected solar power plants (SPP) ▪ Experience in drafting of design/technical specification and Employer's requirements ▪ Knowledge of internationally accepted procurement rules and procedures ▪ Good written and communication skills in English (for international expert) and Ukrainian (for local expert).	▪ Minimum 7 years of professional experience in relevant fields; ▪ At least 5 years of experience in implementation of SPP projects of similar nature and scope; ▪ At least 3 years of experience in preparation, designing, process optimisation, evaluation of SPP as well as project monitoring in Ukraine.

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Position, number of experts, time allocation	Qualifications and skills	Professional experience
Electric engineer	▪ Master's degree in civil engineering (Power generation/distribution), municipal infrastructure or similar ▪ Knowledge of Ukrainian and international standards and rules, best international practices applicable for power supply systems ▪ Experience in drafting of design/technical specification and Employer's requirements; ▪ Knowledge of internationally accepted procurement rules and procedures ▪ Good written and communication skills in Ukrainain and/or Russian is essential.	▪ Minimum 7 years of professional experience in relevant fields; ▪ At least 5 years of experience in implementation water and wastewater infrastructure projects of similar nature and scope; ▪ At least 5 years of experience of working in projects funded by IFIs; ▪ At least 5 years of experience in preparation, designing, process optimisation, evaluation of water/wastewater systems as well as project monitoring in Ukraine.
Technical supervision engineers	▪ Master's degree in engineering, municipal infrastructure or similar; ▪ Technical Expert on work supervision has a qualification certificate according to the law of Ukraine that entitles him/her to perform the technical supervision for construction works with reference to respective certificate in experts' CV**.** Technical supervision certificate shall be attached to the CV. ▪ Strong knowledge and practical experience with work supervision in the construction sector ▪ Good knowledge of project cycle management, in particular for projects financed by Multilateral Development Banks and other international organisations; ▪ Knowledge of internationally accepted procurement rules and procedures; ▪ Good written and communication skills in English are advantageous.	▪ Minimum 7 years of professional experience in relevant fields; ▪ At least 5 years of experience in implementation of infrastructure projects of similar nature and scope; ▪ At least 3 years of experience of working in projects funded by international organisations; ▪ At least 5 years of experience in work supervision in the construction sector ▪ Experience in the field of sustainable energy would be an asset.
Procurement Expert	▪ Master's Degree in engineering, economics, financing or similar, or minimum 5 years of experience in relevant fields; ▪ strong knowledge of project management, in particular for projects financed by international organisations; ▪ Good written and communication skills in English and Ukrainian. **For lead expert:** ▪ proficiency with internationally accepted procurement rules and procedures. ▪ good knowledge of procurement and contracting practices, rules and legislation in Ukraine ▪ excellent written and communication skills in English, good written and communication skills in Ukrainian.	▪ Minimum 7 years of professional experience in relevant fields; ▪ At least 5 years of experience in procurement documentation and contract preparation and administration in projects financed by International Finance Institutions (IFIs) and other international organisations.

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Position, number of experts, time allocation	Qualifications and skills	Professional experience
Financial and Disbursement expert	▪ Master's Degree in finance, economics or similar, or minimum 5 years of experience in relevant fields; ▪ Knowledge and understanding of financing rules and procedures of International Financial Institutions, as well as municipal financial reporting procedures applicable in Ukraine. ▪ Good written and communication skills in English and Ukrainian.	▪ At least 5 years of experience in financial management/ accounting/ economic analysis; ▪ At least 3 years of experience with financing rules and procedures of International Financial Institutions (loans and grants), as well as municipal financial budgeting and reporting procedures applicable in Ukraine and communication with authorities.
Legal expert	▪ Master's degree in law, economics or similar, or minimum 5 years of experience in relevant fields; ▪ Knowledge and understanding of financing rules and procedures of International Financial Institutions, as well as municipal legislation procedures applicable in Ukraine. ▪ Good written and communication skills in English and Ukrainian.	▪ At least 5 years of experience in legal practice, with a focus on municipal sector activities. ▪ At least 3 years of experience with the legal frameworks and procedures of International Financial Institutions (loans and grants), as well as municipal legal regulations and compliance procedures applicable in Ukraine, including communication with relevant authorities.
Environmental and Social expert	▪ Master's degree in in environmental science or management. ▪ knowledge of Ukrainian and EU environmental, social, health and safety laws, regulations and standards with relevance to buildings and water; ▪ Experience in monitoring of compliance with environmental and safety rules during construction/reconstruction of municipal facilities; ▪ Good written and communication skills in English and Ukrainian.	▪ Minimum 7 years of professional experience in fields relevant to environmental and social assessments, studies and monitoring; ▪ At least 5 years of experience in implementation of environmental and social assignments in infrastructure projects of similar nature and scope; ▪ At least 3 years of expertise of environmental monitoring during construction of municipal facilities; ▪ At least 3 years of experience of working in projects funded by IFIs.
Communication expert	▪ Bashelor's Degree in Communication or related field; ▪ Experience in content creation, social media, public relations; ▪ Good written and communication skills in English. Fluency in Ukrainian is essential.	▪ Minimum 5 years work experience in communication activities, public awareness, of which at least 3 years in Ukraine / Ukrainian organisations ▪ Experience of public sector administration in Ukraine. ▪ Experience of working with IFIs, MFIs and/or international organisations.

6.2. Non-key experts

The Consultant is expected to nominate other non-key experts necessary for the Assignment.

The Consultant should provide for reasonable distribution of budget between experts and be prepared for reasonable overall presence in the field during the duration of the Assignment during periods of design and construction phases.

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7. BUDGET

The estimated budget for the Assignment is EUR 250,000 (two hundred fifty thousand euro) (excluding VAT). It is planned that it will be financed by the MFA-DK. Details to be clarified during contracting.

8. KEY CONTACTS AT NEFCO

Nordic Environment Finance Corporation (NEFCO)
Office: Fabianinkatu 34, FI-00171 Helsinki, Finland
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All communication with donors shall be in English, and with the local stakeholders in Ukrainian, unless otherwise agreed.

APPENDIXES

APPENDIX 1 – Feasibility Study for installation of three solar power plants in Mykolaiv city

APPENDIX 2 – Results framework template

Intended for
NEFCO

Document type
Report

Date
July 2024

INSTALLATION OF RENEWABLE ENERGY SYSTEM (RES) AT MYKOLAIV DH COMPANY FOR REDUCTION OF ENERGY EXPENDITURES

INSTALLATION OF RENEWABLE ENERGY SYSTEM (RES) AT MYKOLAIV DH COMPANY FOR REDUCTION OF ENERGY EXPENDITURES CITY

RAMBOLL Bright ideas. Sustainable change.

SCOPING AND PROJECT PROPOSAL FOR THE ESTABLISHMENT OF BIOFUEL HEAT GENERATING CAPACITY IN MYKOLAIV CITY

FEASIBILITY STUDY

Project name	**Scoping and Project Proposal for the establishment of biofuel heat generating capacity in Mykolaiv city, Ukraine**
Project no.	**1100057552**
Recipient	**NEFCO**
Document type	**Report**
Version	**3**
Date	**10.07.2024**
Prepared by	**Sakaliuk Dmytro, Ivan Zhuchenko, Kateryna Shyshka, Dmytro Emelyanenko, Oussama Saad**
Checked by	**Carolina Escudero**
Approved by	**Roxana Cristina Jensen**

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ABBREVIATIONS AND ACRONYMS

ACPMS	Automated Commercial Power Metering System
C&I	Commercial And Industrial
CAPEX	Capital Expenditures
CL	Cable Line
CM	Combined Margin
CMP	Construction Management Plan
COP	Construction Organization Plan
CTS	Complete Transformer Substation
DAM	Day-Ahead Market
DBN	State Construction Standards
DC	Direct Current
DH	District Heating
DIF	Diffuse Horizontal Irradiation
DSTU	State Standard of Ukraine
EBRD	European Bank for Reconstruction and Development
EF	Efficiency Factor
EG	Electric Generators
ENTSO-E	European Network of Transmission System Operators for Electricity
EURIBOR	Euro Interbank Offered Rate
FiT	Feed-In Tariff
GHG	Greenhouse Gases
GHI	Global Horizontal Irradiation
GoO	Guarantees of Origin
ha	Hectares
HPP	Hydropower Plant
HWS	Hot Water Supply
IAM	Incidence Angle Modifier
IFI	International Financial Institutions
IFI	International Financial Institutions
IPP	Independent Power Producers
LCOE	Levelized Cost of Electricity
LID	Light Induced Degradation
MFA-DK	Ministry Of Foreign Affairs
MPP	Maximum Power Point
MPPT	Maximum Power Point Tracking
NEFCO	Nordic Environment Finance Corporation
NGO	Non-Governmental Organization
NOCT	Nominal Operating Temperature of The Cell
NPV	Net Present Value of The Project
OHL	Overhead Lines
OPEX	Operating Expenditure
PBP	Payback Period
PI	Profitability Index
PIU	Project Implementation Unit

POI	Points Of Interconnection
PP&P	Procurement Policy and Procedures
PPAs	Power Purchase Agreements
PR	Performance Ratio
PTS	Packaged Transformer Substation
PV	Photovoltaic
RES	Renewable Energy Sources
SCGB	State Company Guaranteed Buyer
SE	State Enterprise
SPP	Solar Power Plant
SS	Substation
STC	Standard Test Conditions
TPP	Thermal Power Plant
TS	Transformer Station
TSO	Electricity Transmission Operator
UES	United Energy System of Ukraine
USESCS	Unified State Electronic System in The Construction Industry
USP	Universal Service Provider
VAT	Value Added Tax
WPP	Wind Power Plant
ZNPP	Zaporizhzhia Nuclear Power Plant

1. EXECUTIVE SUMMARY

The Russian invasion of Ukraine in 2022 has had a dramatic and destabilizing impact on the Ukrainian heat and power sectors. Fighting and shelling have caused considerable damage to Ukraine's electrical and heat supply infrastructure. The targeting of critical energy facilities has led to widespread outages, exacerbating the humanitarian crisis, and leaving residents without adequate heating and power supply, especially during the harsh winter months. Efforts to repair and maintain the heat and power networks are continuously challenged by ongoing hostilities. Additionally, the economic strain caused by the conflict has made it difficult for local governments and service providers to maintain and repair heat supply systems and the electrical grid, exacerbating the suffering of the civilian population.

This situation has spurred international support, both in terms of humanitarian aid and technical assistance, to rebuild and modernize the Ukrainian power sector by expediting the transition to alternative energy sources and emphasizing resilience and sustainability.

It is in this challenging context and based on a direct request from the President of Ukraine to the Danish Parliament that the Danish Ministry of Foreign Affairs (MFA-DK) chose the city of Mykolaiv for the provision of direct assistance to build back better and re-establish municipal services for the city population.

The administration of Mykolaiv has been in close dialogue with the MFA-DK regarding early recovery investments in key infrastructure sectors as well as longer-term recovery and reconstruction priorities, focusing on needs in the district heating, energy efficiency, water and sanitation, and solid waste sectors.

The MFA-DK assigned the Nordic Environment Finance Corporation (NEFCO) to manage the ministry funds, facilitate the implementation of projects, and channel funds to Ukraine. NEFCO and the city of Mykolaiv have already had several years of cooperation within the district heating sector.

The utility companies in Mykolaiv are looking at establishing their own power-generating capacity to improve the security of power supply and take advantage of the support mechanisms put in place by the Ukrainian government to accelerate the energy transition.

This study evaluates the feasibility of the implementation of solar photovoltaic power plants to support the activities of Mykolaiv’s district heating supply company, Mykolaivoblteploenergo.

Current Situation of the Ukrainian Power Sector

Ukraine's energy market includes domestic power generators and imports from neighbouring countries. In 2022, the country had 59 GW of installed capacity, mainly thermal and nuclear-based. The renewable energy share increased from 8% in 2015 to 25% in 2022. However, ongoing conflict caused 27 GW of power generation capacity loss and €8 billion infrastructure damage. 24% of the renewable energy capacity ended up in occupied territories.

The war led to a 50% reduction in electricity demand due to bombing and population displacement. Despite this, Ukraine struggled to meet demand. In March 2022, the Ukrainian power system was connected to the European system, easing its isolation from Russian and Belarusian grids. In March 2024, export and import capacities increased to 500 MW and 1,700 MW, respectively.

Ukraine's renewable energy sector faces Technical, legal, and economic challenges predating the Russian invasion, and the country is addressing these through support mechanisms and international cooperation. The challenges include reduced interconnection options leading to increased permitting costs and delays, disruptions in supply chains, frequent changes in legislation affecting market stability and predictability, and increased debts between the market participants. The adoption of Law No. 3220-IX and Law No. 3141-IX (REMIT) by the Ukrainian Parliament has improved market stability by introducing new incentive mechanisms to stimulate renewable energy production and improve the electricity market.

The new self-generation mechanism allows businesses to generate, consume, store, and sell electricity, balancing monthly consumption and injected electricity, and works on successive months.

The new regulatory framework and incentive mechanisms aim at accelerating the expansion of renewable energy share in the energy mix. By 2050, Wärtsilä's optimized scenario for the development of the United Energy System of Ukraine predicts that the capacity of solar and wind plants will be 44 GW and 35 GW, respectively. [OBJ]

New Solar Power Plants in Mykolaiv

The city of Mykolaiv has designated three plots for the development of new solar power plants that would support the operations of Mykolaivoblteploenergo. The future plants are in:

- Solar Power Plant # 1 (SPP-1) in 42 Samoilovycha Street
- Solar Power Plant # 2 (SPP-2) in 44 Samoilovycha Street
- Solar Power Plant # 3 (SPP-3) in 36 Vodopiina Street

The first two solar power plants are located near a boiler house. SPP-1 could be connected directly to the supply system of the nearby boiler house (substation 96). SPP-2 could be connected to the same substation or to 35/6 kV Teplychna substation. Further investigations are required to identify the optimal interconnection point. SPP-3 is not located in the vicinity of a boiler house and could be connected to 150/35/6 kV Promzona substation. All plants will be connected at the 6kV busbar of the respective substations.

Considering the area and topology of the sites, Ramboll developed a conceptual layout to assess the capacity of the solar power plant in each location. The total capacity is estimated at 9,933 kWp (8,600 kW AC). SPP-2 is planned to have the largest capacity. The three solar power plants are expected to produce approximately 13 GWh in the first year.

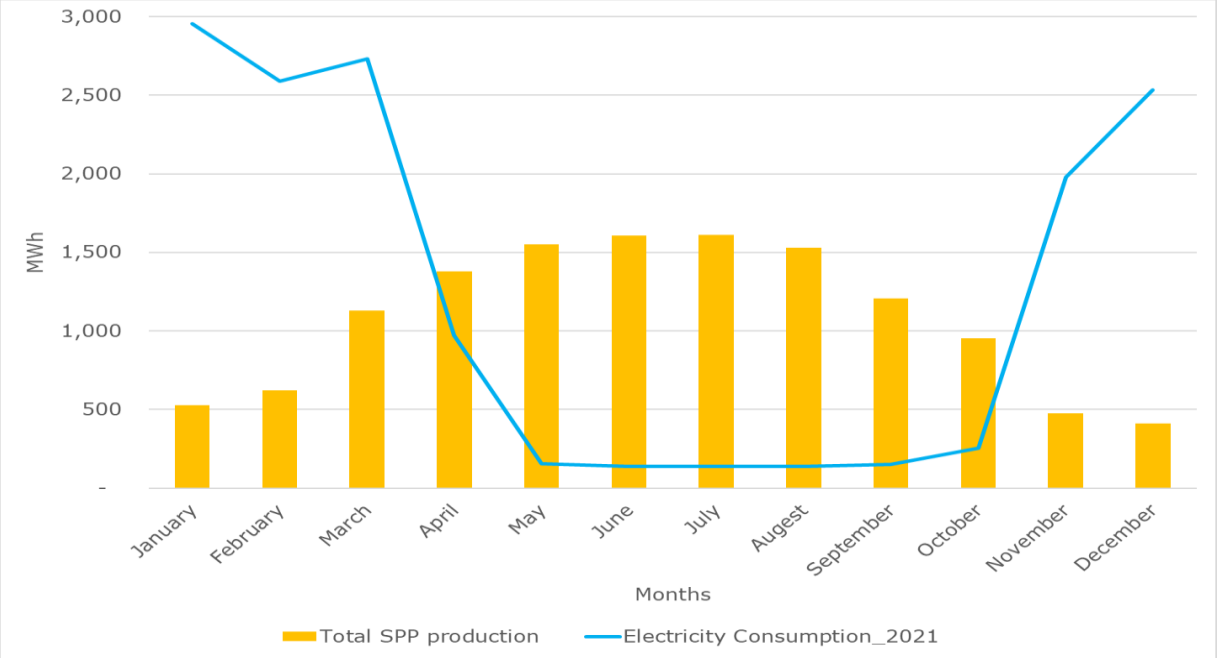
Balancing the Demand and Supply

The yearly electricity demand of Mykolaivoblteploenergo in 2021 (reference year) was 14.7 GWh. This demand is mainly during the heating season (October-April) and could reach up to 95% of the company’s yearly electricity consumption.

The production of the three solar power plants occurs mainly (about 70% yearly production) during the non-heating season. The production of the solar plants in this period is significantly higher than the company's electricity demand during that season. Therefore, the surplus of production will be transmitted via the public networks to other utilities and organizations in Mykolaiv, such as the municipal water supply company -Mykolaivvodokanal. The district heating company owning the solar plants would be required to pay the cost of electricity transmission and will be reimbursed for the electricity consumed by the other utilities using the DAM price structure. During the heating season, all electricity generated by the SPPs will be used by the Company for its energy demand.

Net billing is not a viable option for the district heating company given that the electricity balance in the net billing mechanism is calculated on a monthly basis and not cumulated over the year. Therefore, the company would not benefit from the electricity injected into the grid (credits) during the non-heating season.

Considering the mutual contributions of the three SPPs in a combined scenario, the reduction in the electricity demand of the Company from the grid is estimated at 35% (5.1 GWh/year). The solar projects would contribute to the reduction of 8,356 tonnes of CO_2 per year.



Comparison of electricity demand of the district heating company and the production of the proposed solar power plants

The financial assessment shows that the proposed solar PV projects are profitable, with a net present value of €50 million and a payback period of 7 years for the implementation of the three solar plants. The Levelized cost of electricity of the projects is calculated at € 0.043/kWh, significantly lower than the weighted average tariff of electricity in 2024 (€0.15 /kWh). The projects will not have a significant impact on the heating tariff. It is estimated that the implementation of the three solar power plants will reduce the heating tariffs only by 1.26% considering the current electricity price from the grid.

Table: Summary of the financial assessment of the SPP projects

Indicator	Unit	SPP-1	SPP-2	SPP-3	Combined SPP projects
		42 Samoilovycha Street	44 Samoilovycha Street	36 Vodopiina Street	
DC Capacity	kWp	924.0	7,276.5	1,732.5	9,933.0
Specific Yield	MWh/MWp/year	1,312.0	1,306.3	1,316.0	1,308.5
Electricity generated (i)	MWh/year	1,212.3	9,505.3	2,280.0	12,997.6
Total Electricity generated	MWh	28,896.1	226,568.2	54,345.4	309,809.7
Emissions avoided (i)	tCO2/ year	779	6,111	1,466	8,356
Specific CAPEX	€/kWp	713.5	603.3	653.4	622.3
Total CAPEX	Thousand €	659.32	4,389.62	1,132.04	6,180.98
Specific OPEX	€/kWp/year	23.5	10.9	19.0	13.5
Yearly savings by DH Company	Thousand €/year	510.5	523.2	496.1	350.2
Total Savings by DH Company	Thousand €	13,272.5	13,603.3	12,897	9,104.8
Savings by other utilities	Thousand €/year	3.2	637.5	72.4	958.4

Indicator	Unit	SPP-1	SPP-2	SPP-3	Combined SPP projects
		42 Samoilovycha Street	44 Samoilovycha Street	36 Vodopiina Street	
Total Savings by other utilities	Thousand €	80.0	15,936.5	1,809.5	23,959.7
Yearly OPEX	€/kWp/year	21,732.0	79,177.0	32,944.0	133,853
LCOE	€/kWh	0.055	0.04	0.05	0.043
NPV	Thousand €	6,624.27	37,090.77	9,637.40	50,006.34
PBP	Years	6	6	6	7

(i) Value provided for the first year of production

Other contractual scenarios could be envisaged including the use of the levelized cost of electricity of the SPPs or the average O&M costs instead of the DAM price structure, as well as sharing the transmission costs between the Company and the other municipal utilities.

The capital expenditures of the projects are estimated at €6.18 million. A contingency of 16.5% on top of these expenditures is required to account for risks related to the ongoing war, potential project delays, a lack of clarity on the payment of grid permitting costs, and a shortage of equipment on the local market. Considering contingencies, the total investment amounts to €7.2 million. The project's implementation is expected to span over 20 months.

In the next phases of the projects, it is important to: 1) finalize the transfer of ownership of the sites from the city to the district heating company; 2) confirm the feasibility of the grid connection and have more accurate estimates on the interconnection costs; 3) agree on the payment of the permitting costs between the concerned stakeholders; and 4) approach suppliers to secure the equipment for the projects and avoid delays. 5) establish agreements with local utilities for the supply of the surplus electricity produced by the solar plants.

2. INTRODUCTION

2.1 Project Background

Since the beginning of the Russian invasion on 24 February 2022, the city of Mykolaiv (The City) has experienced regular missile attacks, air strikes, and artillery bombardments targeting both critical infrastructure installations as well as public and residential buildings. The city's power supply has been severely disrupted with risks associated with heating provision particularly during the winter season.

The City is a part of Mykolaiv's territorial community. Due to war hostilities, the population of the City decreased from 491,000 before the invasion to 390,000 in early 2023.

The City's administration has been in close dialogue with the Danish Ministry of Foreign Affairs (MFA-DK) regarding early recovery investments in key infrastructure sectors, as well as longer-term recovery and reconstruction priorities, focusing on needs in the district heating, energy efficiency, water and sanitation, and solid waste sectors.

The City was chosen for the provision of direct assistance to build back better and re-establish municipal services for the population, following a direct request from the President of Ukraine to the Danish Parliament to address the emergency situation in the City.

The City and the Nordic Environment Finance Corporation (NEFCO) (The Client) have several years of cooperation within the district heating sector. NEFCO was assigned and entrusted by the MFA-DK to manage the ministry funds, facilitate the implementation of projects, and channel funds to Ukraine.

The proposed project is aimed at financing the installation of solar power plants (SPP)s to improve the resiliency of the electricity supply to the City's critical infrastructure. Improving the resiliency of the electricity supply is crucial for the heat supply company and the City due to the constant shelling of Ukraine's energy infrastructure by Russia. Constant shelling of energy infrastructure led to widespread blackouts in the country and total blackouts in cities. The installation of solar power plants is one of the important steps to provide the City's population not only with heating services but also with drinking water.

The installation of solar power plants will help the district heating company Mykolaivoblteploenergo (The Company) generate saving on its electricity expenses and improve its emissions footprint.

The Company and Mykolaiv CHP are the operators of the district heating system in the City. The Company provides district heating and water heating services, ensures stable operation of boiler houses, heating units and networks, carries out overhaul repairs of heating equipment, and develops design and construction documentation for heating facilities.

2.2 Scope of Work

Ramboll (The Consultant) was initially commissioned to perform a feasibility study for the installation of heat generation facilities using biofuel in the City.

After an initial analysis of the situation in the City and close consultations with the Company, Ramboll came to the conclusion that the construction of medium and large-scale thermal generation facilities involves high risks and technical challenges, including long construction time, the lack of highly qualified personnel that fled the region as a direct result of the ongoing armed conflict, the shortage of raw materials for the production of the biofuel, and the limited space for installing modular boilers of medium and high capacity. The increased construction price to account for the project risks will also negatively affect the financial performance of the project.

Therefore, at the request of the Company, the scope was changed to study the feasibility of SPPs in the City. SPP projects are not technically challenging to implement and can be implemented in a short time by local experts with minimum risks. SPP projects have a relatively shorter payback period (~6-7 years) and would help the Company reduce its electricity purchases from the grid.

The Client and the Company representatives selected three land plots for the development of the SPPs.

To assess the feasibility of the SPP projects, the Consultant performed the following tasks:

- Perform high level market analysis with a focus on the drivers and barriers for the development of SPP projects in Ukraine;
- Review of the Company's electrical demand;
- Assess site conditions and grid connection possibilities;
- Develop a conceptual layout of the SPPs
- Assess the financial viability of the Projects
- Perform a risk assessment of the Project implementation
- Prepare a high-level project implementation schedule.

3. OVERVIEW OF THE ELECTRICITY MARKET IN UKRAINE

3.1 Current Situation of the Power Sector

3.1.1 Energy Production

At the beginning of 2022, prior to the Russian invasion in February 2022, Ukraine's energy system had approximately 59 GW of installed capacity, mainly thermal and nuclear based power plants, including:

- 12 Thermal Power Plants (TPP)s with unit capacities ranging between 150MW and 800 MW;
- 4 nuclear power plants with unit capacities ranging between 415MW and 1,000 MW;
- 3 large Combined heat and Power plants (CHPs);
- 3 turbo generators.

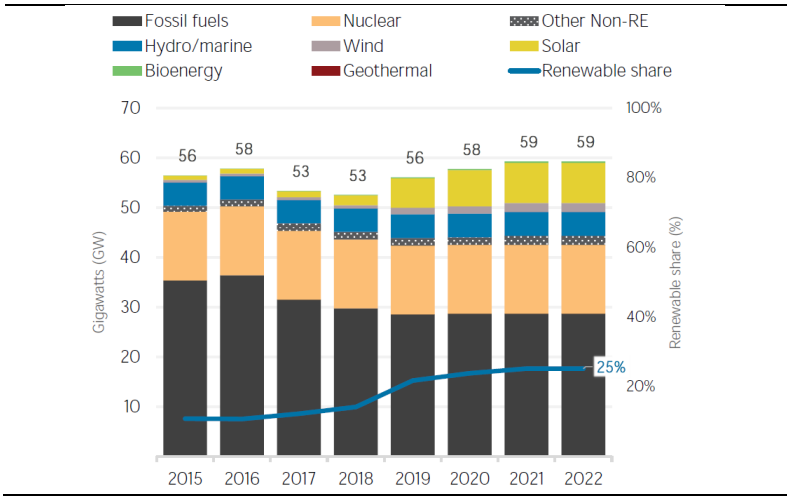


Figure 3-1: Installed electricity capacity trend in Ukraine

Source: IRENA, 2023

The renewable energy sector in Ukraine has been developing steadily since 2015 and its share reached 25% of the total installed generation capacity in 2022. In 2023, more than 146 MW of wind and about 500 MW of solar generation were commissioned. This represents a growth in installed capacity of over 6% over the period 2021-2023.[1] The country has also 10 hydroelectric power plants (HPP)s with a total installed capacity of 4,729.5 MW. As of the beginning of 2024, the installed capacity of renewable energy sources crossed the 10 GW mark.

However, with the outbreak of the war in different areas of the country, about 24% of the renewable energy capacity ended up in occupied territories. The seized energy facilities represent 13% of the country's solar plants and 70% of wind plants.[2]

Before the war, there were about 2,000 industrial solar power plants in Ukraine located mainly in Dnipropetrovsk (290 MW), Odesa (240 MW), Vinnytsia (230 MW), and Kherson (100 MW). Due to the hostilities, some of the SPPs were damaged or ended up in the occupied territory.[3]

[1] Ukraine has taken a significant step forward in the development of renewable energy sources despite the wartime

[2] Energy Security Talks: the results of the second "military" winter and the state of the energy system were discussed in the first series of events

[3] What solar energy lost and gained during the war in Ukraine

As for the production structure, nuclear power is the main generation source covering more than half of the country's demand, followed by thermal power plants. In 2023, electricity generated from renewable sources (HPP, SPPs, wind power plants (WPP), biomass, and biogas) is estimated at about 17% of the country's energy generation. [4]

In May 2023, Ukrenergo, the electricity transmission operator (TSO) in Ukraine, reported that the country lost 27 GW of power generation capacities due to the ongoing conflict.[5] According to the Kyiv School of Economics, the direct infrastructure damage from the fighting, amounted to almost €8 billion.[6]

The occupation of Zaporizhzhia Nuclear Power Plant (ZNPP), the largest nuclear power plant in Europe, after the invasion of Ukraine, could have changed the structure of electricity production, but this did not happen due to the loss of large industrial electricity consumers and a reduction in electricity consumption in general (Figure 3-2 and Figure 3-3).

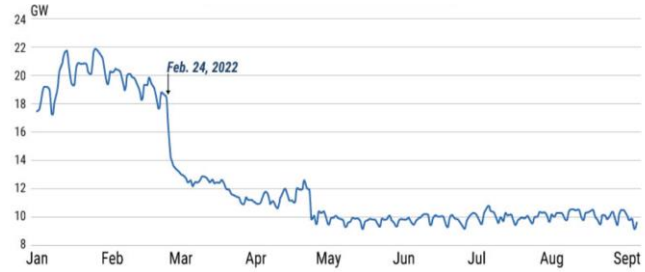


Figure 3-2: Electricity Demand in Ukraine, 2022

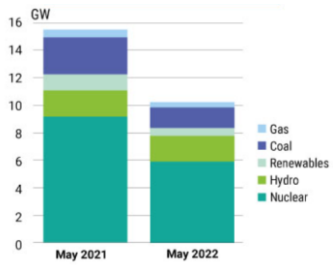


Figure 3-3: Energy production in Ukraine

Source: geopoliticalfutures.com

The continuous attacks on the cities energy infrastructure during the war resulted in long-term outages for a significant number of consumers and increased load and wear on backup power lines. Despite the large number of equipment transferred, and the rapid repair, replacement, and restoration works, the system stability and safety margin are at a critically low level. This pattern was also observed in 2023, albeit with less intensity. Nevertheless, the destruction of key generation facilities, such as Kakhovka and Dnipro HPPs, Kharkiv CHP 5, and Trypillia TPP, had a significant negative impact on Ukraine's power system.

The reduction in the operating capacity of generation facilities and severe damage to the power grid infrastructure made it impossible to cover the load in the power system in full, and, as a result, it was necessary to introduce blackout schedules throughout Ukraine. In some periods, the blackout lasted for five days. Such a situation had a negative impact on the quality of life of Ukrainian citizens and the operations of industrial enterprises, and social and municipal facilities, such as schools, hospitals, pumping stations, etc.

For most facilities, a power outage is unacceptable even for a short time. As a result, in the winter period of 2022-2023, most institutions were forced to install electric generators (EG). The use of internal combustion engine power generators in urban areas in compliance with all existing rules is virtually impossible. Moreover, their operation is costly.

3.1.2 Power Exchange

Simultaneously with the start of the invasion, Ukraine permanently disconnected its grid from the Russian and Belarusian power systems. The integration of Ukraine into the European Network of Transmission System Operators for Electricity (ENTSO-E) in March 2022 played a pivotal role in

[4] https://www.epravda.com.ua/columns/2023/12/26/708108/

[5] Ukraine loses 8 GW of energy capacity in recent months, April 2024

[6] https://kse.ua/wp-content/uploads/2024/04/01.01.24_Damages_Report.pdf

supporting the country's energy sector. With this new interconnection Ukraine started exchanging electricity with the European Union and Moldova (Figure 3-4).

Starting March 2024, the export and import capacities of the Ukraine/Moldova block were increased to 500 MW and 1,700 MW, respectively.[7] With this change, Ukraine doubled its electricity exports and imports in March 2024 compared to the previous month. The largest daily volume of electricity import in March 2024 was 18,741 MWh, and export was 13,337 MWh.[8]

Figure 3-4: Existing and planned Ukrainian international grid connections

Source: geopoliticalfutures.com

3.2 Drivers and Barriers to the Development of Renewable Energy in Ukraine

Renewable energies, particularly solar energy, are perceived in Ukraine as viable solutions to overcome the country's challenging energy situation. However, the development of the RE sector in Ukraine faces multiple challenges resulting from a combination of pre-war and post-war conditions. Conscious of the important role renewable energies can play in meeting national and international obligations in reducing greenhouse gas emissions and improving power supply, the Ukrainian government has enacted a series of measures to enable the fast and large-scale deployment of renewable energy plants.

In the next sections, we discuss the technical, legal, and economic drivers and barriers to the development of the RE sector in the country.

3.2.1 Technical Drivers and Barriers

The interconnection of renewable energy plants has always been a challenge, even before the Russian invasion. This issue was only accentuated by the constant and targeted Russian attacks on the Ukrainian electrical grid, leading to additional delays in the approval of requests for new RE units and an increase in interconnection costs.

The intermittency of renewable energy generation and the decrease in balancing capacities, due to the damage sustained by the thermal plants, add more constraints to a large deployment of RES. The Distribution System Operators (DSOs) are working to address these constraints. However, there is still a lack of clear and harmonized technical conditions for the integration of renewable energy sources (RES).

[7] ENTSO-E to raise export limit of Ukrainian electricity to 550 MW as of March 1, February 2024

[8] In March, Ukraine doubled its electricity imports, April 2024

In addition, the COVID-19 pandemic in 2020 led to serious disruptions in the supply chain of critical components of renewable energy systems. The lead time for transformer stations is more than 2 years. [9]

In contrast, the short construction period and modularity of the renewable energy plants could effectively contribute to addressing the growing energy demand locally and exporting electricity to support the European power system.

3.2.2 Political and Regulatory Drivers and Barriers

Political pressure from the rising Green Party and the population following the October 2019 smog that covered the capital and a large part of the country, as well as the energy crisis that started in spring 2020, contributed significantly to advancing the deployment of clean energy resources.

The Ukrainian government has since shown its interest in achieving the goal of energy decentralization and developing renewable energy infrastructure to diversify its energy mix and reduce its dependence on fossil fuels. The government is actively seeking partnerships and cooperation with international organizations and investors to develop the renewable energy sector. This cooperation can bring experience, technology, and financing to support the growth of the solar energy market in Ukraine. The main challenge for Ukraine to attract investors remains restoring the political stability lost due to the Russian invasion.

As for infrastructure facilities, the government's focus is on water utilities and heating companies. These companies are among the largest and least efficient consumers of electricity. At the same time, water utilities and heat generating companies are eternally hostage to tariff-related challenges and, at the same time, are obliged to buy electricity at market prices. As a result, businesses are totally dependent on local government subsidies.

On the legal side, the regulatory environment for RES has been subject to many revisions and uncertainties. Changes in legislation and the regulatory framework have affected market stability and predictability, shaking investor confidence. However, the adoption of Law No. 3220-IX (the Law) by the Ukrainian Parliament on June 30, 2023 signalled a positive change. In particular, the Law introduced new incentive mechanisms to stimulate the production of electricity from renewable sources and improve the functioning of the electricity market. Key points of the Law will be depicted in the next sections.

3.2.3 Economic and Financial Drivers and Barriers

The Ukrainian renewable energy market is facing several economic and financial challenges, particularly the accumulation of debts between market participants following the energy crisis that started in the country in spring 2020. As of November 2023, market participants owe the Ukrainian Transmission system operator (TSO), Ukrenergo, about €1.4 billion. In turn, Ukrenergo owes them €1.2 billion, of which €0.7 billion is owed to the State Company Guaranteed Buyer (SCGB). [10]

The decrease in overall resilience caused by regular shelling during winter 2023 contributed further to the accumulation of additional debts. Settling these debts is crucial to guarantee prospects for future development in the renewable energy sector and system decentralization. The adoption of Laws No. 3141-IX (REMIT) and 3220-IX (Green Transformation) in 2024 laid the foundation for changes in tackling these challenges.

The amendments included in Law 3220-IX are particularly aimed at addressing the economic and financial difficulties in the market. The Law introduced two new incentive systems (the market premium mechanism and the self-generation mechanism), brought changes to the feed-in-tariff

[9] Supply shortages and an inflexible market give rise to high power transformer lead times, April 2024

[10] Energy transformation of Ukraine: results of the first year

(FiT) and auction systems, and introduced the notion of Guarantees of Origin (GoO) for electricity produced by RES.

3.2.3.1 The market Premium Mechanism

This mechanism is an alternative incentive system for a RE project owner that has been attributed a FiT or the winner of an auction. This mechanism provides that a guaranteed buyer would pay for the difference between the FiT or auction price and the estimated market price. In the case that the auction price is lower than the market price, the RE project owner has to pay the difference to the guaranteed buyer.

3.2.3.2 Self-generation Scheme (Net-billing)

The Ukrainian government introduced a self-generation mechanism for active consumers to reduce the electricity demand from the general grid. This model allows consumers to install generation units (e.g., solar panels) to cover their needs and inject the surplus into the grid.

According to the Law, an active consumer can produce, consume, store electricity, and sell the surplus. An active consumer can be a private household, a cooperative, a municipal entity or any other institutions with critical infrastructure.

The cost of electricity for the active consumer is determined monthly based on the results of hourly balancing of the cost of electricity injected into the grid and the cost of electricity withdrawn from the grid (consumption), considering the costs of electricity transmission and distribution services, which are separately paid to a universal service provider (USP) (only for private households and small non-household consumers) or other electricity suppliers. As of the first day of the calendar month after the end of the billing period, the funds accumulated for the injected electricity are used first and foremost automatically to pay for the withdrawn electricity and transmission and distribution services.

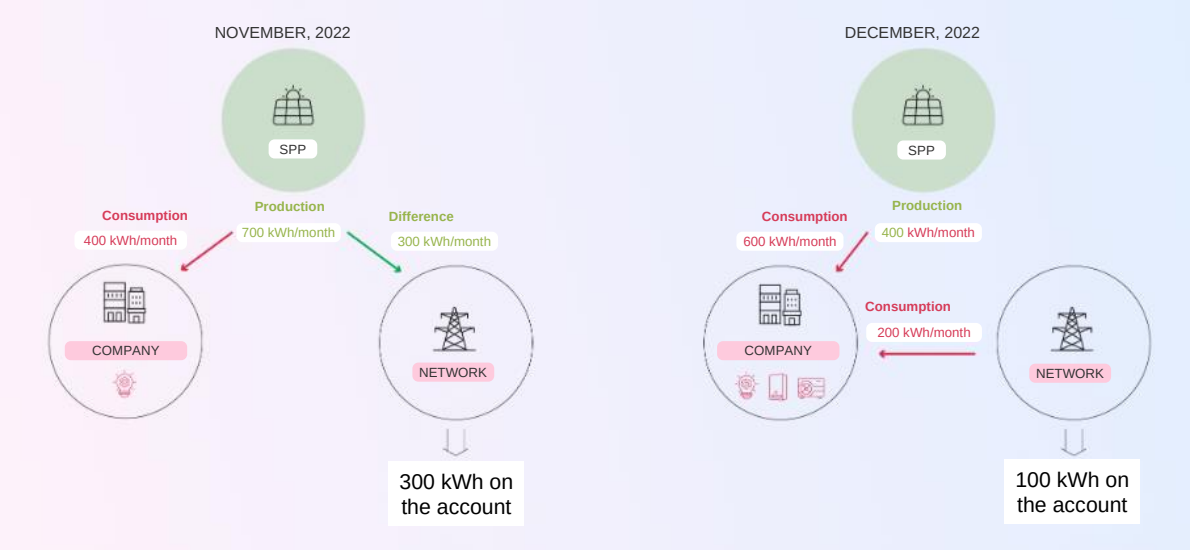


Figure 3-5: Graphical explanation of the self-generation mechanism

Note: figures are conditional

Active consumers can supply electricity to their own buildings and neighbouring households and companies connected to their generating facility. They must install a commercial metering unit, determine the supply price and terms, and conclude a self-generating electricity purchase and sale agreement. This mechanism does not require permits for electricity production or supply provided that the installed capacity of such generating facilities at one metering site does not exceed 5 MW.

An active consumer also has the right to connect third-party energy storage facilities to its own power grids. Such facilities can be used to provide balancing services, ancillary services, and/or the purchase and sale of electricity in organized market segments.

Operations under the self-generation mechanism are carried out under a Power Purchase Agreement (PPA), which is an annex to the agreement on the electricity supply to the consumer.

Surplus electricity is supplied to household consumers and small non-household consumers who have entered into an agreement at the day-ahead market (DAM) price. If the facility uses an energy storage system, the price of electricity supply at which it can operate with the USP is the general DAM price, which is higher than the DAM price, for example, during daytime hours. If small non-household and other consumers conclude an agreement with a separate electricity supplier instead of the USP, they will supply electricity at free prices agreed upon in the agreement.

The Law defines the capacity limit within which it is possible to install a generating facility for the use of the self-generation mechanism:

- Private households: an installed solar or wind capacity of up to 30 kW;
- Small non-household consumers: an installed solar and wind capacity of up to 50 kW;
- Other non-household consumers: generating electricity from solar, wind, biomass, biogas, hydropower, and geothermal energy, provided that their installed capacity does not exceed the permitted (contractual) capacity of such consumer's electrical installations intended for electricity consumption.

The Law also restricts the permitted grid-connected power of an active consumer (except for household and small non-domestic consumers), from exceeding 50% of the permitted (contractual) power of such a consumer.

Non-household consumers are prohibited from concluding simultaneously a FiT and a self-generation PPAs for the same generating system.

The self-generation mechanism presents another challenge for the active consumer: balancing the quantity of electricity supplied to the network. Indeed, the Law stipulates that an active consumer with an installed capacity of more than 1 MW loses its status for a calendar year if, in the previous calendar year, the volume of electricity supplied by its generating units to the grid exceeded 50 percent of its total electricity consumption.

For generating units up to 1 MW under the self-generation mechanism, the Ministry of Energy of Ukraine stated that balancing the surplus of electricity will be carried out monthly. In this case, the owner of the generating unit will need to control and possibly limit the supply to the grid during the period of higher annual insolation. In the autumn-winter period, it will not be possible to consider the energy supplied to the grid during the spring-summer period.

Therefore, for a non-household active consumer, the need to increase the capacity of the generating unit will depend on its operation schedule, as the active consumer will not be able to accumulate enough energy in the summer to cover the winter demand if the installation capacity is below 1 MW.

3.2.3.3 Changes to the Feed-in-Tariff

The Law extended the commissioning period for renewable energy facilities until December 31, 2023, except for solar energy, for installations with a FiT agreement. In addition, the Law allows for renegotiating FiT and grid connection agreements. If parties agree on a reasonable revision of connection service costs, technical conditions will remain valid until December 31, 2025. Private household installations commissioned as of January 1, 2024, will have a FiT agreement.

The Law expands the list of counterparties to RE projects under service agreements to ensure price stability. It grants the right to enter into such agreements to consumers, electricity suppliers, and traders. The Law also distinguishes an agreement on participation in the balancing group of the guaranteed buyer (GB), which must be approved by the Regulator.

The Law also allows the Ukrainian government to approve the GB's trading policy, aiming to increase profitability and FiT payments. The GB must consider these principles when buying and selling electricity. The state's obligation to purchase all electricity generated from RES is limited to the installed capacity of generating equipment.

3.2.3.4 Changes to the auction system

The main changes to the auction system are described below:

- A service provision agreement based on the market premium mechanism will replace the PPA based on auction results.
- The TSO is the only body with the authority to prepare proposals for the amount of annual support quotas.
- The period for construction and commissioning of an SPP has been reduced from 2 years to 18 months from the date of conclusion of the auction-based service agreement under the market premium mechanism.
- The term of auction support is reduced from 20 to 12 years.
- RES auction winners can lease state and municipal properties for the construction of SPPs without holding an auction under the Law of Ukraine "On Lease of State and Municipal Property".
- The government may set the maximum price offer of the auction participant.

3.2.3.5 Solar Power Plants for Businesses

Installing an SPP is beneficial for any business, especially if the operation takes place during daylight hours. Today, privately owned SPPs are becoming a real salvation for businesses of various categories. The installation of the plant will:

1. Significantly reduce electricity costs. In 2023, they grew by 50% for the nighttime period, 40% for the daytime hours, and 80% for the evening period. Installing an SPP will save up to 80% on electricity bills.[11]
2. Reduce production costs and become more competitive in the market.
3. Protect the operation from accidents on the centralized system and outages.
4. Become independent of rising electricity prices.

Installing an SPP for business is one of the most profitable investments that will pay off within 4 years or less. Owners of solar power plants receive:

1. An inexhaustible resource generator at the lowest price.
2. Durable equipment. Solar panels are designed for 20-30 years of operation. So, after the investment is paid back, the owner will receive a net profit.
3. Opportunity to save money.

Businesses and utilities pay an average of €0.19/kWh for electricity from the grid. During the winter of 2022-2023, due to the blackouts caused by Russian attacks on the power grid, the cost of electricity was twice as expensive due to the use of generators and liquid fuel.

High electricity prices and the declining costs of SPPs encourage companies to install them for self-consumption.

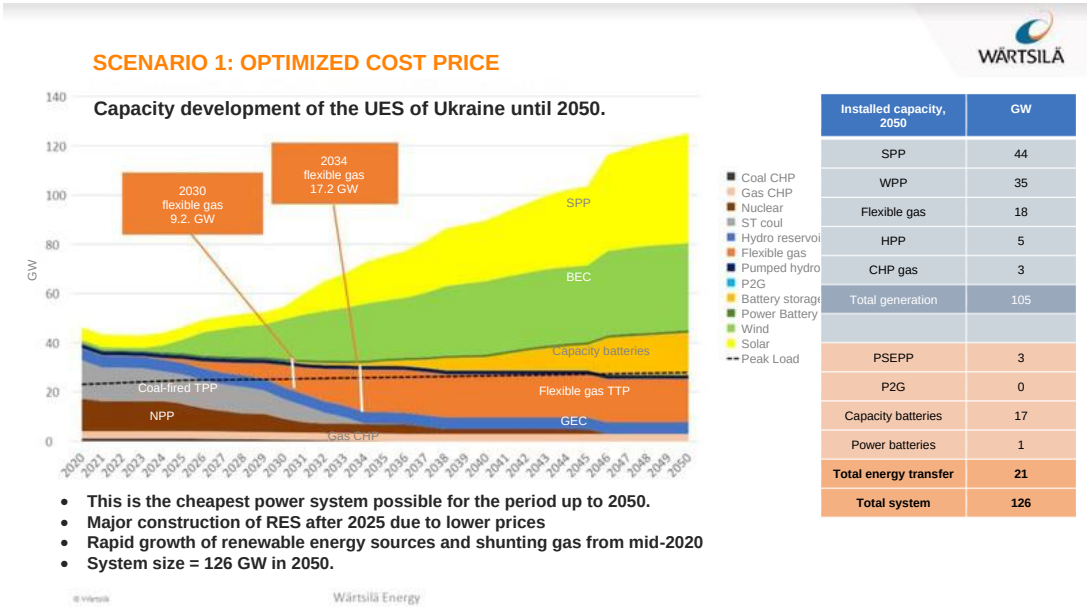
3.3 Development Prospects for the Renewable Energy Sector

According to *Wärtsilä*'s optimized scenario (Figure 3-6) for the development of the United Energy System (UES) of Ukraine, solar and wind power will become the mainstay and dominate in terms of volumes starting in the mid-2030s, reaching 83% by 2050. The capacity of SPPs and WPPs will be 44 GW and 35 GW, respectively. This model also allocates 18 GW to batteries as of 2050. [12] In the

[11] Zero profit and total energy efficiency. Rising electricity tariffs are forcing retailers and food manufacturers to raise prices.

[12] Pickers and balancers: What technologies does Ukraine's energy system need?

near term, wind and flexible gas generation will grow rapidly. By 2030, there is a need for 9 GW of flexible gas generation.[13]



Installed capacity, 2050	GW
SPP	44
WPP	35
Flexible gas	18
HPP	5
CHP gas	3
Total generation	105
PSEPP	3
P2G	0
Capacity batteries	17
Power batteries	1
Total energy transfer	**21**
Total system	**126**

Figure 3-6: Forecast of the development of energy generation

Source: Wartsila Energy

[13] Tripling Global Renewables by 2030

4. ASSESSMENT OF SITE CONDITIONS

4.1 Site Selection

The Company and the City identified several sites for the possible installation of SPPs. For safety reasons, the Consultant recommended excluding some of the pre-selected sites from the project. Based on the analysis of the City's urban areas, three plots were selected and allocated for the development of ground-mounted SPPs:

- **Land plot No. 1 -** 42 Samoilovycha Street
- **Land plot No. 2 -** 44 Samoilovycha Street
- **Land plot No. 3 -** 36 Vodopiina Street

All sites are located in Mykolaiv, as shown in Figure 4-1. All sites were physically inspected to provide the most reliable information.

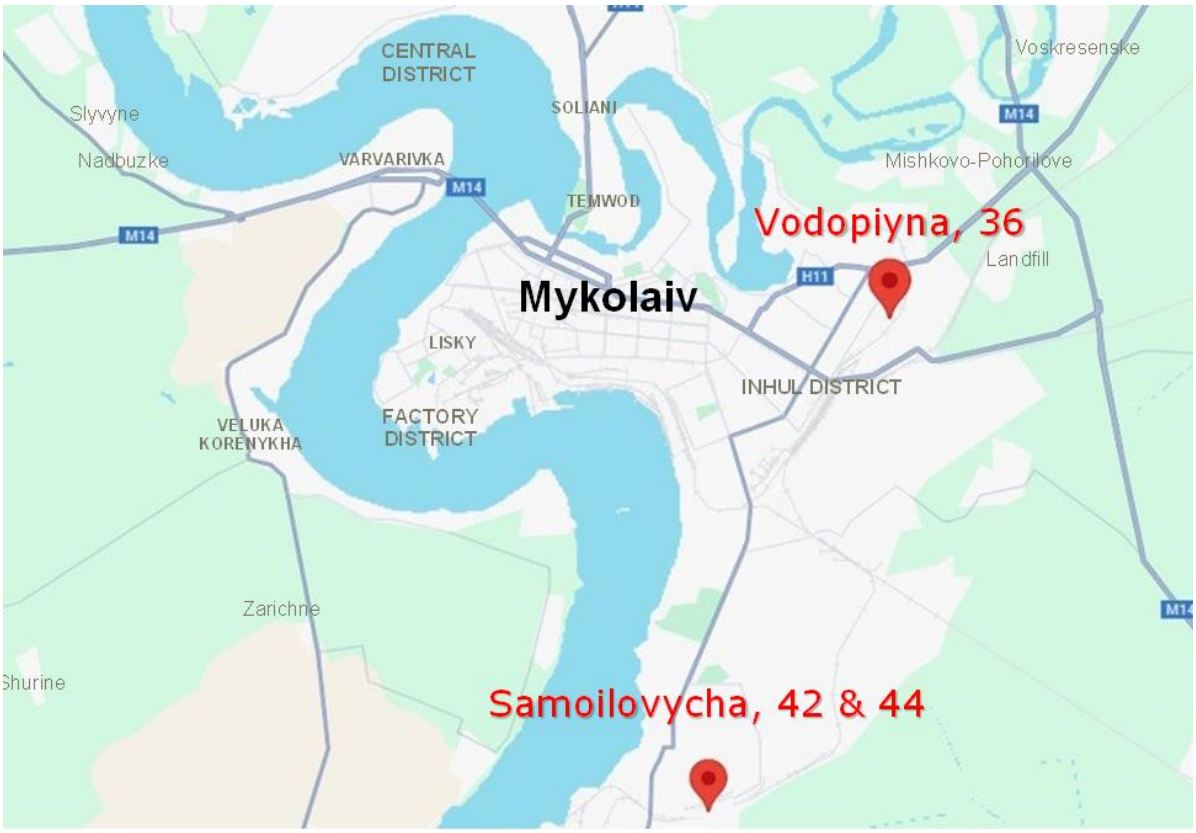


Figure 4-1: Location of the selected sites for the project

4.1.1 Land Plot No. 1 - 42 Samoilovycha Street

The first land plot selected for the project is located in the Korabelnyi district, near the territory of the boiler house at 42 Samoilovycha Street, with an area of 1.4 ha. According to the open data of the Land Cadastre of Ukraine, cadastral number 4810136600:07:029:0012, this land plot was formed with the intended purpose of the placement, construction, operation, and maintenance of buildings and structures of electricity and heat transmission facilities, following the classification of types of land purpose: J.14.02.

The plot is completely free and has wide, free access. Additional work will be done in advance to prepare the site (garbage removal, cutting down wild trees, levelling the site, etc.). The land plot is owned by the City and is being transferred to the Company’s balance sheet. The tentative deadline for processing all documents is the beginning of July 2024.

Figure 4-2: Aerial view of land plot No. 1 (approximate boundaries)

Figure 4-3: Ground view of land plot No. 1

4.1.2 Land Plot No. 2 - 44 Samoilovycha Street

The second land plot is located in Korabelnyi district, 44 Samoilovycha, with an area of 36.0 ha. According to the open data of the land cadastre of Ukraine, cadastral number 4810136600:07:029:0009, this land plot is formed with the intended purpose of the placement and operation of main and auxiliary buildings and structures of processing, machine and other industries, following the classification of types of land purpose: J.11.02

The plot is completely free and has a significant potential for the installation of an SPP. Additional work will also be done in advance to prepare the site (garbage removal, cutting down wild trees, levelling the site, etc.).

The land plot is owned by the City and is being transferred to the Company's balance sheet. The tentative deadline for processing all documents is the beginning of July 2024.

Figure 4-4: Aerial view of land plot No. 2 (boundaries according to the cadastre)

Figure 4-5: Ground view of land plot No. 2

4.1.3 Land Plot No. 3 - 36 Vodopiina Street

Th third land plot is located in Inhulskyi district, within the territory of the company at 36 Vodopiina Street. The plot has an approximative area of 3.5 ha and has a formed asphalt access. The Company will additionally prepare the site by dismantling old structures, removing garbage and dismantled elements, cutting down wild trees, and levelling the site.

Figure 4-6: Aerial view of land plot No.3 (approximate boundaries)

Figure 4-7:Ground view of land plot No. 3 (south side)

Figure 4-8: Ruins to be dismantled land, plot No. 3

4.2 Site Conditions

The assessment of site conditions is based on desktop research. The next paragraphs describe the meteorological and environmental conditions relevant to the design of SPP projects.

4.2.1 Solar Resources

The solar resource dataset represents one of the key inputs for PV system performance simulation. The uncertainty a solar resource estimate can have on the total energy uncertainty ranges from 5% to 17%.[14] Reliable and bankable energy assessment requires accurate values of solar irradiance data that are based on high spatial resolution, a long-term time series dataset, and site-specific measurement.

In the absence of ground-measured data, Ramboll relied on satellite-based solar data to produce an accurate solar resource dataset. Therefore, the following statements can only be seen as assumptions that have to be verified through additional databases and ground measurements.

As shown in figures Figure 4-9 and Figure 4-10, the country has ideal conditions for solar energy production. The long-term average of the global horizontal irradiation (GHI) could exceed 1,325 kWh/m² in Mykolaiv, with a PV power potential that could reach 1,320 kWh/kWp.

[14] Schnitzer, M, et al (2011). "Reducing uncertainty in Bankable Solar Resource and Energy Assessment through On-site Monitoring" Proceedings of the 2011 ASES National Solar Conference, American Solar Energy Society, 2011.

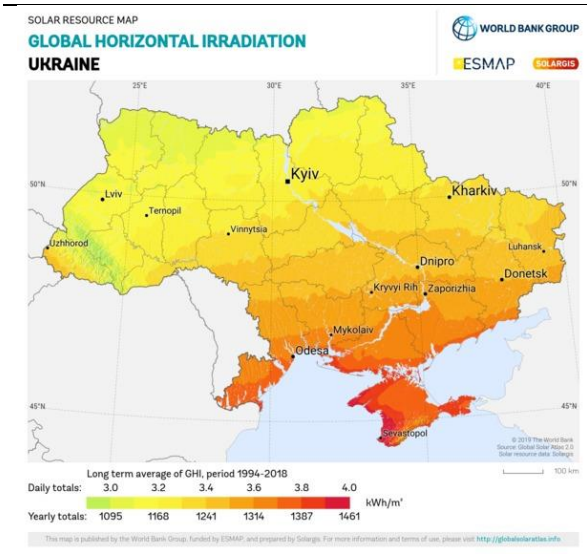


Figure 4-9: Map of global horizontal irradiance in Ukraine

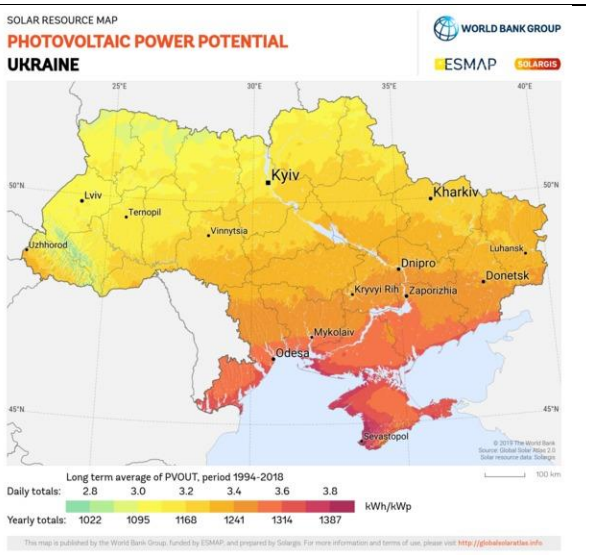


Figure 4-10: Map of photovoltaic power potential in Ukraine

Table 4-1 presents the global and diffuse horizontal irradiation (DIF) in Mykolaiv obtained from different solar resource databases.

Table 4-1: Solar resource in Mykolaiv

Source		Global Solar Atlas	Meteonorm	PVGIS
Global horizontal irradiation	GHI (kWh/m²)	1329.2	1351.2	1350.6
Diffuse horizontal irradiation	DIF (kWh/m²)	584.6	606.1	567.5

A synthetic time series for the project site was created in PVsyst, and it was possible to extract the average monthly GHI and DIF values for the site. Table 4-2 shows that the solar regime in the City could be divided into two periods. The first period (March to October) with relatively high GHI values and the second period, from (November to February) with lower GHI values.

Table 4-2: Monthly global horizontal and diffuse irradiance in Mykolaiv

	Meteonorm		PVGIS	
Month/ Values	GHI (kWh/m²)	DIF (kWh/m²)	GHI (kWh/m²)	DIF (kWh/m²)
January	35	17.8	37.4	20.9
February	53.5	31.5	46.9	29.3
March	100.3	49.6	109.1	48.9
April	142.4	70.1	142	59.8
May	187.2	77.8	154	68.6
June	197.8	79.8	189.9	74.7

	Meteonorm		PVGIS	
Month/ Values	GHI (kWh/m²)	DIF (kWh/m²)	GHI (kWh/m²)	DIF (kWh/m²)
July	197.6	79.3	203.8	76.7
August	170.3	69.9	174.2	63.9
September	122.9	46.8	144.9	47.3
October	78.7	41.3	85.8	38.5
November	37.3	25.2	39.3	22.3
December	28.2	16.9	23.3	16.6
Year	**1351.2**	**606.1**	**1350.6**	**567.5**

4.2.2 Temperature and Precipitation

The climate of the Mykolaiv region is temperate continental, with low rainfall, warm, often dry summers, and relatively mild, unstable winters. Mild frosts (-2 to -5ºC) are often followed by thaws; temperatures dropping to minus 20 ºC are rare and short-lived. The snow cover is unstable.

The average annual temperature is 10.1°C. The absolute maximum temperature is plus 39.4°C and the absolute minimum temperature is minus 26.0 °C. The heating period lasts 161 days. Figure 4-11 shows the average monthly temperature in the project area.

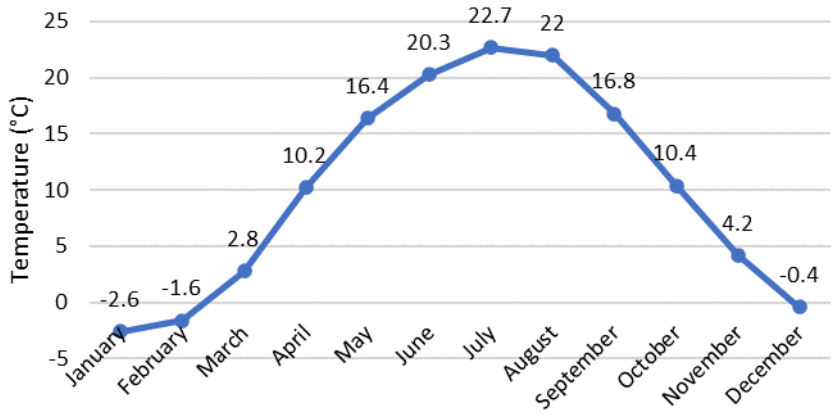


Figure 4-11: Average monthly air temperature in Mykolaiv

Precipitation is unevenly distributed over the seasons in Mykolaiv, with an annual average of 434.6 mm and a long-term average of 406 mm. The annual course is marked by a predominance of precipitation in the summer months. In this period, precipitation falls in the form of short-term storms, as a result of which the bulk is spent on surface runoff, evaporation, and only a small part on infiltration. The autumn and winter seasons are characterized by prolonged, low-intensity rains. During these seasons, infiltration increases, and there is a widespread rise in groundwater levels. The average annual number of days of rainfall is 63.

4.2.3 Snow and Wind Characteristics

When designing the structure for a solar power plant, one of the most important technical decisions is to calculate the maximum snow and wind loads, which determines the design of the supporting system, the thickness of the supporting structure elements, and other important specifications. These calculations are made during the development of design and cost documentation according to "DBN B.1.2-2:2006 Systems for Ensuring Reliability and Safety of Construction Facilities. Loads and Impacts. Design Standards".[15]

The snow cover in Mykolaiv rarely exceeds 10-12 cm. The average annual number of days with snow cover is 46. Mykolaiv belongs to the area with a snow load of 1,000 Pa (see Figure 4-12).

Figure 4-12: Snow zones in the territories of Ukraine

The average annual wind speed is 3.9 m/s. The prevailing wind direction in winter and summer is north, northeast, and east. Winds with a speed of 15 m/s and above are most common in the cold season. The average number of days with such winds is 1-2 during the year. In the warm season (April - October), a well-defined breeze wind circulation prevails during the day from the south, in the evening and at night from the north. The wind load in Mykolaiv is 500 Pa (see Figure 4-13).

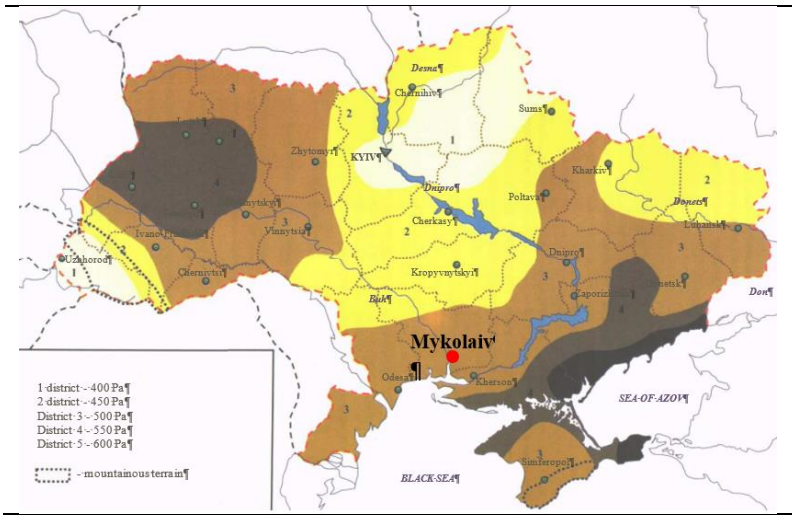


Figure 4-13: Wind zones in the territories of Ukraine

[15] DBN B.1.2-2:2006 Systems for Ensuring the Reliability and Safety of Construction Facilities. Loads and Impacts. Design Standards https://dbn.co.ua/load/normativy/dbn/1-1-0-753

4.2.4 Seismic Activity

Design and construction should consider seismic activity. This is done by considering the DBN B. 1.1-12-2014 Construction in Seismic Areas of Ukraine[16]. These construction codes set out the mandatory requirements that must be met by the designer when designing a solar power plant to protect against the negative effects of seismic events. The map of seismic activity is presented below. The sites are in the seismic zone 5.

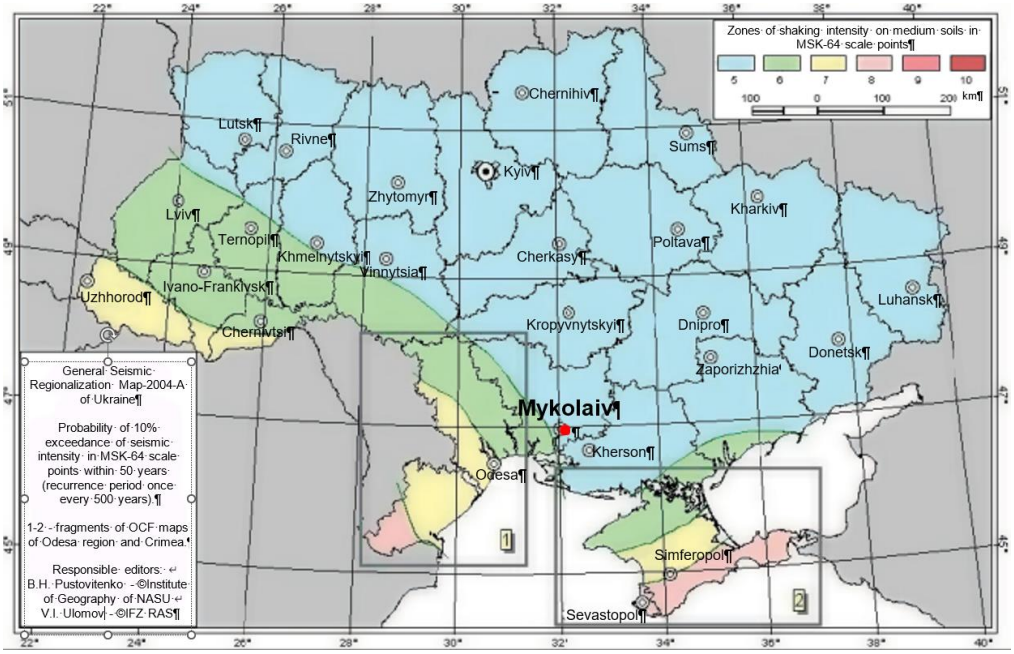


Figure 4-14: Map of general seismic zoning of Ukraine

[16] DBN B.1.1-12-2014 Construction in Seismic Areas of Ukraine https://e-construction.gov.ua/laws_detail/3038077155897509804?doc_type=2

5. TECHNICAL ASSESSMENT

5.1 Solar Plant Components

The first step in the conceptual design process is to select the components that will be used as the basis for the design. This selection considers both the technical performance, the suitability of the product for the site conditions, and its availability on the market.

It is important to note that the selection of equipment used to inform the 'high-level' concept design at this stage of the project is preliminary and based on the currently available technologies in the PV industry/market.

5.1.1 Photovoltaic Modules

A photovoltaic (PV) module or panel is a set of series-connected solar cells, packaged into a protective multi-layered structure. A typical PV module has 7 main components (Figure 5-1): Metal frames consisting of racking components, and brackets are used to better support the panel structure; a front cover (tempered glass); the electrical circuit (the interconnected solar cells matrix) in an envelope of two encapsulant layers (front/back); a back cover (back sheet or tempered glass) and a junction box to export the produced DC power.

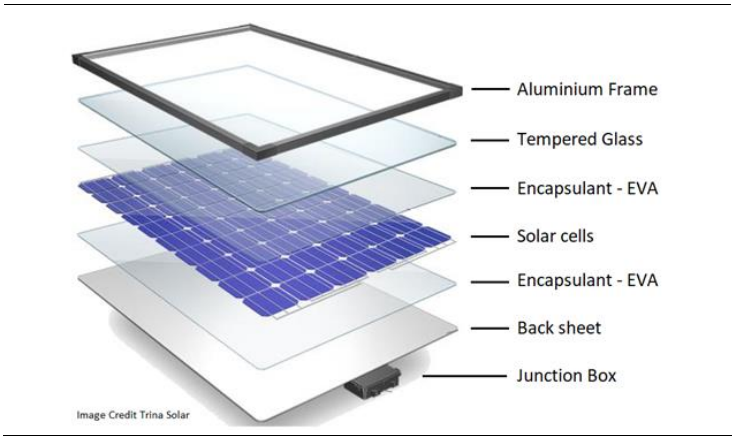


Figure 5-1: PV module components

Source: Trina Solar

The calculations were based on the use of a PV module with a capacity of 550 W. The main technical specifications of the selected PV module are shown in Table 5-1. These specifications are indicative. The final parameters will be determined based on the results of the tender procurement.

Table 5-1: Main technical specifications of the PV module

No.	Parameter	Value at standard test conditions (STC)
	Electrical parameters	
1.	Maximum power, W	550
2.	No-load voltage, V	49.90
3.	Short circuit current, A	14.00
4.	Maximum power voltage, V	41.96
5.	Maximum power current, A	13.11

No.	Parameter	Value at standard test conditions (STC)
	Temperature parameters	
6.	Module efficiency, %.	21.3
7.	Maximum assembly voltage, V	1500
8.	Nominal operating temperature of the cells (NOCT), °C	45±2
9.	Temperature coefficient for power, %/°C	–0.35
10.	Temperature coefficient for no-load voltage, %/°C	–0.275
11.	Temperature coefficient for short-circuit current, %/°C	0.045
	Mechanical parameters	
12.	Operating temperature range, °C	–40…+85
13.	Overall dimensions, mm	2,278×1,134×35
14.	Weight, kg	28.1
15.	Type of solar cells	Monocrystalline
16.	Protection level according to GOST 14254-96	IP68
17.	Type of connectors	MC-4

5.1.2 Inverters

PV inverters are among the key critical components of a solar PV installation. They determine the efficiency and reliability of the entire system. Inverters are solid state equipment used to convert modules or arrays' direct current to alternative current.

In addition, today's inverters provide other services to help ensure PV systems operate at optimal performance level including maximum power point tracking (MPPT), data monitoring and anti-islanding protection.

The calculations assume that the facilities will be equipped with string inverters with a rated capacity of 100 kW.

The inverters must be tested and comply with the VDE-AR-N-4105 grid standards: this implies ensuring the quality and reliability of the grid. The inverters should also include the following features:

- Limiting the maximum rate at which the active power of PV modules can be changed in the event of a change in solar radiation intensity or a change in the absolute power limitation setpoint;
- Regulation of reactive power;
- Power factor adjustment;
- Voltage regulation.

The inverters shall have a minimum ingress protection of IP65 and RS485 as the main communication interface.

When choosing the inverters for the design, the following features should be noted:

- High efficiency (efficiency of at least 96.0%);
- A high-speed and accurate MPPT algorithm that provides real-time monitoring of power output to increase energy production;
- Flat efficiency curves that ensure high efficiency at all output power levels and constant and stable operation at different input power levels;
- High quality of electricity supplied to the grid;
- Built-in control and monitoring systems for the general power grid, which allow synchronizing the inverters with the grid to ensure uninterrupted operation of the SPP;

- Built-in system for monitoring the operation of PV strings;
- Mandatory monitoring system that allows to set operating parameters and receive production data.

The inverter must have input protection against overvoltage and polarity reversal. The inverter must be equipped with the following automatic functions:

- Two channels for the search for the maximum power point (MPP) of the PV modules;
- Stopping the supply of energy to the grid when the power generated by the PV modules falls below the specified minimum power limit;
- Stopping the supply of energy to the grid and alerting with a warning signal if the input (DC) or output (AC) voltage changes above or below the permissible value, as well as if the frequency (AC) deviates from the tolerance;
- Insulation status detector with warning signal.

The main technical specifications of the selected solar inverter are shown in Table 5-2. These specifications are indicative. The final parameters will be determined based on the results of the tender procurement.

Table 5-2: Main technical specifications of a 100-kW inverter

No.	Parameter	Value
1.	Maximum efficiency, %	98.8
Input parameters		
2.	Maximum voltage, V	1100
3.	Operating voltage range of the MPPT controller, V	200-1000
4.	Initial energy drop voltage, V	200
1.	Maximum string current, A	20
2.	Number of DC inputs per one MPPT	2
3.	Number of MPPT controllers	10
Output parameters		
4.	Rated active power, kW (kVA)	100 (110)
5.	Rated voltage, V	380/400
6.	Rated current, A	144.4
7.	Network frequency, Hz	50/60
Protection		
8.	Disconnector on the DC input	Yes
9.	Protection against islanding	Yes
10.	Protection against AC over currents	Yes
11.	DC reverse polarity protection	Yes
12.	Failure monitoring of each PV string	Yes
13.	DC overvoltage protection	Type 2
14.	AC overvoltage protection	Type 2
15.	DC isolation monitoring	Yes
16.	Leakage current monitoring device	Yes
17.	Protection against arcing	Yes
Mechanical parameters		
18.	Overall dimensions, L x W x H, mm	1035x700x365
19.	Operating temperature range, 0C	-25…+60
20.	Weight, kg	43
21.	Protection level according to GOST 14254-96	IP66

5.1.3 Racking System

The racking system must be designed to meet the requirements described in Section 4.2.3.

There are three types of foundations used for the PV mounting structure (Figure 5-2). A brief account of each type of foundation and its best application is described below.

Pile-driven foundation: This foundation uses piles driven (inserted) into the soil to anchor the mounting structure. It comes in various size categories. The driven piles grant optimum anchoring in the soil and maximum bending stiffness for the PV power plant. It provides the power plant with optimum structural wind and load resistance. Key advantages of the pile driven foundation are:

- Low material needs
- Cost-effective
- Can be flexibly adapted to the highest wind loads by sufficiently dimensioned or more ground screws
- Fast pile-driving (in case there are no big rocks in the ground)
- Optimal structural safety against wind loads.

Earth screw foundation: This foundation resembles the pile-driven foundation except it uses a steel screw in piling. The disadvantages of earth screw foundations are their limited commercial availability to be sourced locally; they require special machinery to drive the pile, and it is more complicated to adapt them to mesoscale geological changes at large sites.

Concrete foundation: This foundation uses concrete to anchor the mounting structure. It is best used in rocky soil where the size, density, and number of rocks make ground penetration impractical, or in sandy soil areas, which cannot provide support for penetration method foundation, and in high water table areas, which cannot provide adequate support and may lead to corrosion of the penetrating anchor. Prefabricated concrete blocks are also a viable alternative.

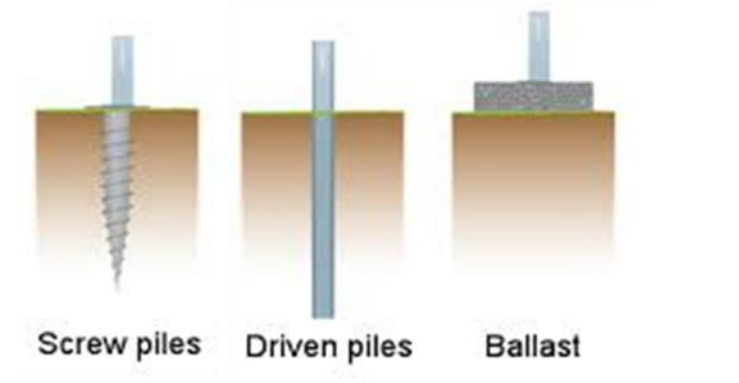


Figure 5-2: Types of foundations for PV mounting structures

The site with hard ground conditions, bedrock close to the surface, or inadequate soil sheer strength will require pre-drilling combined with compression of the drill holes with gravel or concrete.

Table 5-3 summarises the selection criteria for the foundations of PV mounting structures.

Table 5-3: Summary of racking foundation selection

	Driven Piles	Screw Piles	Ballast
Best used for the following sites	Dense sand/clay/gravel Low water table site High soil cohesiveness	Hard soil/rock Low water table site High soil cohesiveness	Loose sand Rocky soil High refusal High water table site Low soil cohesiveness
Other considerations	Lower cost	Higher cost Specialized equipment	Lower cost

The Consultant prepared a preliminary design for the PV mounting system. Annex 1 - Pages 1-2 provides the structure design details.

5.2 Conceptual Design

The second step in the design process is to define the plant/string topology. The local electrical code and other relevant standards (e.g., fire protection) should be followed to ensure that the installation is safe and compliant. The design methodology is summarized below:

- Specify site conditions affecting component performance such as maximum and minimum ambient temperatures on-site.
- Determine the number of modules per string. Using the maximum open circuit voltage of the modules (obtained for the lowest ambient temperature) to determine the largest number of modules in series that comply with the maximum input voltage of the inverter but also with the MPP voltage range.
- Determine the total number of strings for the estimated capacity that complies with the maximum short circuit current of the inverter.
- Create a 3D shading scene, including obstacles onsite, to compute optical losses.
- Run the yield simulations.
- Check the loss diagram and optimize the design to reduce the electrical and optical losses.

Considering the technical characteristics of the selected PV components, 15 PV modules will be connected in series to ensure the required voltage at a string level. The strings are connected to inverters located near the rows of PV modules in such a way as to minimize power losses in the DC grid.

The maximum capacity of the SPP for each site was determined based on the physical dimensions of each site, considering its shape, orientation relative to the cardinal points, surrounding buildings, the presence of underground utilities, overhead power lines, and their protection zones.

Multiple configurations of the PV table structure were examined to determine the optimal combination of the pitch angle, table width, and inter-row distance. To maximize the DC capacity and reduce shading losses and electrical losses, Ramboll proposes to install PV modules in portrait (2V) with a pitch angle of 30°.

For the site located at 44 Samoilovycha Street (SPP-2), given the considerable capacity, a possible restriction from the distribution system operator was additionally considered, namely, the installed capacity of the SPP was taken at the level of the maximum capacity of one transformer of the 35/6 kV Teplychna substation. This solution will make it possible to supply all the electricity generated by the SPP through a single transformer without restrictions. More details on the grid connection opportunities are provided in Section 5.3.

A more accurate estimate of the maximum installed capacity of an SPP is possible only after receiving the initial data from the distribution system operator and performing the relevant calculations.

The conceptual designs for each site are provided in Annex 1 - Pages 3-8. A summary of the SPP design is provided in Table 5-4.

Table 5-4: Conceptual design of the SPPs

Item	SPP-1 42 Samoilovycha St.	SPP-2 44 Samoilovycha St.	SPP-3 36 Vodopiina St.
DC Capacity (kWp)	924	7,276.5	1,732.5
AC Capacity (kW)	800	6,300	1,500
DC/AC ratio	1,155	1,155	1,155
Configuration	15 modules per string / 2 Modules Vertical (portrait)	15 modules per string / 2 Modules Vertical (portrait)	15 modules per string / 2 Modules Vertical (portrait)
Pitch (m)	11,18	11,10	11,18
Module Tilt / Azimuth:	30º/0º (South)	30º/0º (South)	30º/0º (South)
PVM Capacity (Wp)	550	550	550
Nº of panels	1,680	13,230	3,150
Inverter Capacity (kW)	100	100	100
Nº of inverters	8	63	15
Nº of Transformers	1	7	2

5.3 Consideration of Grid Connection Opportunities

The grid connection options for the solar power plants, described in this section, are based on publicly available data. These options are preliminary and include the supply of the SPP production to the Company's boiler houses and other utilities through direct connection lines or using the public grid. The technical requirements for such connections are required to confirm the points of interconnection (POI) and to assess the scope and cost of construction work.

There are already several operating solar power plants in the area of the selected project sites (see Table 5-5). This may impose a decrease in the capacity of the SPPs at the project sites due to lack of capacity of the power grid.

It should also be considered that if the technical requirements from the regional utility include equipment that should be transferred to its balance sheet, this equipment and works should be financed by the Company or the City, since the grant funds can only be spent on equipment and works that will remain on the balance sheet of the Company. This issue can be clarified only after receiving the technical requirements for the regional utility.

Table 5-5: List of existing renewable energy sources in the vicinity of the SPP construction sites

No	Facility	Capacity, MW	Take-over point	Name of the 110-150 kV substation (SS) to which the power plant's power is transmitted
1.	SUNLIGHT ENERGY LLC (Photovoltaic power plant (I, II and III stages), solar power plant)	12,5	35 kV switchgear, cell 1; 35/0.4 kV transformer substation-1, 35 kV switchgear, cell 2; 35/0.4 kV transformer substation-1, 35 kV switchgear, cell 3; 35 kV distribution substation, cell DM1	154 kV Promzona Substation
2.	OVOCHEVA PHOTOVOLTAIC POWER PLANT LLC (Solar power plant)	5.0	35/6 kV Ovoshchna SS, 35 kV distribution substation, cell B-35 of the Ovocheva PPP.	154 kV Promzona Substation
3.	Horokhivska PPP LLC (solar power plant)	12.0	35/10 kV Gorokhovka SS, 35 kV distribution substation, cell 1	154 kV Promzona Substation
4.	VITRIANYI PARK PRYCHORNOMOSRKYI LLC (Limanska WPP (first, second and third start-up complexes))	9.6	35 kV Closed-Type Switchgear at Limanska WPP, cell No. 2	154 kV Oktiabrska Substation
5.	NIKO SOLAR LLC (solar power plant)	5.7	cell 2 of 35 kV distribution substation, 35/0.4 PTS, sq. No. 1; cell 3 of 35 kV distribution substation, 35/0.4 PTS, sq. No. 2	154 kV Oktiabrska Substation
6.	ECO ENERGY PRO LLC (Teplychnasolar power plant)	10.0	35kV switchgear of Teplychna PPP, cell 1	154 kV Oktiabrska Substation

In addition, the Company has gas reciprocating cogeneration units with a total capacity of about 5 MWh and plans to install additional units with a total capacity of 12.6 MWh. According to the Company's plans, part of the gas reciprocating units is to be installed on the territory of SPP-1 (42 Samoilovycha Street) and SPP-3 (36 Vodopiina Street). These units will potentially act as additional balancing sources for the operation of SPPs in the grid, and therefore the connection of new SPPs should not adversely affect the stability of the grid.

The connection costs for each site were calculated in accordance with the standards SOU-N MEV 45.2-37471933-44:2011 Consolidated Cost Indicators for the Construction of Substations with Voltage from 6 kV to 150 kV and Transmission Lines with Voltage from 0.38 kV to 150 kV.

5.3.1 Grid Connection Options for SPP-1

The site of SPP-1 at 42 Samoilovycha Street is adjacent to the existing boiler house of Mykolaivoblteploenergo. The SPP is planned to be connected to the existing 6 kV reserve cell of the distribution substation-96. The electrical scheme of SS-96 is shown in Figure 5-3.

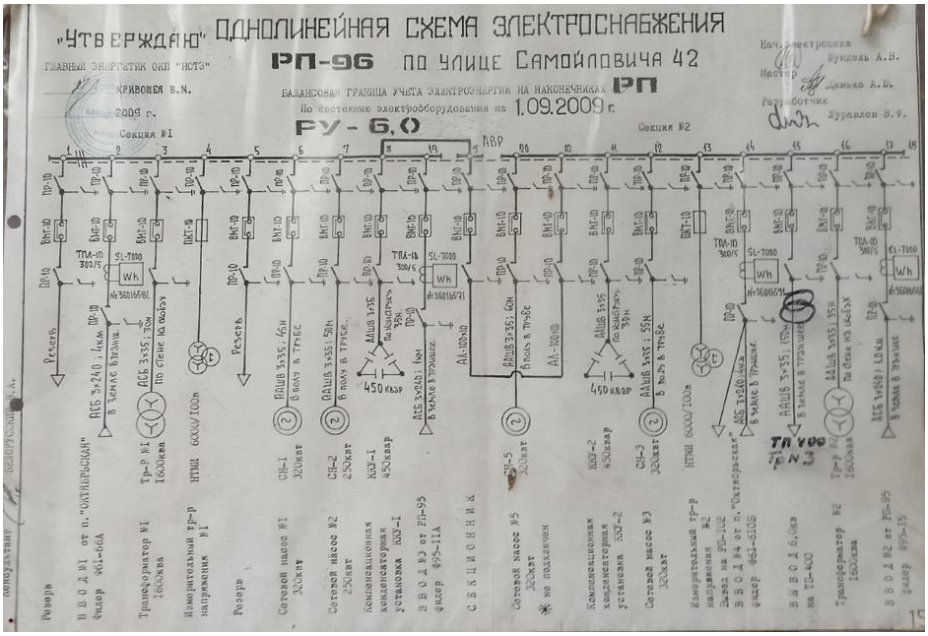


Figure 5-3: Schematic of SS-96 of the boiler house of Mykolaivoblteploenergo

To connect the SPP to SS-96, it is necessary to lay a cable line from the backup cell to the 6/0.4 kV transformer station (TS) located at the SPP site. The power will be collected via 6 kV cable lines. TS 1 has a dead-end circuit on the 6 kV side (Figure 5-4).

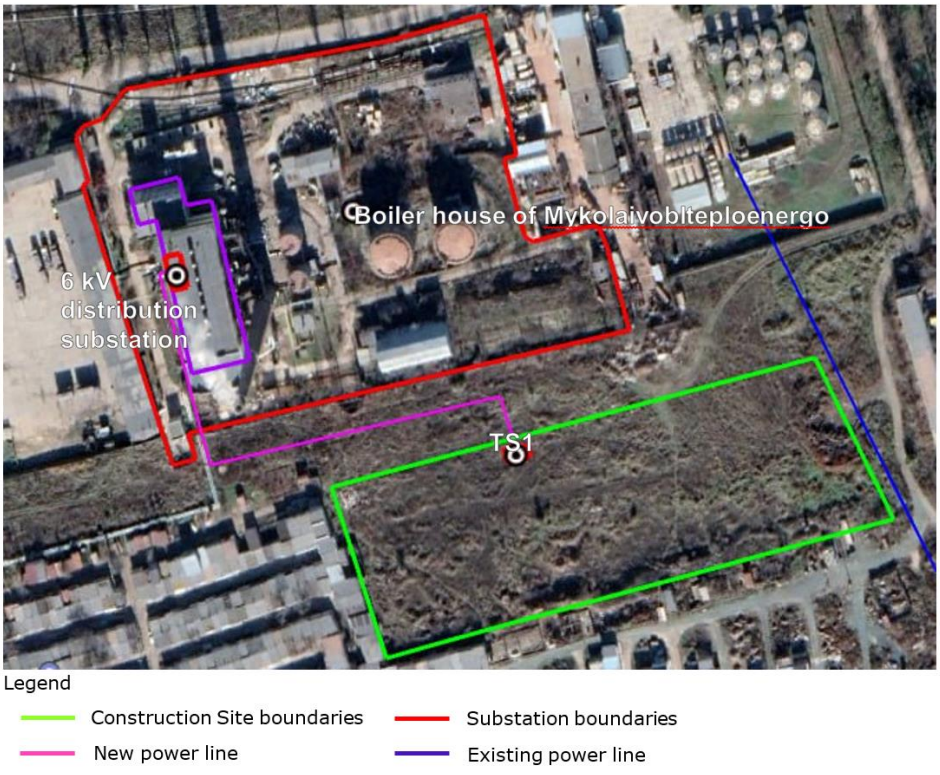


Figure 5-4: Schematic of the proposed grid connection for SPP-1

The grid connection costs for SPP-1 are estimated at €99 thousand. The cost breakdown is shown in Table 5-6.

Table 5-6: Breakdown of grid connection cost estimates for SPP-1

Item	Cost, thousand €/km	Quantity	Cost, thousand €
6 kV overhead line	66.0	1.5	99.0

5.3.2 Grid Connection Options for SPP-2

No existing power grid lines are crossing the installation site at 44 Samoilovycha Street. The power grid is available via 150 kV and 35 kV OHLs. The 35/6 kV Teplychna substation is located to the southwest of the site (Figure 5-5). SS-96 is located north of the SPP-2 site.

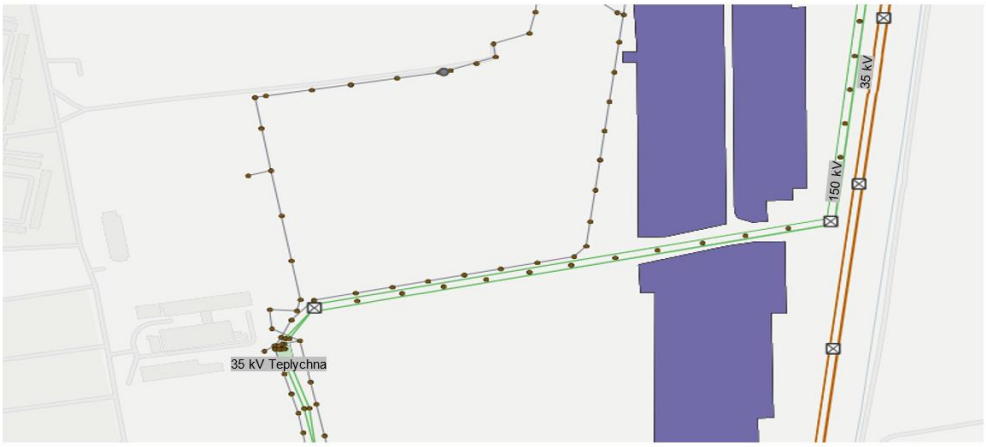


Figure 5-5: Power grid infrastructure near SPP-2

5.3.2.1 Option 1 – Connection to Teplychna substation

Two transformers of 6.3 kVA each are installed at Teplychna 35/6 kV substation. Given the proximity of SPP-2 to 35/6 kV Teplychna substation, it is advisable to connect to the 6 kV busbars of the substation. The electrical scheme of the district networks is shown in Figure 5-6.

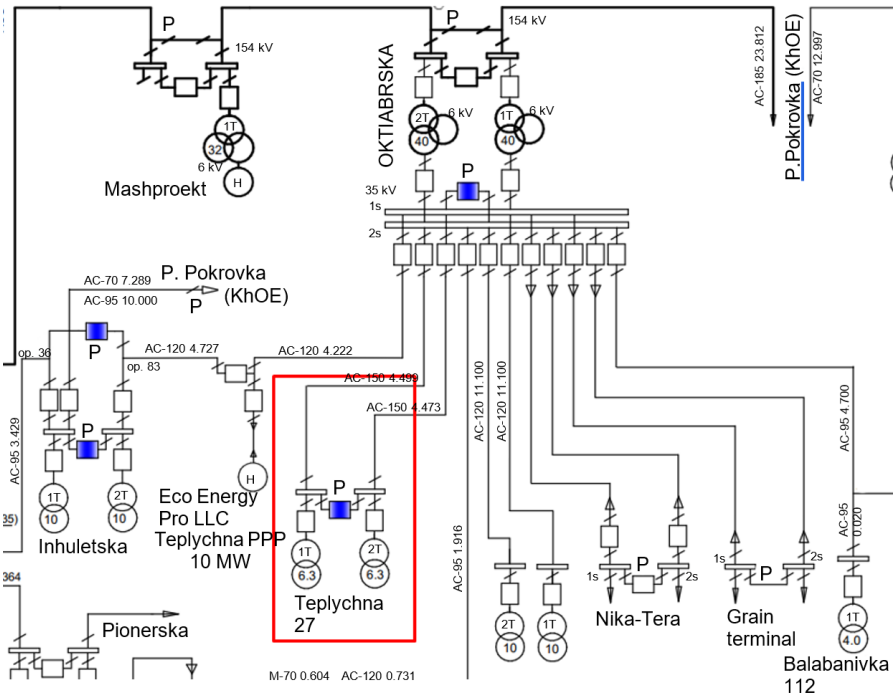


Figure 5-6: Electrical scheme of the power grid near SPP-2

To connect SPP-2 to the 6 kV busbars at 35/6 kV Teplychna SS, it is necessary to install two additional cells with 6 kV vacuum circuit breakers and lay cable lines from the designed cells to the 6/0.4 kV switchgear located at the SPP site. Power will be collected via 6 kV cable lines (Figure 5-7).

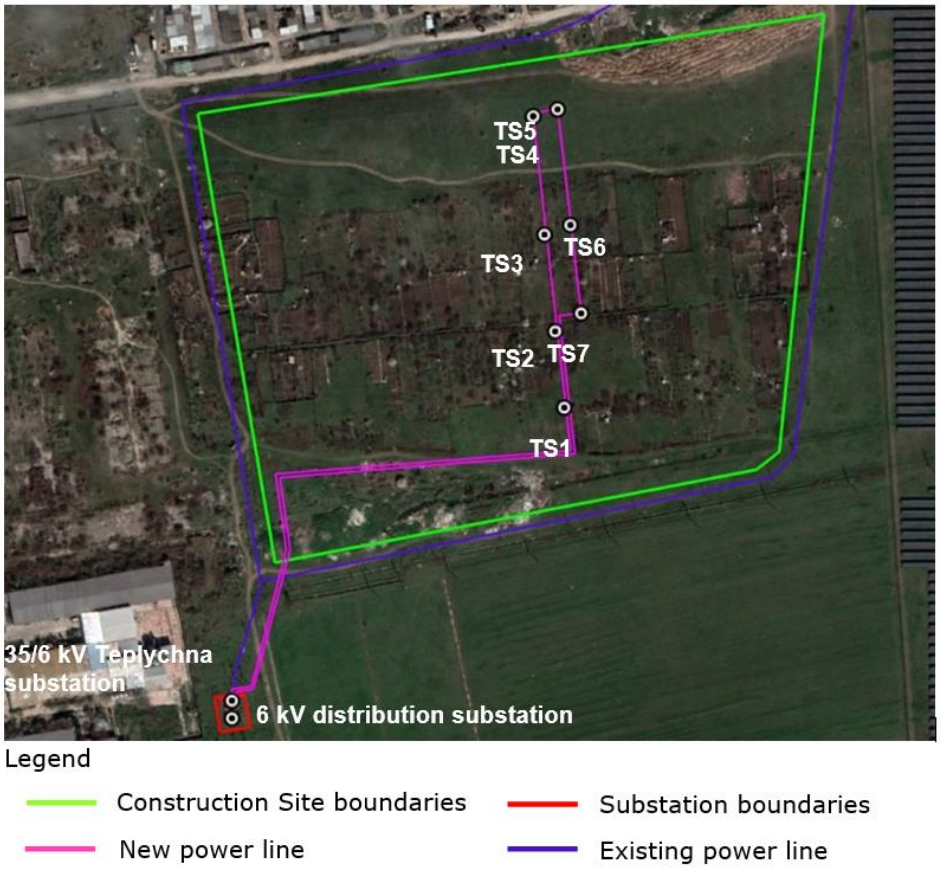


Figure 5-7: Schematic of the proposed grid connection for SPP-2

The grid connection costs for SPP-2 are estimated at €235.6 thousand. The cost breakdown is shown in Table 5-7.

Table 5-7: Breakdown of grid connection cost estimates for SPP-2

No.	Item	Cost, thousand €/km	Quantity, km	Cost, thousand €
1	6 kV overhead line	66.0	2	132.0
2	6 kV line chamber with vacuum switch	10.6	2	21.2
3	Commercial electricity metering unit	41.2	2	82.4
	Total			235.6

5.3.2.2 Option 2- Connection to substation 96

The second connection option investigated consists of a direct connection from SPP-2 to SS-96. The linear distance from the site to substation 96 is approximately 350 m.

SPP-1 and SPP-2 could be connected to SS 96 to reduce transmission costs and supply the demand for the boiler house at 42 Samoilovycha Street.

In this option, SS-96 receives power from the two SPPs via ASB 3x240 cable lines. The permissible current for these cables when laying in the ground without considering the coefficients for the laying conditions is about 314 A. Thus, one cable can transmit about 3 MW.

For a more accurate assessment, it is necessary to conduct a survey of cable lines, SS-96 equipment, and investigate the possibility of the electrical network at the POI of the substation to receive the surplus of generated electrical energy of SPP-2.

5.3.3 Grid Connection Options for SPP-3

There are no existing power grid lines crossing the installation site at 36 Vodopiina Street. Overhead lines (OHL) of 150 kV and 35 kV are present in the vicinity of the SPP-3 location a shown in Figure 5-8. The 150/35/6 kV Promzona substation (SS) is located southwest of the site.

Figure 5-8: Power grid infrastructure near SPP-3

Two transformers of 25 kVA each are installed at Promzona substation. Given the low capacity of SPP-3 and the proximity of Promzona substation, it is advisable to connect to the 6 kV busbars. The electrical scheme of the district networks is shown in Figure 5-9.

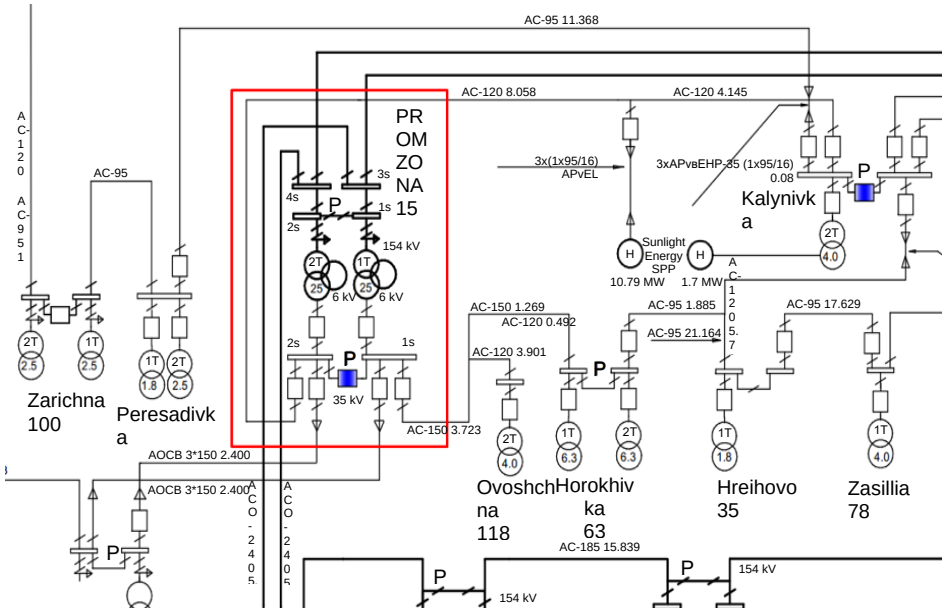


Figure 5-9: Electrical scheme of the power grid near SPP-3

To connect SPP-3 to the 6 kV busbars of the Promzona substation, it is necessary to install an additional cell with a 6 kV vacuum circuit breaker and lay a cable line from the designed cell to the 6/0.4 kV transformer stations located at the plant site (Figure 5-10).

The power is collected via 6 kV cable lines. TS1 has a dead-end circuit on the 6 kV side. TS2 has a pass-through circuit.

Figure 5-10: Schematic of the proposed grid connection for SPP-3

The grid connection costs for SPP-3 are estimated at €117.8 thousand. The cost breakdown is shown in Table 5-8.

Table 5-8: Breakdown of grid connection cost estimates for SPP-3

No.	Item	Cost, thousand €/km	Quantity	Cost, thousand €
1	6 kV overhead line	66.0	1	66.0
2	6 kV line chamber with vacuum switch	10.6	1	10.6
3	Commercial electricity metering unit	41.2	1	41.2
Total				117.8

5.4 Energy Yield Assessment

The calculations are mainly carried out with the simulation program PVsyst (version 7.4) from PVsyst SA. PVsyst is a time-step simulation program developed by the University of Geneva for small and large PV systems.
From the climate database, GHI and DIF are generated in hourly resolution for the location, and the irradiation on the modules or module strings is calculated in hourly resolution. The yield of the PV system, determined by an annual simulation, is based on a mathematical model that enables the exact reproduction of the characteristic curve for each PV module, even with different levels of irradiation. Using the characteristics of the selected components, the yield at the output of the inverter or transformer station is calculated for every hour of the year, considering the PV module temperature and irradiation (mean values).

The interconnection of the modules and inverters as described in Section 5.2 is considered for the specific PV system. Both the electrical properties of the module under standard conditions and under partial load behaviour are included. With the help of the available climate data, the temperature of the modules is also considered depending on the structure (height above ground, cooling / rear ventilation, free field, or roof) and the characteristic curves are adapted using the temperature-dependent properties of the modules. Furthermore, the efficiency characteristics of the inverters are mapped depending on the input voltage and partial load behaviour. In addition, the losses due to the interconnection of several modules ("mismatching") and the deviations due to the variation in the spectral composition of the irradiation are included in the calculation.

5.4.1 System Assumptions

The creation of a model calculation in the PVsyst software on the basis of the basic conceptual layout with the planned components (including PV modules, inverters, and string connections) is based on the following assumptions:

5.4.1.1 Shading

There are two types of shading to be considered:

- Near shading which include shades drawn by the arrays on each other’s and other obstacles on sites (trees, transmission towers, etc.). A 3D model is introduced in the simulation software to account for these near shading losses.

- Far shading caused by obstacles sufficiently far for considering the sun over or under the horizon line at a given time. The horizon line is defined in the simulation software using PVGIS and computed as a spherical integral.

These sources of shading have been analysed and negatively considered in the yield forecast. In addition to the PV arrays, the vegetation and HV transmission towers present on site have been included in the shading scene created in PVsyst.

5.4.1.2 Soiling Losses

Soiling losses refer to reduction in power output resulting from dust, dirt, snow, and other particles that cover the surface of the PV module. Dust is a thin layer that covers the surface of the solar array, and the typical dust particles are less than 10mm in diameter, but this depends on the location and its environment. Dust is generated from many sources such as pollution by wind, vehicular movements, and agricultural activities among many others.[17]

5.4.1.3 Ground Albedo

Albedo is the proportion of the incident radiation that is reflected by a surface. It is dimensionless number ranging between 0 and 1.

5.4.1.4 Irradiance losses

Low irradiance levels lead to lower module efficiency. The irradiance losses are estimated in respect to module STC performance at 1000 W/m². These losses differ from one PV manufacturer to another.

5.4.1.5 Temperature losses

The power output of the PV module decreases with rising cell temperature. The rated module power is measured under STC at 25°C ambient temperature. Therefore, temperature losses should be accounted for depending on local conditions. These losses are computed by the simulation software depending on the characteristics of the selected module. Module temperature loss factor per °C is provided in the manufacturer datasheet.

5.4.1.6 IAM factor

The incidence angle modifier (IAM) is dependent on the location and the module. This parameter is accounts for losses related to non-perpendicular irradiance falling on the module surface. It is computed by the simulation software for the selected location.

5.4.1.7 Module quality losses

This parameter reflects the manufacturer confidence on the real module performance and covers potential deviations from the technical specifications. Modules with positive tolerance will exhibit a gain and not a loss in performance modelling.

5.4.1.8 Light Induced Degradation

Light Induced Degradation (LID) is a loss of performances arising in the very first hours of exposition to the sun, with Crystalline modules. The LID is a loss with respect to module performance at STC and is related to the quality of the wafer manufacturing. It is usually in the order of 1% to 3%.[18]

5.4.1.9 Module and string mismatch losses

When many modules are interconnected in series or in parallel, the I-V curve characteristic of the cells changes in comparison to a standalone module. This is due to the fact that even modules from the same production batch are not identical. In a string, the module with the lowest current drives the current of the whole string. The string wire length can be different from string to string in a

[17] Maghami, M.R., Hizam, H., Gomes, C., Radzi, M.A., Rezadad, M.I. and Hajighorbani, S., 2016. Power loss due to soiling on solar panel: A review. Renewable and Sustainable Energy Reviews, 59, pp.1307-1316.

[18] Light Induced Degradation - https://wiki.openmod-initiative.org/wiki/Light_Induced_Degradation

block, which will cause differences among the string's voltage. Cell's temperature could also be different on the same module, higher in the middle than at the edges. These are collectively accounted for in the mismatch losses.

5.4.1.10 Ohmic losses

These losses refer to electrical losses accruing in DC cables due to their inherent resistance. These losses should not exceed a value of 1.5% at STC.

5.4.1.11 Inverter losses

The inverter losses correspond to power losses during the conversion from DC to AC. The inverter losses are provided in the manufacturer's datasheet and are usually below 2% for both string and central inverter.

5.4.1.12 Transformer and AC losses

These losses are an indication of the LV to MV transformer efficiency. They also include the ohmic losses on the AC cables from the inverter to the substation. AC ohmic losses and transformer losses should not exceed 1%.

5.4.1.13 Summary of Assumptions

Table 5-9 below provides a summary of the assumptions considered in the energy yield assessment.

Table 5-9: Summary of EYA assumptions

Loss/Gain Factor	Value	Note
Near shading	Computed	
Far shading	0%	Imported from PVGIS. The site is free from any shading caused by obstacles at the horizon.
Reflection (IAM)	Computed	
Soiling losses	2%	Based on assessment of site location and surroundings
Irradiance losses	Computed	
Temperature losses	Computed	A thermal loss factor of 29 W/m²k has been considered for a ground mounted installation
Module quality factor (Gain)	0.7%	This represents a gain in the performance of the PV module
Module mismatch	1%	Based on Consultant experience
String mismatch	0.1%	
Light-induced degradation	1.5%	LID is usually between 1% and 3%.
DC Ohmic	<1.5%	
Inverter losses	Computed	
AC losses	<1%	
Transformer losses	<1%	

5.4.2 Energy Yield Assessment Results

The main results of the energy yield assessment performed in PVsyst are detailed in next sections. The yield reports are provided in Annexes 2-4.

5.4.2.1 Energy Yield Assessment Results of the SPP-1 Project

The yield assessment results for SPP-1, reported in Table 5-10, show that the plant achieves a high yearly Performance Ratio (PR). [19] The specific yield [20] results are in line with the PV potential described in section 4.2.1.

Table 5-10: Main yield assessment results of the SPP-1 Project

Parameter	Unit	Value
Specific energy yield	(MWh/MWp/year)	1,312
Expected annual production	(MWh/year)	1,212
Performance ratio	(%)	83.5

Figure 5-11 provides an overview of the monthly energy production. The period from May to August has a stable energy production with a monthly average production of 147 MWh. The lowest energy production is expected in December with 39 MWh.

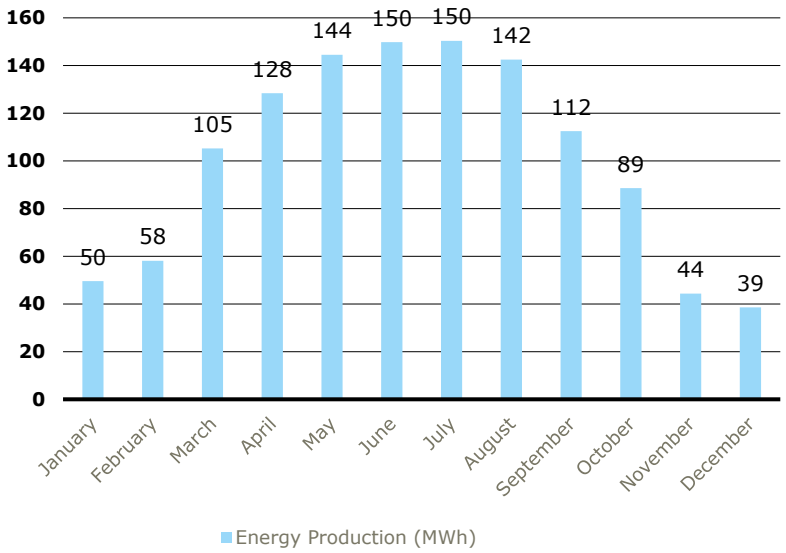


Figure 5-11: Monthly energy production of SPP-1

Figure 5-12 presents the loss diagram for SPP-1. Temperature, near Shading and soiling are the main loss factors, with a relative percentage of 2.4%, 2%, and 2% of the plant output.

[19] The performance ratio is defined as the relationship between a plant's useful yield (AC yield) and ideal yield (the product of the total amount of irradiance on the generator surface area and nominal module efficiency)

[20] The specific yield [MWh/MWp] of a PV plant is the relationship between the useful yield (AC yield) over a certain period of time (often one year) and the installed DC capacity.

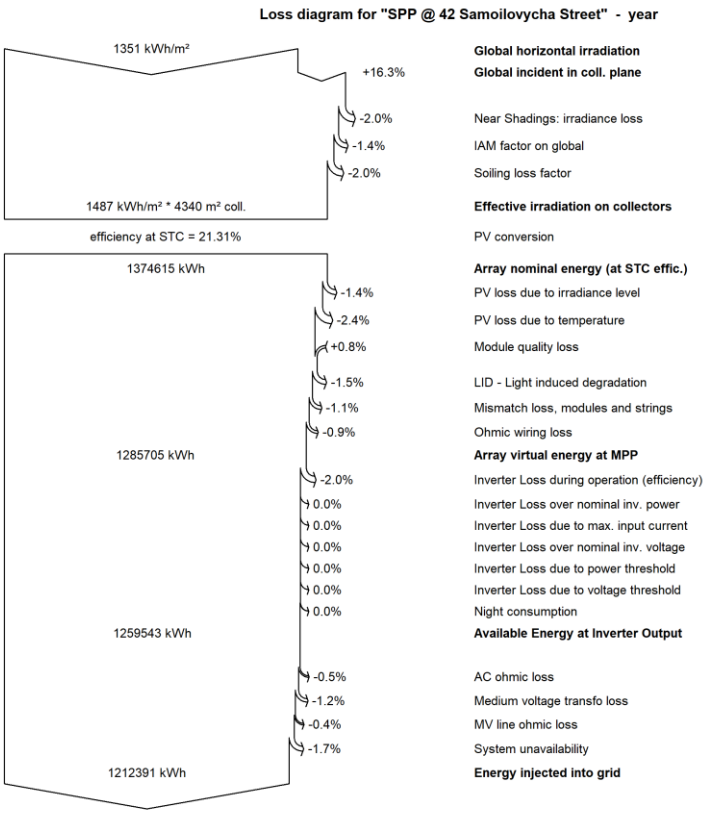


Figure 5-12: SPP-1 loss diagram

5.4.2.2 Energy Yield Assessment Results of the SPP-2 Project

Table 5-11 summarizes the yield assessment results for SPP-2. The solar plant is expected to have a high yearly PR.

Table 5-11: Main yield assessment results of the SPP-2 Project

Parameter	Unit	Value
Specific energy yield	(MWh/MWp/year)	1,306
Expected annual production	(MWh/year)	9,505
Performance ratio	(%)	83.2

Figure 5-13 provides an overview of the monthly energy production. The period from May to August has a stable energy production with a monthly average production of 1,151 MWh. The lowest energy production is expected in December with 300 MWh.

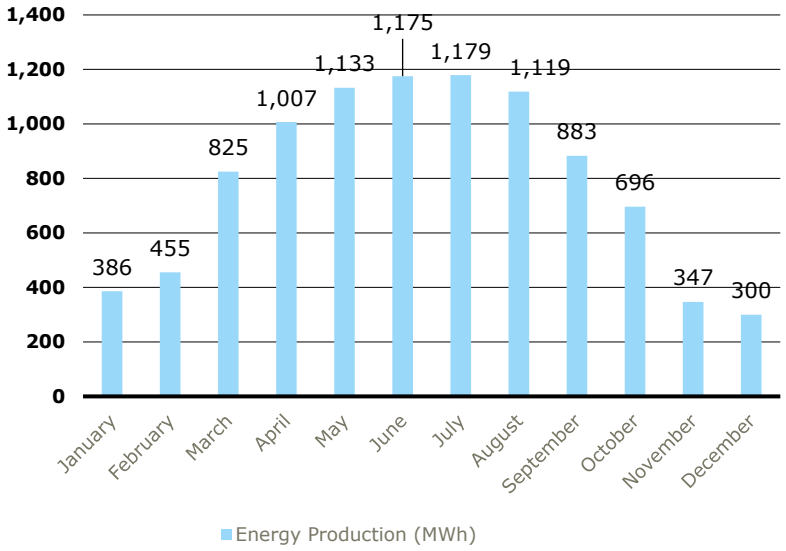


Figure 5-13: Monthly energy production of SPP-2

Figure 5-14 presents the loss diagram for SPP-2. Temperature, near Shading and soiling are the main loss factors, with a relative percentage of 2.4 %, 2.4% , and 2% of the plant output.

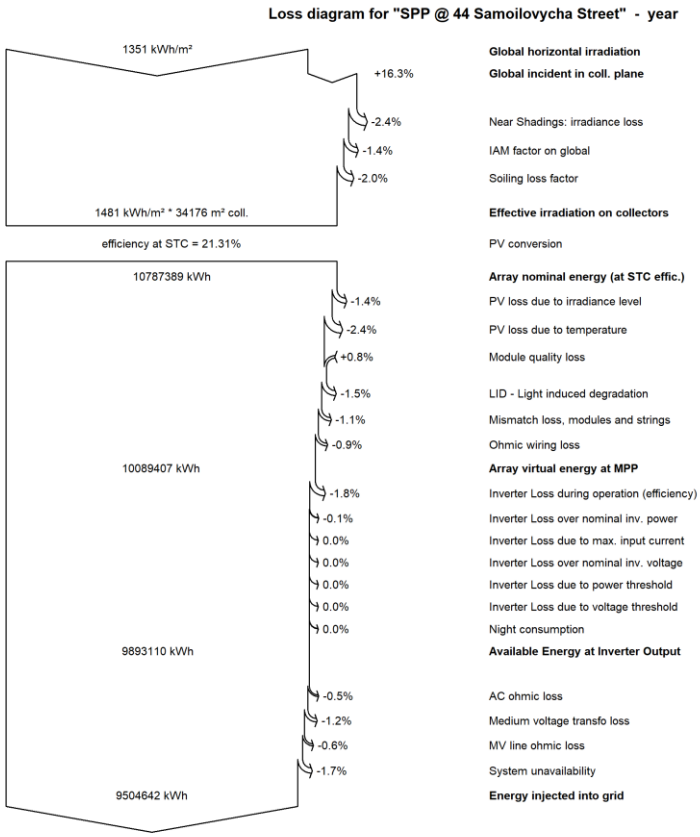


Figure 5-14: SPP-2 loss diagram

5.4.2.3 Energy Yield Assessment Results of the SPP-3 Project

Having similar design parameters, the specific yield and PR for SPP-1 and SPP-3 are practically the same.

Table 5-12: Main yield assessment results for SPP-3

Parameter	Unit	Value
Specific energy yield	(MWh/MWp/year)	1,316
Expected annual production	(MWh/year)	2,280
Performance ratio	(%)	83.8

Figure 5-15 provides an overview of the monthly energy production. The period from May to August has a stable energy production with a monthly average production of 276 MWh. The lowest energy production is expected in December with 73 MWh.

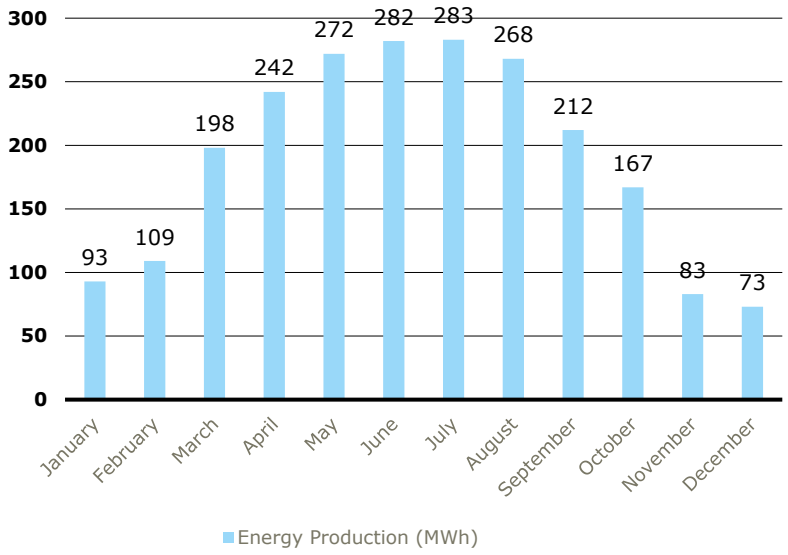


Figure 5-15: Monthly energy production of SPP-3

Figure 5-16 presents the loss diagram for SPP-3. Temperature, near Shading and soiling are the main loss factors, with a relative percentage of 2.4 %, 2.1% , and 2% of the plant output.

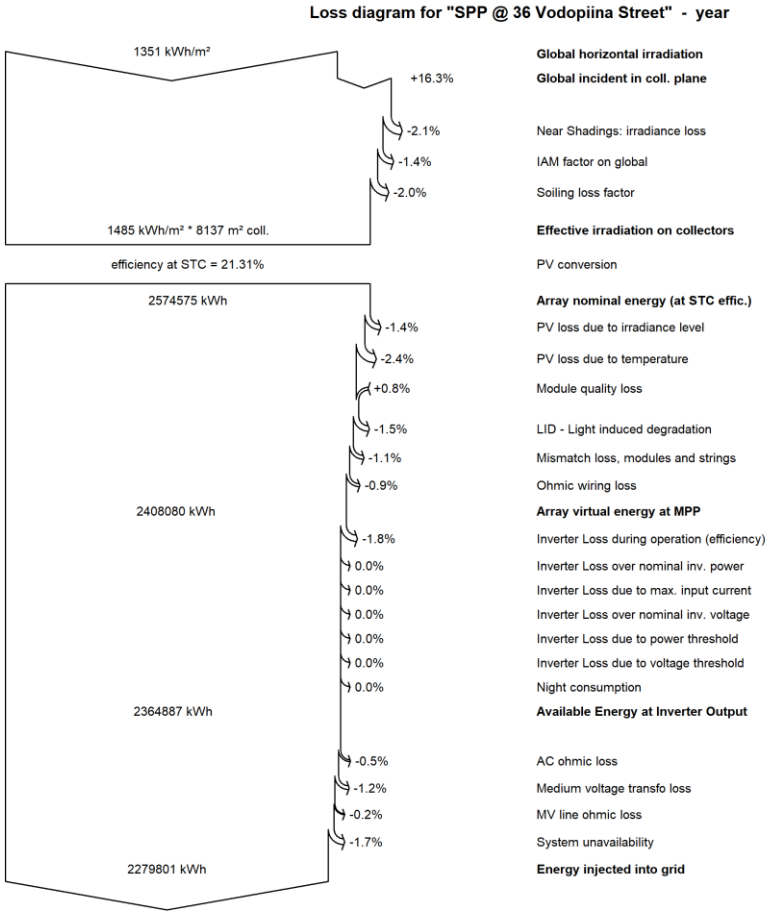


Figure 5-16: SPP-3 loss diagram

5.4.2.4 Summary of Yield Assessment Results

A summary of the yield assessment result is provided in Table 5-13. The three SPPs are expected to produce a cumulative power of 13 GWh in the first year of operation.

Table 5-13: Summary of yield assessment results

Item	SPP-1 @ 42 Samoilovycha Street	SPP-2 @ 44 Samoilovycha Street	SPP-3 @ 36 Vodopiina Street
DC Capacity (kW)	924	7,276.50	1,732.5
Yield (kWh/kW DC/year)	1,312	1,305	1,316
Annual energy (MWh/year)	1,212	9,504	2,280

5.5 Energy Savings

In this section, we assume that SPP-2 will be connected to Teplychna SS and not directly to the boiler house at 42 Samoilovycha Street. Therefore, the electricity produced by SPP-2 and SPP-3 will be transmitted to the Company's facilities and other utilities through the city networks. SPP-1 will be connected directly to the Company's boiler house.

5.5.1 Electricity Demand of the Company

The yearly electricity consumption of the Company for the past three years ranged from 14,700 MWh/year in 2021 to 10,700 MWh/year in 2023. Considering the Company's operations, i.e., heat generation, the electricity demand is mainly during the heating season (October to April). About 95% of the Company's yearly electricity consumption is attributed to the heating season.

Figure 5-17 shows that the electricity consumption during the heating season decreased in 2022 and 2023, which could be justified by the reduction in the population that fled the armed conflict in the region. On the contrary, the monthly electricity demand in the non-heating season remained relatively unchanged during the study period.

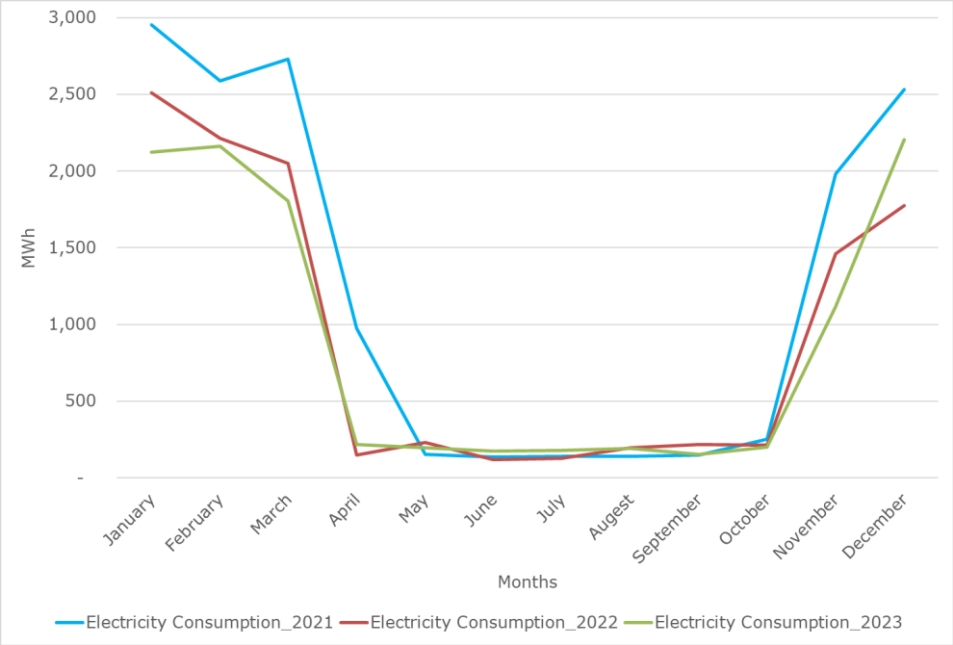


Figure 5-17: Electricity consumption of the Company (2021-2023)

After reviewing the available data, we decided to consider 2021 as the reference year for the electricity demand since it reflects the stable pre-war electricity demand.

5.5.2 SPP Operating Modes

The total yearly production of the SPPs is estimated at 13,000 MWh. This could theoretically cover 88% of the electricity demand of the Company in the reference year. However, about 70% of the production of the SPPs occurs during the non-heating season, which is significantly higher than the Company's demand during the same period (Figure 5-18).

Net billing is not a viable option for the Company. Indeed, the electricity balance in the net billing mechanism is calculated every month and not cumulated over the year. Therefore, the Company would not benefit from the electricity injected into the grid (credits) during the non-heating season.

In the non-heating season, the production of the SPPs will be mainly fed to the grid and will be transmitted to other utilities and organizations in Mykolaiv. The municipal water supply company, Mykolaivvodokanal, is among the local utilities that have significant electricity consumption during the non-heating season (16,710 MWh between April and October 2021). The excess electricity production from the SPPS will be transmitted via networks owned by the energy transmission company. The Company would be required to pay the cost of electricity transmission. The Company will be reimbursed for the electricity consumed by the other utilities using the DAM price structure.

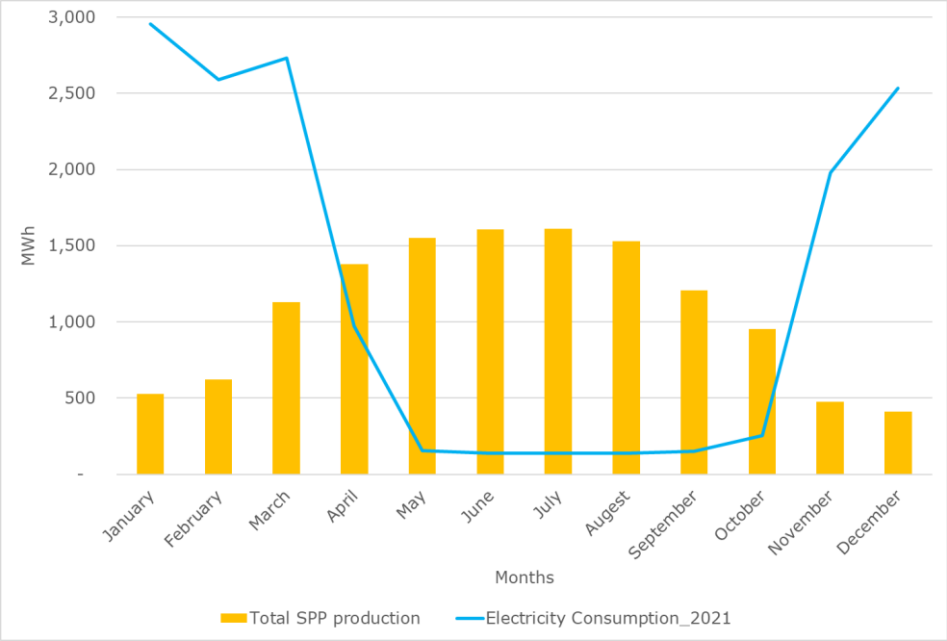


Figure 5-18: Comparison of electricity demand and SPP production

During the heating season, all electricity generated by the SPPs will be used by the Company to cover its demand.

Separately, SPP-1, SPP-2, and SPP-3 would contribute to the reduction in energy demand by 8%, 29%, and 11%, respectively. However, considering the mutual contributions of the three SPPs in a combined scenario, the reduction in the electricity demand of the Company from the grid is estimated at 35% (5.1 GWh/year), which is lower than the sum of the contributions of each SPP. In other words, in a combined scenario where the three SPPs are constructed and operational, more electricity will be injected into the grid since the energy savings are limited to the Company's electricity demand.

The planned SPP's operations are illustrated in figures Figure 5-20 to Figure 5-23Figure 5-23.

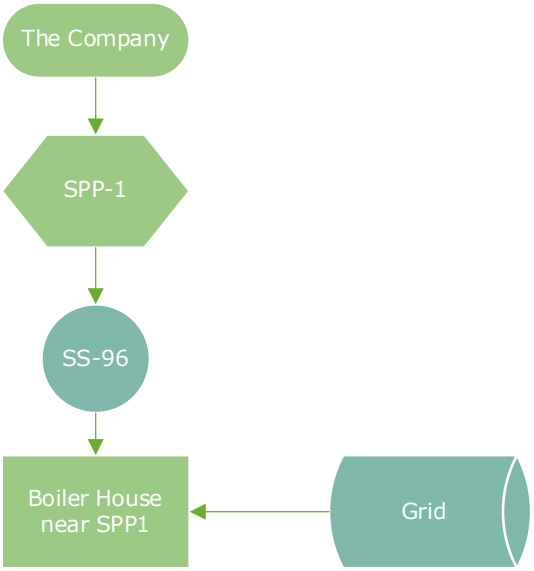


Figure 5-19: Process diagram of SPP-1 operations during the heating season

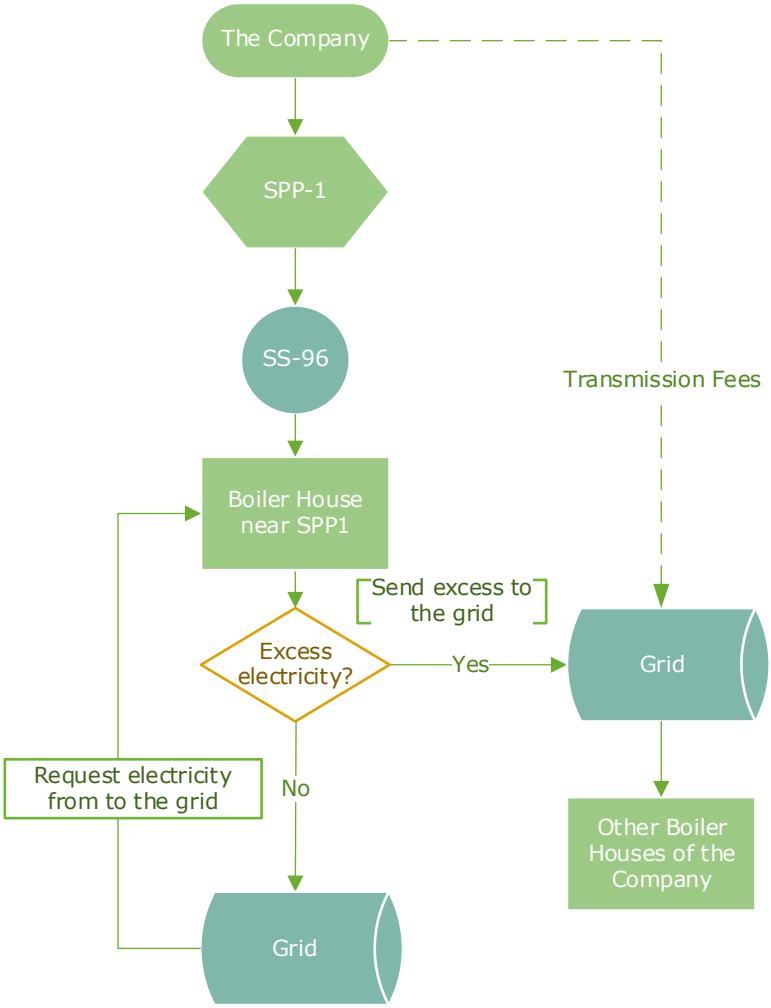


Figure 5-20: Process diagram of SPP-1 operations during the non-heating season

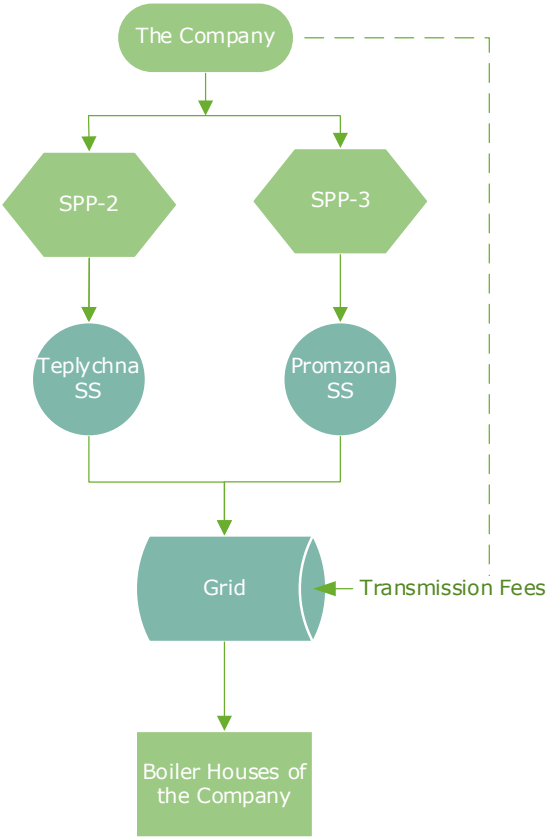


Figure 5-21: Process diagram of SPP-2 and SPP-3 operations during the heating season

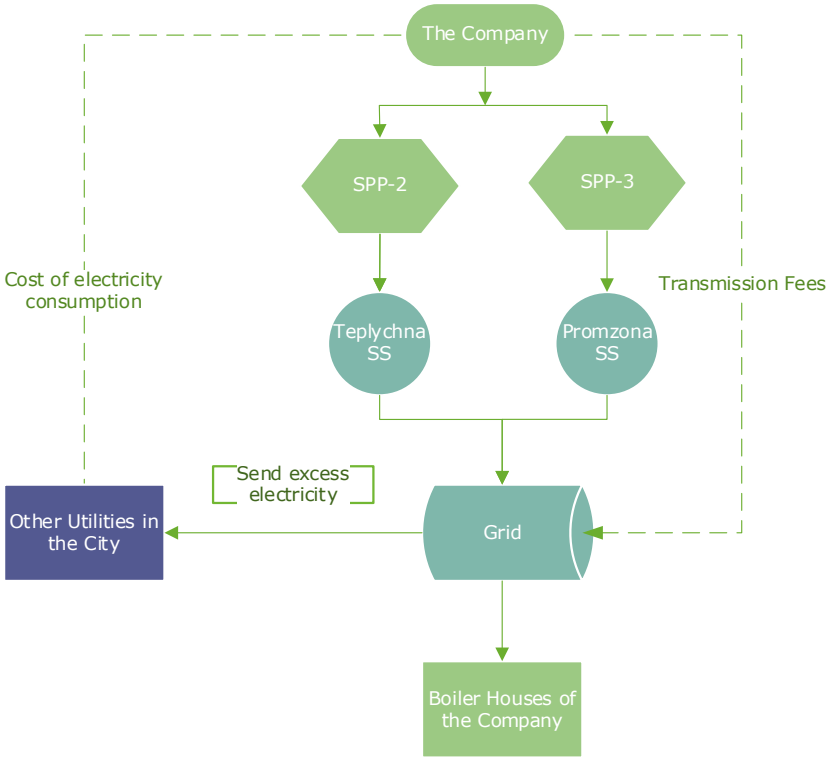


Figure 5-22: Process diagram of SPP-2 and SPP-3 operations during the heating season

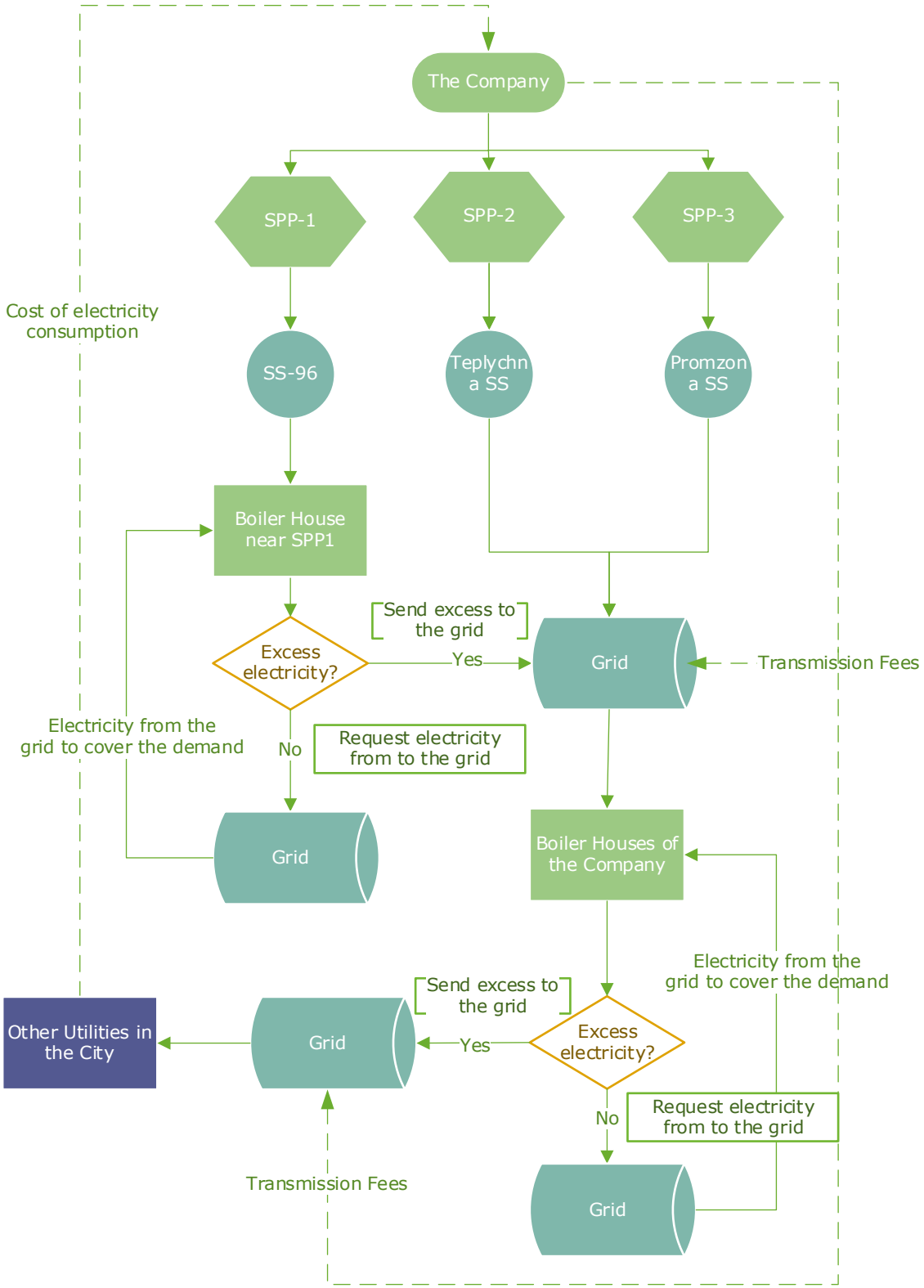


Figure 5-23: Combined process diagram of the SPP operations in Mykolaiv

5.6 Calculations of CO_2 Emission Reduction

The structure of electricity generation in Ukraine in 2022 is shown in Table 5-14.

Table 5-14: Structure of electricity production in Ukraine in 2022[21]

The energy source used to generate electricity	Share per 1 kWh, %.
Coal	18.43
Natural gas	0.61
Nuclear fuel	60.10
Hydropower (large hydropower facilities)	1.95
Renewable energy sources	3.09
Other sources	15.82

The combined margin (CM) grid emissions factor for renewable projects in Ukraine, following the methodology of the International Financial Institutions (IFI), is calculated at 643 gCO2/kWh. The baseline emissions, as defined by IFI, are calculated by multiplying the CM emissions factor by the electricity output from the renewable energy project.

The yearly baseline emission calculations for the SPPs are shown in Table 5-15.

Table 5-15: Baseline emissions calculation results

Item No.	SPP	Total Production (MWh/year)	Total emissions avoided (tCO_2)
1	SPP-1	1,212	779
2	SPP-2	9,504	6,111
3	SPP-3	2,280	1,466
Total		12,996	8,356

Considering a project lifetime of 25 years, the total electricity production of the SPPs is estimated at **324,900 MWh**, which would result in a reduction of **208,911** tonnes of CO_2 emissions.[22]

[21] Information on the share of each energy source that was used in the overall structure of the balance of purchased electric energy for 2022

[22] These calculations do not consider the degradation of the SPPs.

6. FINANCIAL ASSESSMENT

This chapter outlines the results of an indicative financial assessment of the proposed SPP projects. We relied on publicly available data and expert judgment developed by the local team to develop cost estimates for the implementation of the projects.

The next sections present the financial modelling strategy, costing assumptions, inclusions and exclusions, and modelling results.

6.1 General Provisions and Definitions

The analysis of the project financial performance was carried out in accordance with the requirements of GKD 340.000.002-97[23] and based on the general investment calculation methods adapted to the specifics of SPP projects.

The assessment focuses on key financial indicators that were agreed upon with the Client, namely, the net present value (NPV), the Levelized Cost of Energy (LCOE), and the Payback Period (PBP).

6.1.1 Levelized Cost of Energy (LCOE)

The LCOE reflects the present value of all costs to produce one unit of energy. It combines all types of costs and allows to simplify the analysis of the cost of energy.

The LCOE of solar PV is function of different parameters:

- Specific investment cost for the construction and installation of the solar plant
- Operating cost during the power plant's operational lifetime
- Local meteorological conditions with typical irradiance, temperature, and wind profile which define the plant's energy generation
- Lifetime of the plant
- Financing scheme considering shares of equity, grants, and debt, including technology-specific risk surcharges and country-specific financing conditions.

Taking into consideration the above-mentioned parameters, the LCOE could be expressed as defined in the next equation:

$$LCOE = \frac{\sum_{t=0}^{n} \frac{CAPEX_t + OPEX_t}{(1+i)^t}}{\sum_{t=0}^{n} \frac{PV_{out,t}}{(1+i)^t}}$$

Where:

- $CAPEX_t$ are the capital investment expenditures in the year t
- $OPEX_t$ are the operation and maintenance expenditures in the year t
- $PV_{out,t}$ is the electricity generation in the year t
- i is the discount rate
- n is the project lifetime in years

6.1.2 Net Present Value (NPV)

The NPV is a common measure of investment profitability. It is the difference between the amount of cash flow discounted at an acceptable rate of return and the amount of investment. It is calculated by discounting (bringing to the current value, i.e., at the time of investment) the expected cash flows (both income and expenses). The net present value reflects the investor's return (the incremental value of the investment) that the investor expects to receive from the project after cash

[23] *Determination of the Economic Efficiency of Capital Investments in the Energy Sector. Methods. Power Systems and Electric Networks*

inflows have paid for its initial investment costs and periodic outflows associated with the operation of the project.

The more positive NPV is, the more profitable the project investment can be. The formula for the NPV is:

$$NPV = -CAPEX_t + \sum_{t=1}^{n} \frac{C_t}{(1+i)^t}$$

Where:

- C_t the net cash in year t

6.1.3 Payback Period

The PBP is the year after which the cumulative (increasing) amount of net cash flows moves from the negative to the positive zone. This is the period during which the sum of net income discounted at the end of the investment equals the amount of investment, i.e., the investment reaches the breakeven point. The ROI period shows when the invested funds can be used for new investments.

6.2 Financial Model Assumptions

To calculate economic indicators, we considered the following assumptions:

- A degradation factor of 0.4% per year is considered for the electricity production of the SPPs to account for the degradation of the PV equipment.
- The discount rate is based on the 12-month Euro Interbank Offered Rate (EURIBOR) rate of 3.72%.
- The depreciation rate was set at 4%.
- The balancing costs are not considered. The Company is expected to maintain the grid stability using its gas reciprocating units.
- The electricity purchase tariff is set at €0.15/kWh which represents the average tariff for supply and distribution of electricity to the Company in the period between January and May 2024.
- The electricity transmission (distribution) tariff in 2024 is €0.046 /kWh.
- For the electricity injected into the grid, the Company will be compensated at the Ukrainian DAM weighted average price of electricity purchases in June 2024 (€0.12 /kWh).[24]
- The data provided by the Company shows that electricity tariffs increase by 15% in average between 2022 and 2024 (see Figure 6-1). This escalation rate in the electricity tariffs is most likely induced by the ongoing armed conflict in Ukraine. It is not currently possible to predict the changes in the electricity rates. Therefore, we conservatively used an escalation rate of 10%, which would reflect a more stable situation in the Ukrainian market.
- The capital expenditures (CAPEX) are based on quotes from suppliers in the Ukrainian market.
- The total operating expenditure (OPEX) and costs for remuneration and security are assumed to be between 1.5% and 2.75% of the investment in a grid tied SPP project (according to the international company Lazard[25]).
- The CAPEX and OPEX include a contingency to account for risks related to the ongoing conflict in Ukraine and project implementation.
- All costs and tariffs exclude the Value Added Tax (VAT).
- The project implementation is planned to last 20 months (see more details in chapter 7). The construction is expected to start in 2025 and the first year of electricity generation is assumed to be in 2026.
- The SPPs have a lifetime of 25 years.
- The inverters have a lifetime of 15 years.

[24] Market Operator, Ukraine, https://www.oree.com.ua/?lang=english

[25] https://www.lazard.com/research-insights/2023-levelized-cost-of-energyplus/

- The energy balance between the electricity demand and production of the SPPs is calculated monthly for the reference year 2021.

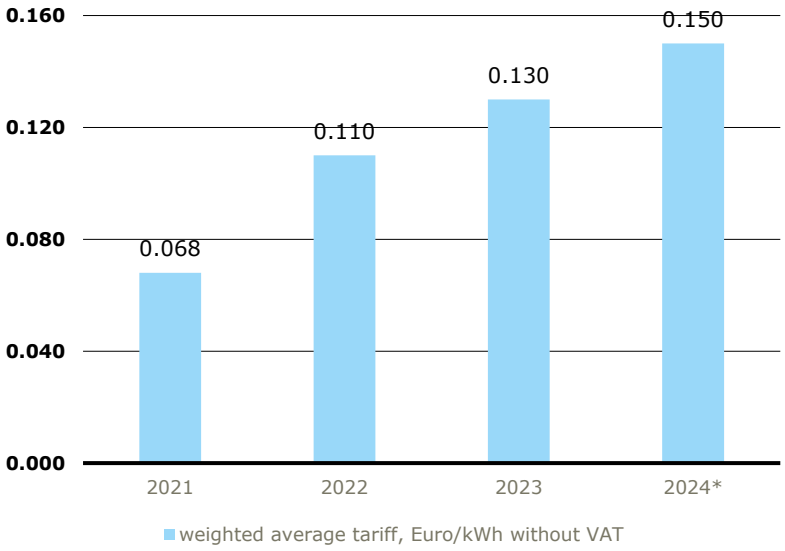


Figure 6-1: Electricity weighted average tariff with taxes, (2021-2024*)

* The weighted average tariff for 2024 is based on data from January to May.

The financial model assumptions are summarized in Table 6-1.

Table 6-1 Financial modelling assumptions

Item	Unit	Value
Project lifetime	years	25
Inverter replacement	N/A	After 15 years
Construction year	N/A	2025
First year of production	N/A	2026
Electricity Demand	MWh/year	14,700
Discount rate for cash flows	%	3.72
Depreciation rate of fixed assets	%	4
Electricity purchase tariff	€/kWh	0.15
Compensation for electricity fed to the grid	€/kWh	0.12
Electricity transmission tariff	€/kWh	0.046
Annual escalation rate for the electricity tariff	% / year	10
Standard of operating costs	% of investment/year	1.5-2.75
Electricity degradation factor	%	0.4
Share of own investment	%	100

6.2.1 Financial Assessment of the SPP-1 Project

6.2.1.1 Cost Breakdown of the SPP-1 Project

CAPEX

Table 6-2 provides the breakdown of total CAPEX of SPP-1. Considering the plant capacity, the specific CAPEX is estimated at €713.5 /kWp.

Table 6-2: CAPEX Breakdown of the SPP-1 project

Cost item	Amount, €
Panels	203,000
Inverters	36,173
Structures	108,304
Electrical Equipment	77,827
Site improvement (fence, roads)	27,793
Connecting to the network	82,933
Design work	16,081
Construction and installation works	107,206
Total	**659,318**

The main cost items are related to the panels, structure, construction works, and grid connection with over 75% of the total project CAPEX, as shown in Figure 6-2.

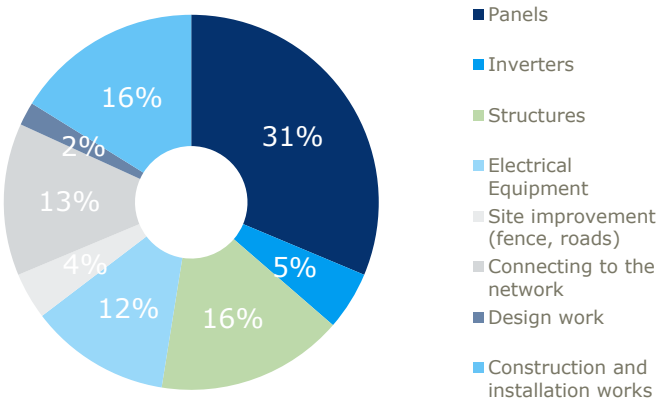


Figure 6-2: Breakdown of the CAPEX of the SPP-1 project

OPEX

Table 6-3 provides the breakdown of the total yearly OPEX of SPP-1. The yearly OPEX represents 2.75% of the total CAPEX, with a specific cost of €23.5 /kWp/year.

Table 6-3: Breakdown of total OPEX of the SPP-1 project

Cost item	Amount, €
Maintenance	4,200
Repairs	6,432
Monitoring and energy efficiency	3,000
Accounting expenses	2,700

Cost item	Amount, €
Administrative expenses	5,400
Total costs per year, €	**21,732**

Maintenance and repairs account for half of the OPEX costs (Figure 6-3).

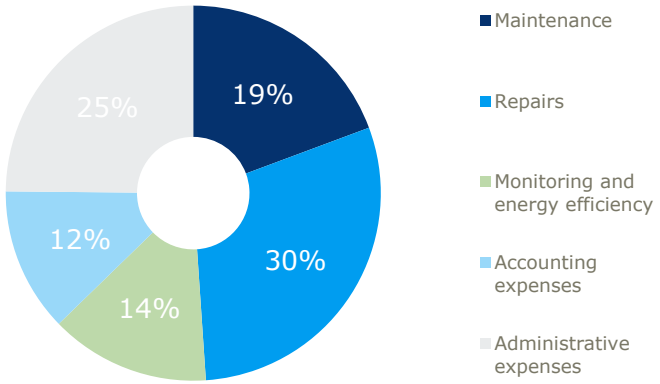


Figure 6-3: Breakdown of OPEX of the SPP-1 project

6.2.1.2 Financial results of the SPP-1 Project

The financial modelling results of the SPP-1 project are presented in Table 6-4 and Figure 6-4.

Table 6-4 Financial modelling results, SPP-1

Indicator	Unit	Value
LCOE	c €/kWh	5.50
NPV	Thousand €	6,624.27
PBP	Years	6

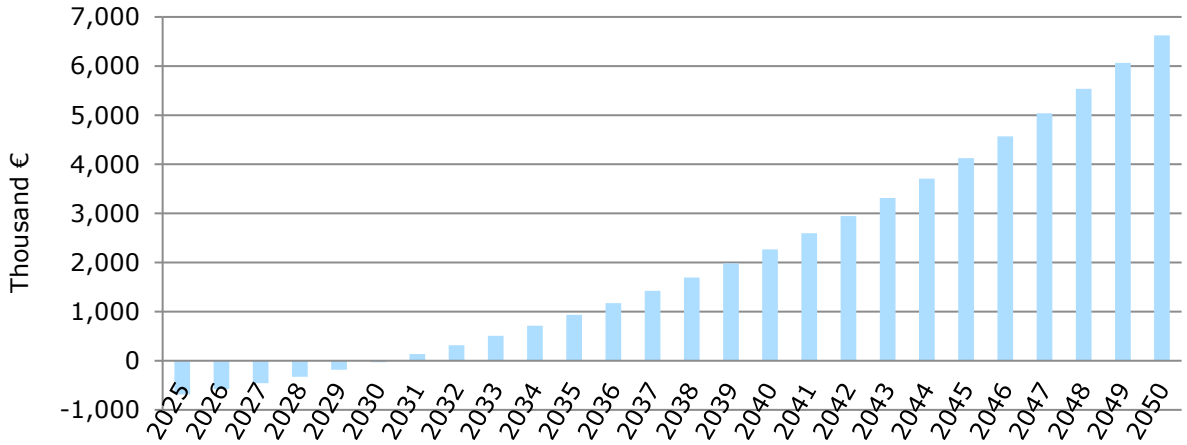


Figure 6-4: NPV dynamics of the SPP-1 Project

6.2.1.3 Monetary savings of the SPP-1 Project

In this paragraph, we present the monetary savings expected by the DH Company and other utilities benefiting from the generated electricity of the solar plant.

The monetary savings for the DH Company account for the reduction in electricity purchases from the grid, the cost of electricity transmission, O&M costs, and depreciation of assets. The compensation paid by the other utilities for the use of electricity produced by the solar plant is not accounted for in the calculation of the savings of the DH company.

On the other hand, as the DH Company is responsible for covering the transmission costs, the monetary savings for the other municipal utilities using the clean energy produced by the solar plant is based only on the price difference between the electricity purchased from the grid and the electricity purchased from the DH company.

Table 6-5 presents the monetary savings generated by SPP-1 for both parties.

Table 6-5 Monetary savings generated by SPP-1

Item	Unit	Value
Savings by DH Company	Thousand €	13,272.5
Savings by other utilities	Thousand €	80.0

The DH company is consuming about 98% of the production of SPP-1. Therefore, the savings of the DH company are more significant than those made by other utilities in the City.

6.2.2 Financial Assessment of the SPP-2 Project

6.2.2.1 Cost Breakdown of the SPP-2 Project

CAPEX

The total CAPEX required for the implementation of SPP-2 is estimated at approximately €4.4 million. Considering the plant capacity (7,276.5 kWp), the specific CAPEX is estimated at €603.3/kWp. Table 6-6 provides the cost breakdown of the total CAPEX for SPP-2.

Table 6-6: CAPEX Breakdown of the SPP-2 project

Cost item	Amount, €
Panels	1,598,625
Inverters	284,865
Structures	852,894
Electrical Equipment	585,045
Site improvement (fence, roads)	79,098
Connecting to the network	197,525
Design work	71,961
Construction and installation works	719,610
Total	**4,389,623**

The cost of panels, structure, and construction works represent over 2/3 of the CAPEX, as shown in Figure 6-5.

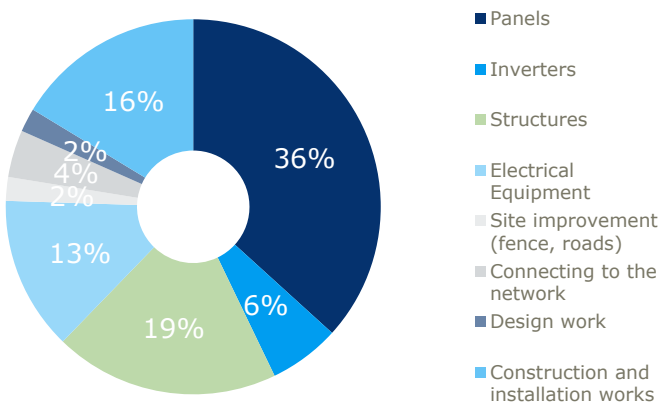


Figure 6-5: Breakdown of the CAPEX of the SPP-2 Project

OPEX

Table 6-7 provides the breakdown of the total yearly OPEX of SPP-2. The yearly OPEX represents 1.5% of the total CAPEX. With a higher capacity than the other two solar plants, SPP-2 has a lower specific OPEX (€10.9/kWp/year).

Table 6-7: Breakdown of total OPEX of the SPP-2 project

Cost item	Amount, €
Maintenance	16,200
Repairs	43,177
Monitoring and energy efficiency	6,600
Accounting expenses	7,800
Administrative expenses	5,400
Total costs per year, €	**79,177**

Maintenance and repairs represent 75% of the OPEX costs (Figure 6-6).

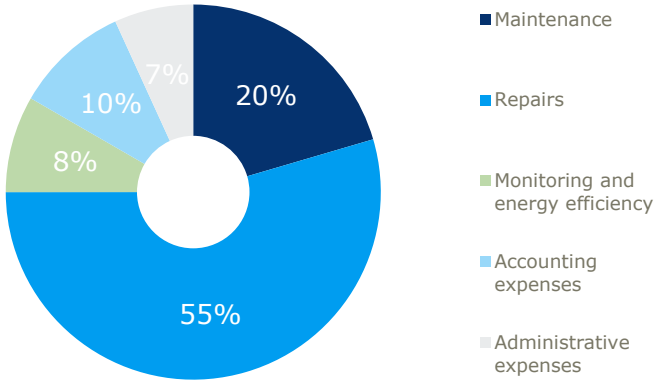


Figure 6-6: Breakdown of OPEX of the SPP-2 project

6.2.2.2 Financial results of the SPP-2 project

The financial modelling results of the SPP-2 project are presented in Table 6-8 and Figure 6-7.

Table 6-8: Financial modelling results, SPP-2

Indicator	Unit	Value
LCOE	c €/kWh	3.97
NPV	Thousand €	37,090.77
PBP	Years	6

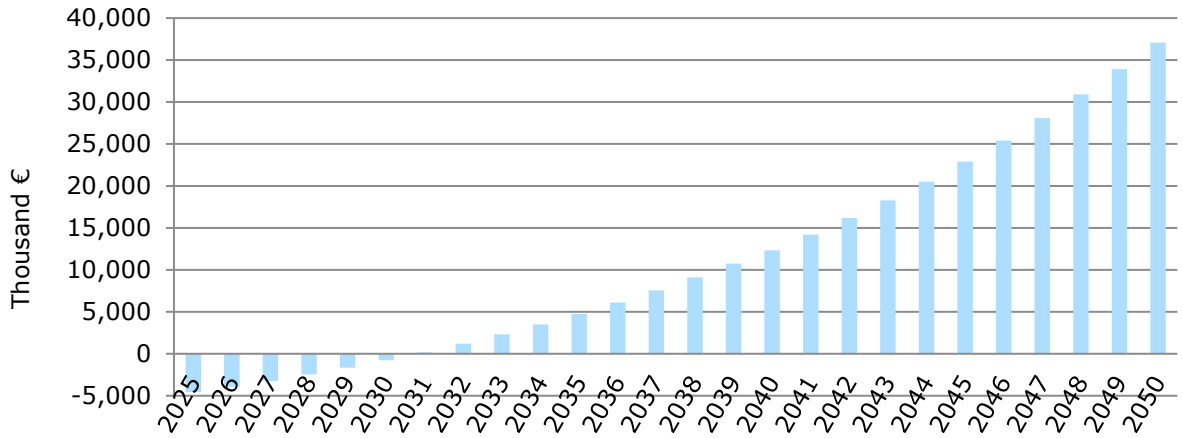


Figure 6-7: NPV dynamics of the SPP-2 project

6.2.2.3 Monetary savings of the SPP-2 Project

The monetary savings generated by SPP-2 for the DH Company and the other utilities, presented in Table 6-9, are calculated using the same approach described in Section 6.2.1.3.

The DH Company consumes about 45% of the production of SPP-2. However, all the electricity generated by SPP-2 is injected into the grid. This results in a high transmission costs, which reduces the total savings generated by the SPP.

Table 6-9 Monetary savings generated by SPP-2

Item	Unit	Value
Savings by DH Company	Thousand €	13,603.3
Savings by other utilities	Thousand €	15,936.5

6.2.3 Financial Assessment of the SPP-3 project

CAPEX

The total CAPEX required for the implementation of SPP-3 is estimated at approximately €1.13 million. The specific CAPEX, considering the plant capacity, is calculated at €653.4/kWp. Table 6-10 provides the cost breakdown of the total CAPEX for SPP-3.

Table 6-10: CAPEX Breakdown of the SPP-3 project

Cost item	Amount, €
Panels	380,625
Inverters	67,825
Structures	203,070
Electrical Equipment	152,205
Site improvement (fence, roads)	17,865
Connecting to the network	98,767
Design work	27,611
Construction and installation works	184,071
Total	**1,132,039**

The cost of panels, structure, and construction works represent over 2/3 of the CAPEX, as shown in Figure 6-8.

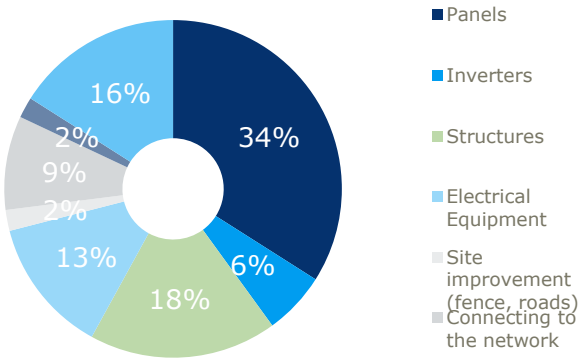


Figure 6-8: Breakdown of CAPEX of the SPP-3 project

OPEX

Table 6-11 provides the breakdown of the total yearly OPEX of SPP-2. The yearly OPEX represents 2.4% of the total CAPEX. The specific OPEX for SPP-3 is estimated at €19 /kWp/year.

Table 6-11: Breakdown of total OPEX of the SPP-3 project

Cost item	Amount, €
Maintenance	10,800
Repairs	11,044
Monitoring and energy efficiency	3,000
Accounting expenses	2,700
Administrative expenses	5,400
Total costs per year, €	**32,944**

Maintenance and repairs accounts for 2/3 of the OPEX costs (Figure 6-9).

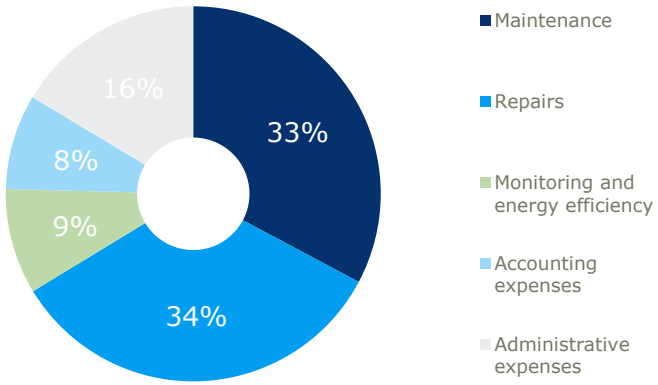


Figure 6-9: Breakdown of OPEX of the SPP-3 project

6.2.3.2 Financial results of the SPP-3 project

The financial modelling results of the SPP-3 project are presented in Table 6-12 and Figure 6-10.

Table 6-12: Financial modelling results, SPP-3

Indicator	Unit	Value
LCOE	c €/kWh	4.83
NPV	Thousand €	9,637.39
PBP	Years	6

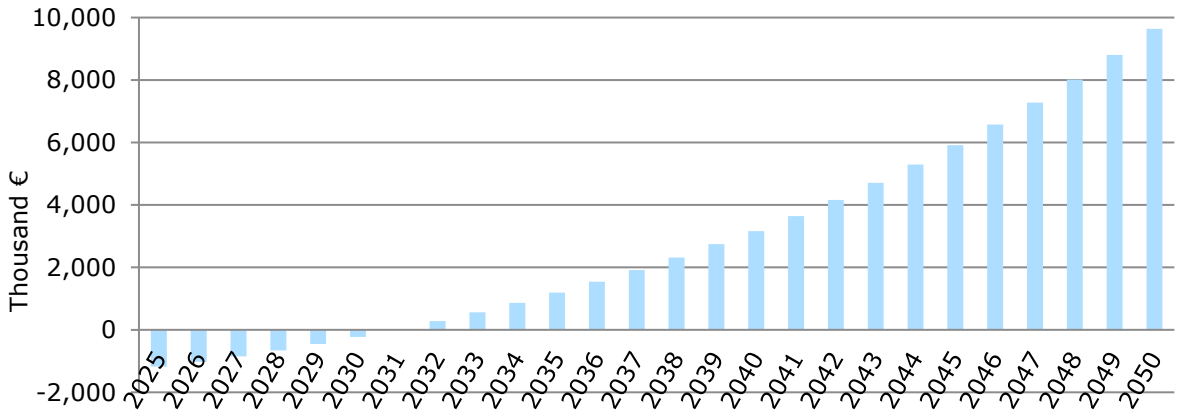


Figure 6-10: NPV dynamics of the SPP-3 project

6.2.3.3 Monetary savings of the SPP-3 Project

The monetary savings generated by SPP-3 for the DH Company and the other utilities are presented in Table 6-13, are calculated similarly to the other two SPPs.

The DH Company consumes about 74% of the production of SPP-3. Therefore, the savings by the DH company are more significant than for the other municipal utilities.

Table 6-13 Monetary savings generated by SPP-3

Item	Unit	Value
Savings by DH Company	Thousand €	12,897.9
Savings by other utilities	Thousand €	1,809.5

6.2.4 Financial Assessment of the Combined SPP Projects

6.2.4.1 Capital and Operational Expenditures

The total CAPEX required for the implementation of the three SPPs is estimated at approximately €6.18 million. The specific CAPEX per installed unit of production is calculated at €622.3/kWp. For the OPEX, the weighted average value of €13.5 /kWp/year is considered.

6.2.4.2 Financial results of the combined SPP projects

In this scenario, the share of electricity injected into the grid is higher than if we consider the sum of injected electricity for each SPP separately. Given that the compensation tariff for the injected electricity into the grid is lower than the tariff of electricity purchase, and considering the additional transmission costs, the NPV of the combined SPP projects is lower than the sum of the NPVs of the separate SPP projects. This also will result in a longer Payback Period. The financial modelling results for the combined SPPs are presented in Table 6-14 and Figure 6-11.

Table 6-14: Financial modelling results, combined SPP projects

Indicator	Unit	Value
LCOE	c €/kWh	4.26
NPV	Thousand €	50,006.34
PBP	Years	7

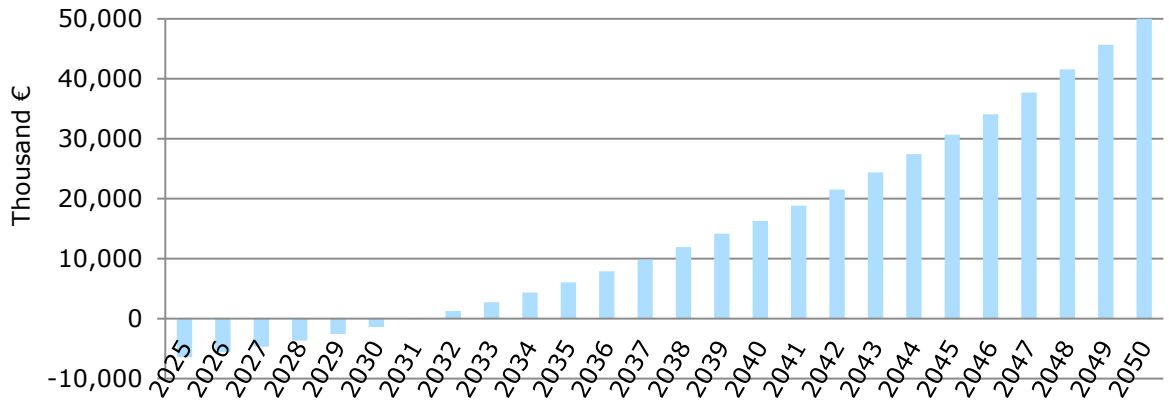


Figure 6-11: NPV dynamics of the combined SPP projects

6.2.4.3 Monetary savings of the combined SPP Projects

The monetary savings generated by the combined SPP projects for the DH Company and the other utilities are presented in Table 6-15.

The DH Company consumes about 39% of the production of the combined projects. The savings of the other utilities 2.5 times higher than the savings of the DH company.

Table 6-15 Monetary savings generated by the combined SPP projects

Item	Unit	Value
Savings by DH Company	Thousand €	9,104.8
Savings by other utilities	Thousand €	23,959.7

6.3 Summary of the Financial Assessment of the SPP Projects

Table 6-16 provides a summary of the financial assessment results for each of the three SPPs, and for the combined scenario. The total CAPEX of the Projects is estimated at €6.18 million. The yearly OPEX is €0.134 million/kWp/year. The LCOE of the combined SPP Projects is calculated 4.26 c €/kWh. The Projects have a payback period of 7 years and a net present value of €50 million.

Table 6-16: Summary of the financial assessment of the SPP projects

Indicator	Unit	SPP-1	SPP-2	SPP-3	Combined SPP projects
		42 Samoilovycha Street	44 Samoilovycha Street	36 Vodopiina Street	
DC Capacity	kWp	924.0	7,276.5	1,732.5	9,933.0
Specific Yield	MWh/MWp/year	1,312.0	1,306.3	1,316.0	1,308.5
Yearly Electricity generated	MWh/year	1,212.3	9,505.3	2,280.0	12,997.6
Total Electricity generated	MWh	28,896.1	226,568.2	54,345.4	309,809.7
Specific CAPEX	€/kWp	713.5	603.3	653.4	622.3
Total CAPEX	Thousand€	659.32	4,389.62	1,132.04	6,180.98
Specific OPEX	€/kWp/year	23.5	10.9	19.0	13.5
Yearly OPEX	€/kWp/year	21,732.0	79,177.0	32,944.0	133,853
Yearly savings by DH Company	Thousand €/year	510.5	523.2	496.1	350.2
Total Savings by DH Company	Thousand €	13,272.5	13,603.3	12,897	9,104.8
Savings by other utilities	Thousand €/year	3.2	637.5	72.4	958.4
Total Savings by other utilities	Thousand €	80.0	15,936.5	1,809.5	23,959.7
LCOE	c €/kWh	5.50	3.97	4.83	4.26
NPV	Thousand €	6,624.27	37,090.77	9,637.40	50,006.34
PBP	Years	6	6	6	7

The Consultant has assessed the Projects' financial performance using two other different contractual scenarios for the transfer of electricity to the other municipal utilities.

The first scenario consists of the DH company receiving compensation for the electricity consumed by other users based on the calculated LCOE. The transmission costs are shared between the DH company and the final electricity users. The second scenario consists of the DH company receiving compensation only for O&M costs. The transmission costs are shared similarly to the first scenario. Both scenarios increase the savings of the DH company and the other municipal utilities but have lower NPVs in comparison with the results shown in Table 6-16.

It is important to establish a clear contractual structure for the transmission of electricity and compensation mechanisms for the DH company.

6.4 Impact on Heating Tariffs

It is a common practice in Ukraine not to include depreciation costs of a grant-financed project in the heating tariffs. Therefore, the implementation of the SPP projects will not result in an increase of the heating tariffs.

By excluding the depreciation costs from the yearly savings calculations for the DH Company and considering the current electricity price from the grid, the heating tariff are expected to be reduced by 1.26%.

This assessment is based on non-discounted figures were used for the tariff reduction calculation.

7. PLANNING AND ORGANIZATION

7.1 Estimated Project Implementation Schedule and Procurement Plan

The Project Procurement and Implementation Plan (PIP) has been developed based on the following principles:

- NEFCO's Procurement Policy and Procedures (PP&P)
- Practical approach: Timing, potential issues & mitigation measures, sector & regional specifics are considered.
- Cost-efficiency: Implementation of the project according to the strategies contained in the Procurement Plan shall lead to the minimum cost of the components/lots foreseen by the PIP.

To clarify the procurement cycle that would bring the suggested investments to reality, this section describes the proposed implementation strategy and outlines the type of contract which is necessary given the nature of the project.

Table 7-1 provides an overview of the proposed Procurement Plan. The Plan provides an overview of the following:

- The proposed lot under capital expenditure.
- Financing source.
- Contract type.
- Procurement method.
- Indicative dates for tender invitation, contract award and contract completion.

The three SPPs were combined in one procurement package due to the similar nature of procurement and works.

The proposed procurement plan includes additional following contingency.

(i) price contingency of approximately 10%, and
(ii) Additional contingency of approximately 6.5%.

It is particularly important to have additional contingencies to the regular 10% of contingency as Ukraine is now under active war and contractors can face additional expenses related to additional insurances and risks to be included in the contract price.

It is important to note that the interconnection of the solar plant to the grid in the Samoilovycha 42 boiler house will need to be conducted during the non-heating seasons to avoid disrupting heating services. The Project Implementation Unit (PIU) will need to take this into consideration with regards to the detailed planning of the procurement process.

The Consultant recommended that the Company prepare all geological and geodesy surveys prior to the tender period as this will reduce the contractor's risks in the price proposal.

Finally, Figure 7-1 and Figure 7-2 illustrates the project implementation plan and show the activities and key events for design, approvals, construction, commissioning, completion, etc.

The legend in the PIP provides clarity and understanding of the roles to be fulfilled by the Company, the European Bank for Reconstruction and Development (EBRD), the potential contractors and the Consultant.

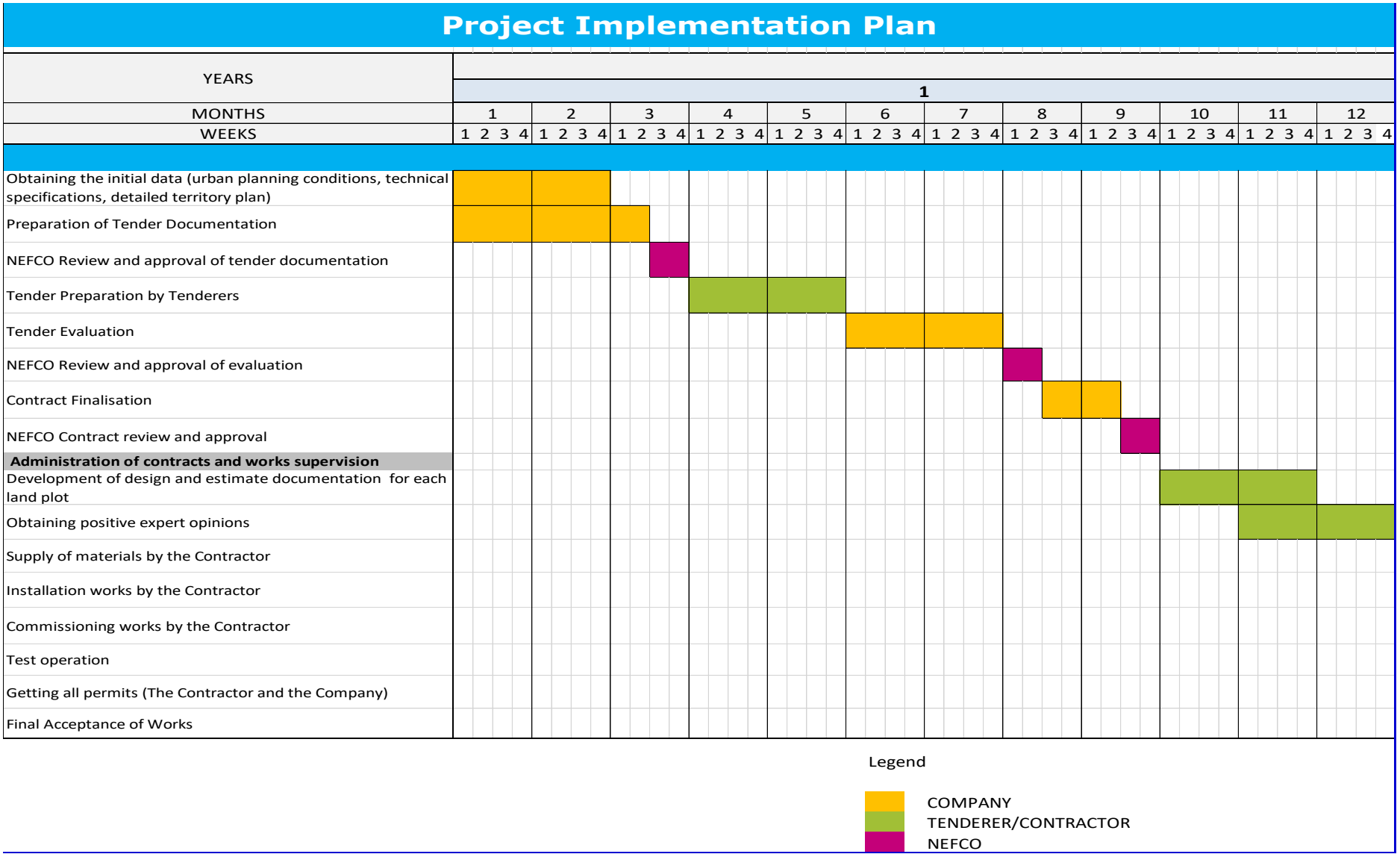


Figure 7-1: Project implementation plan year 1

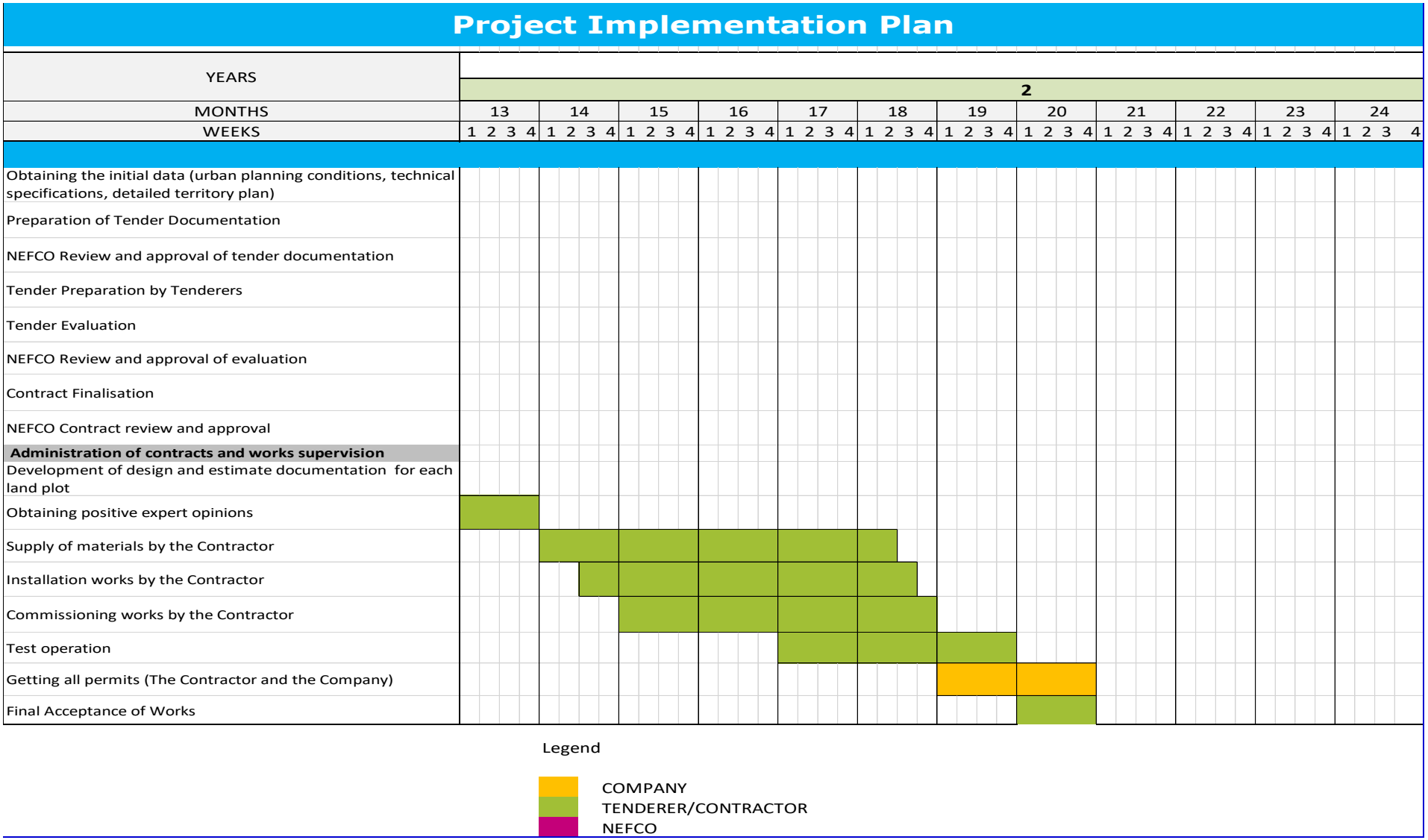


Figure 7-2 Project implementation plan year 2

Table 7-1: Procurement plan

LOT Nr.	Description	Estimated contract value	Financing sources	Contract type	Procurement method	Time Schedule		
			DSIF grant			Publish Invitation for Tenders 1st Stage mm/yy	Contract Signature mm/yy	Contract completion mm/yy
		€ 1,000	€ 1,000					
MKLV-1	Supply, installation, and commissioning of Solar Power Plants	6,181	6,181	Supply & install	One-stage Open Tendering	November 2024	April 2025	March 2026
MKLV-1	Contingencies	1,019	1,019					
	TOTAL Project	**7,200**	**7,200**					

7.2 Assessment of Project Risks and Mitigation Actions

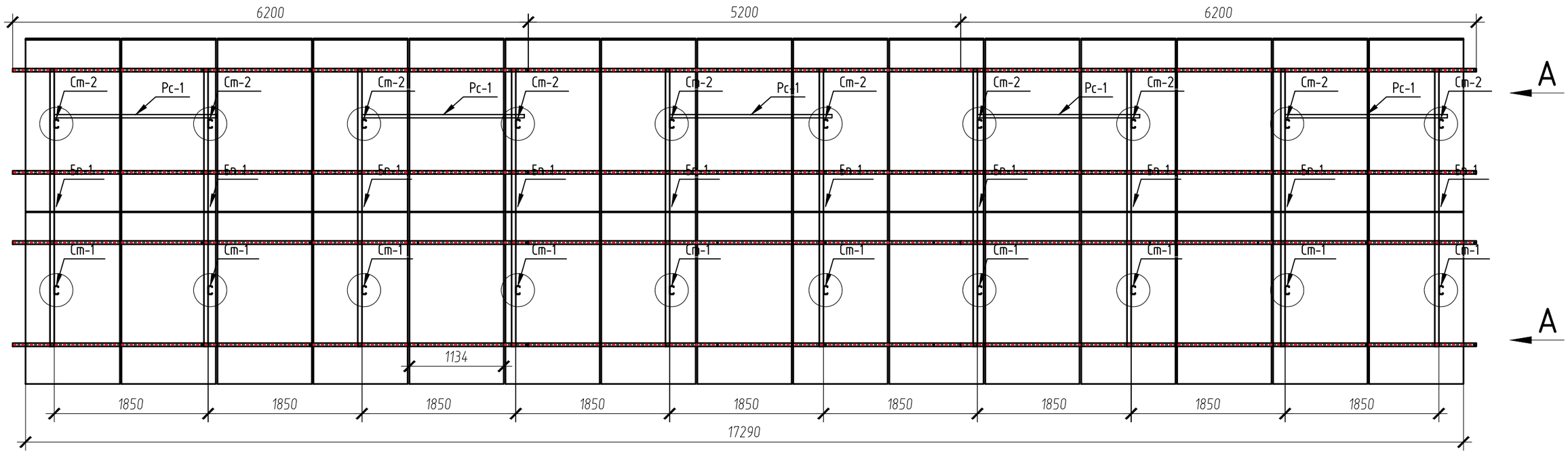
The risk assessment is an important activity in the project management process. It allows the identification of potential negative events that may affect the success of the project and the development of strategies to reduce the likelihood of their occurrence or to overcome them. It is impossible to predict all risks. Table 7-2 presents only the risks with a high probability of occurrence and/or over which local actors can have an impact.

Table 7-2: Project risk assessment

Item	Risk definition	Risk level	Mitigation actions
1	Lack of funding for implementation	High	Diversify funding options and keep stakeholders informed and engaged.
2	Obtaining permits and licenses	Medium	Preliminarily work out the issues of obtaining land permits and ownership of facilities.
3	Lack of clarity on the responsibility for covering the Grid connection permitting costs	Medium	Engage with the City and the Company in the next phase of project implementation to establish the responsible party for the connection permitting costs. Include a contingency in the CAPEX.
4	Increase in the cost of equipment and work	Medium	Given the downward trend in the unit cost of solar system elements, the risk is more related to currency fluctuations. To minimize it, it is necessary to speed up the implementation time
5	Lack of equipment on the local market	Low	Given that it is proposed to implement the project at different sites using the same type of equipment, it is envisaged to pre-purchase at least part of the main equipment before the completion of the design work
6	Lack of sufficient qualifications of the company specialists	Low	Conducting additional training on system operation.
7	Lack of opportunities to sell surplus electricity	High	Limiting the capacity of power plants to the estimated values in this report, which minimizes this risk. Lobbying for amendments to the relevant regulatory documents
8	Premature equipment failure	Low	Provision for extended warranty obligations and the use of higher-end equipment.
9	Risk of hostilities	High	Generation should be dispersed to minimize damage in the event of explosions nearby. Improving air defence capabilities (not project-specific)

ANNEX 1 – CONCEPTUAL LAYOUT OF THE SOLAR POWER PLANTS

Вид зверху М 1:50



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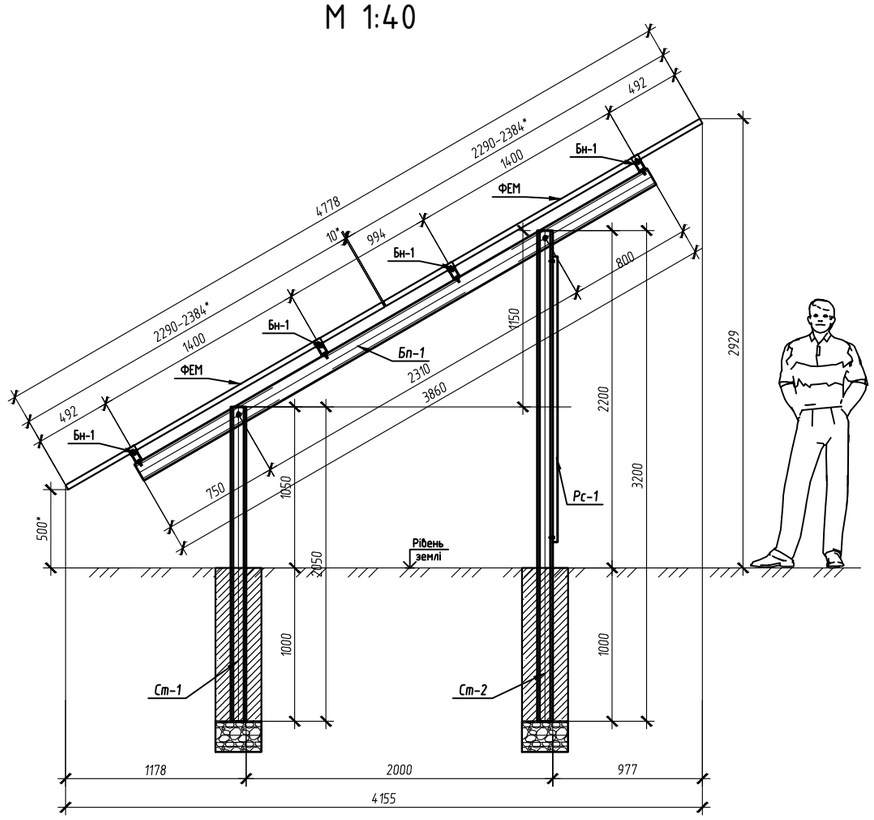


Примітки:
1. Влаштування стійок-паль проводити відповідно до рельєфа місцевості.
2. Різниця рівня поверхні землі ±200 мм, при цьому різниця рівня верха паль ±20 мм.
3. Нахил паль від вертикальної осі ±3° в будь-якому напрямку.
4. Кут нахилу площини ФЕМ 30°±1°.
5. Відстань від низа ФЕМ до рівня поверхні землі 500 мм ± 100 мм.
6. Конструкція збирається на будівельному майданчику із готових деталей;
7. Перепади висоти грунту до 500 мм на 16 м можуть бути нівельовані методом регулювання глибини занурення опор.

Зм.	Кіл. уч.	Арк.	№ док.	Підп.	Дата
Розроб.					
Перевірив					
ГІП					
Н. контр.					

Погоджено

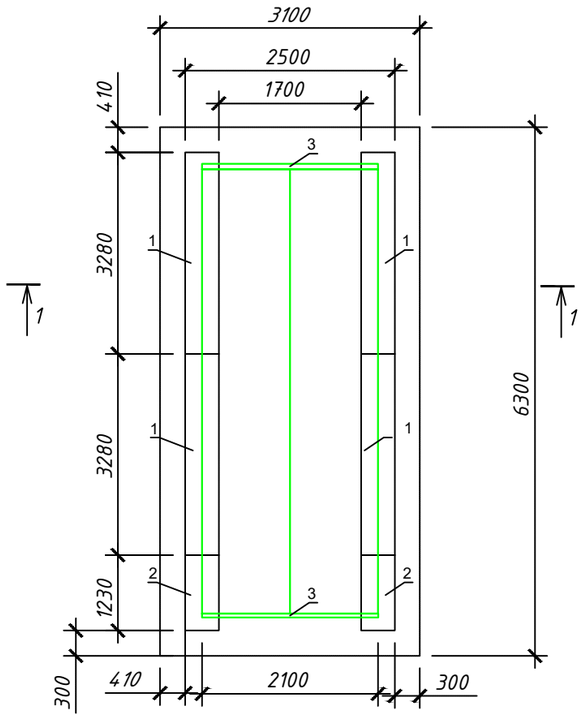
Н. контр.

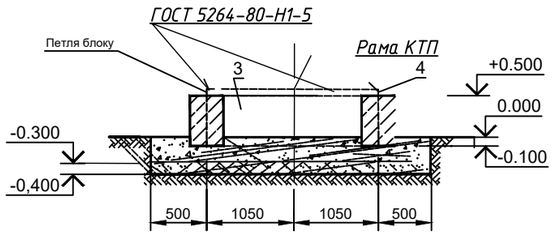
01/03-24.ТЕО-ТХ

Техніко-економічне обґрунтування будівництва сонячної електростанції для ОКП «Миколаївоблтеплоенерго» – м. Миколаїв, вул. Миколаївська, 5-а

Техніко-економічне обгрунтування	Стадія	Аркуш	Аркушів
	ТЕО	1	8
Конструкція для ФЕМ			

Формат А3





марка поз.	позначення	найменування	кіл од.	маса од,кг	прим.
1	ГОСТ 13579 - 78*	ФБС 24.4- 6т	4		
2	ГОСТ 13579 - 78*	ФБС 9.4- 6т	2		
3	ГОСТ 19903 - 74*	Сталь листова -			
		- 3 х 700 х 1800 мм	2		
4		Штроба 40х4 L=5,3м	2		
		Пісок	1.953		
		Щебінь фракція 20-40	5,403		
		Емаль ПФ-115	1,2	кг	
		Грунтовка ГФ-021	0,6	кг	
		Мастика гідроізоляційна	4,43	кг	

Загальні вказівки

1. Монтажні роботи проводити згідно вказівок ВБН В.2.2-58.2-94 .

2. Зварювання металевих конструкцій проводити електродами типу Э-42. Товщину шва приймати по найменьшій товщині зварювальних деталей.

3. Антикорозійний захист металевих конструкцій виконувати двома шарами емаллю ПФ-115 по грунтовці ГФ-021.

4. Виключаючи можливість нещасних випадків, передбачити металеві захисні пластини, які приварити до конструкції КТП та заробити у ґрунт на 100 мм.

5. Згідно норм витрат будівельних матеріалів для визначених потребах у ресурсах при виконанні робіт коефіцієнт витрат на пісок приймати 1,1, на щебінь 1,15.

6. Виконати гідроізоляцію для фундаментних блоків тої частини котра знаходиться нижче рівня нуля

7.За фактом виконання робіт виконати акти на приховані роботи згідно ДБН, рекомендований перелік актів:

- Підготовлена основа під фундаменти із зазначенням розмірів, позначок дна котловану, відповідності фактичного нашарування та властивостей ґрунту тим, що зазначені в проекті

-Відповідність арматури та закладних деталей робочим кресленням

-Прийняття фундаментів та інших опорних елементів, включаючи геодезичну перевірку відповідності їх фактичного положення проектному (у плані та по висоті) зі складанням виконавчої схеми.

-Прийняття змонтованих конструкцій споруди або окремих її частин

Погоджено

Н. контр.

Зм.	Кіл. уч.	Арк.	№ док.	Підп.	Дата	01/03-24.ТЕО-ТХ			
						Техніко-економічне обґрунтування будівництва сонячної електростанції для ОКП «Миколаївоблтеплоенерго» - м. Миколаїв, вул. Миколаївська, 5-а			
Розроб.						Техніко-економічне обгрунтування	Стадія	Аркуш	Аркушів
Перевірив							ТЕО	2	8
ГІП									
Н. контр.						Фундамент для КТП			

Формат А3

вул. Самойловича, 42

КТП 0.4/6
1000 кВА

Умовні позначки:

- Паркан існуючий
- Паркан проект.
- Зона затінення
- Охоронна зона
- Дороги
- КЛ проект.
- Інвертор
- Стіл на 30 ФЕМ

Примітки:
1680 шт. ФЕМ 550Вт;
8 шт. Хуавей 100 кВт;
1 шт. КТП 6/0,4 1000кВА;
потужність: 924,0 (800) кВт ;
довжина нового паркану: 500 м;
довжина КЛ 0,4 кВ: 390 м;
довжина КЛ 6 кВ: 250 м.

Погоджено

Н. контр.

Зм.	Кіл. уч.	Арк.	№ док.	Підп.	Дата
Розроб.					
Перевірив					
ГІП					
Н. контр.					

01/03-24.ТЕО-ТХ

Техніко-економічне обґрунтування будівництва сонячної електростанції для ОКП «Миколаївоблтеплоенерго» – м. Миколаїв, вул. Миколаївська, 5-а

Техніко-економічне обґрунтування	Стадія	Аркуш	Аркушів
	ТЕО	3	8
План-схема розміщення ФЕМ. Ділянка №1			

Формат А3

Схема підключення ТП

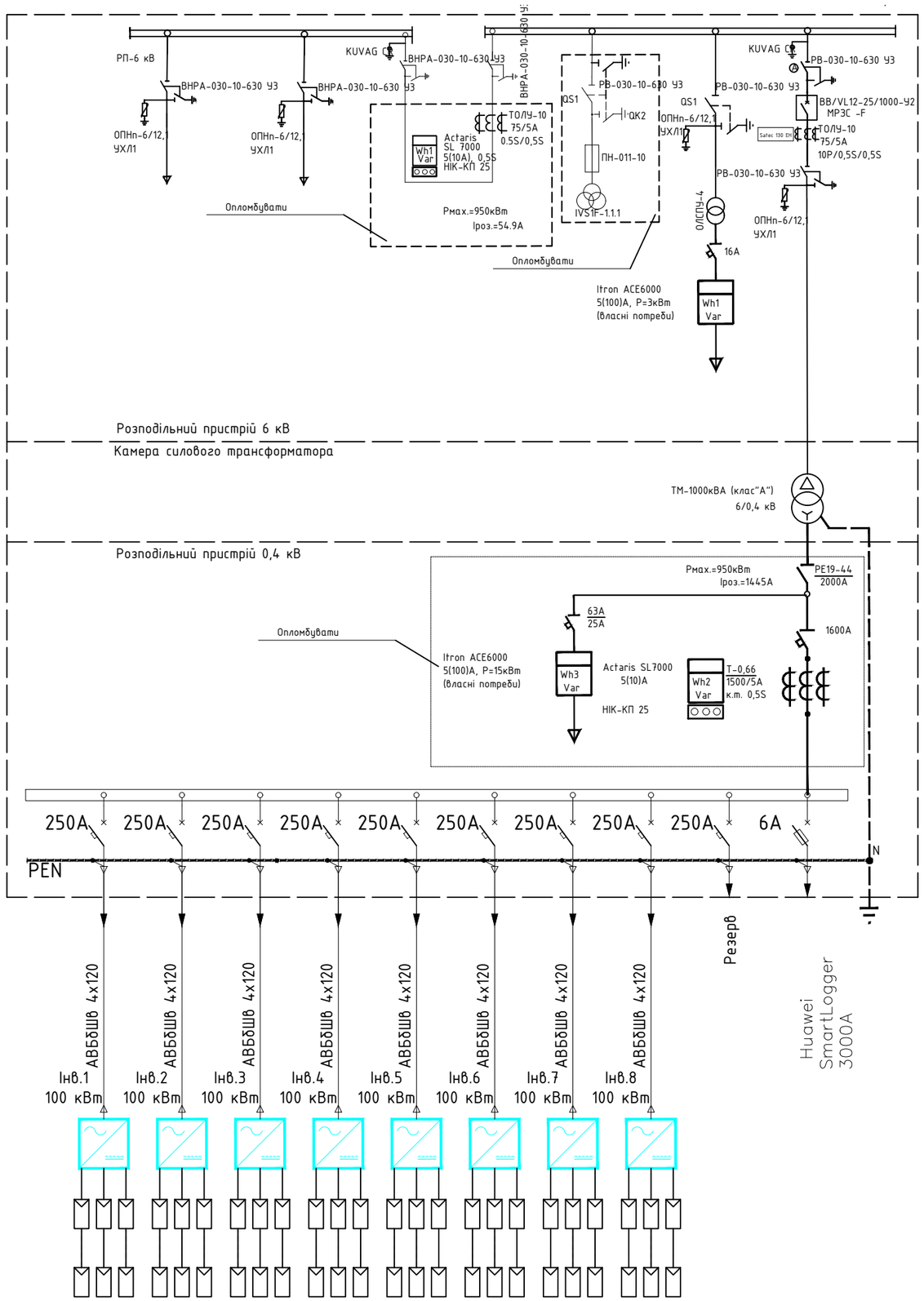
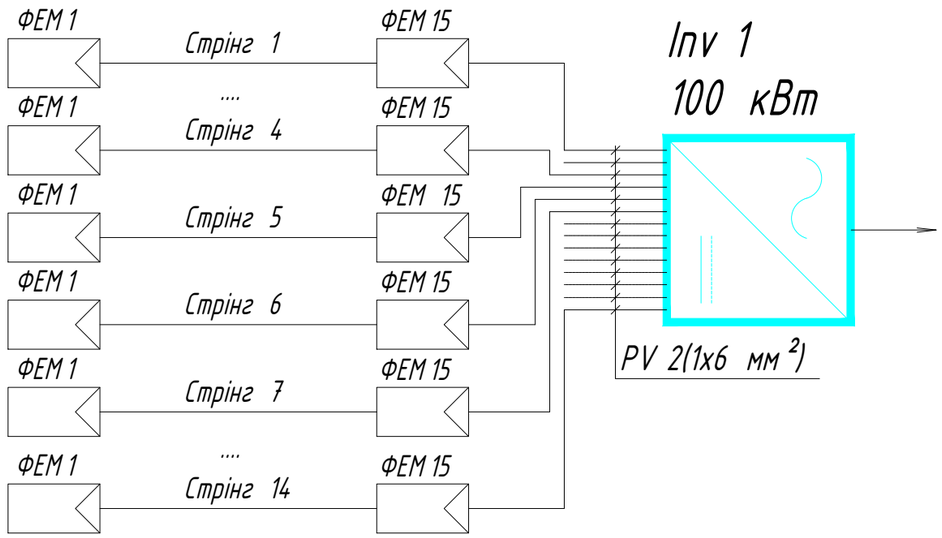


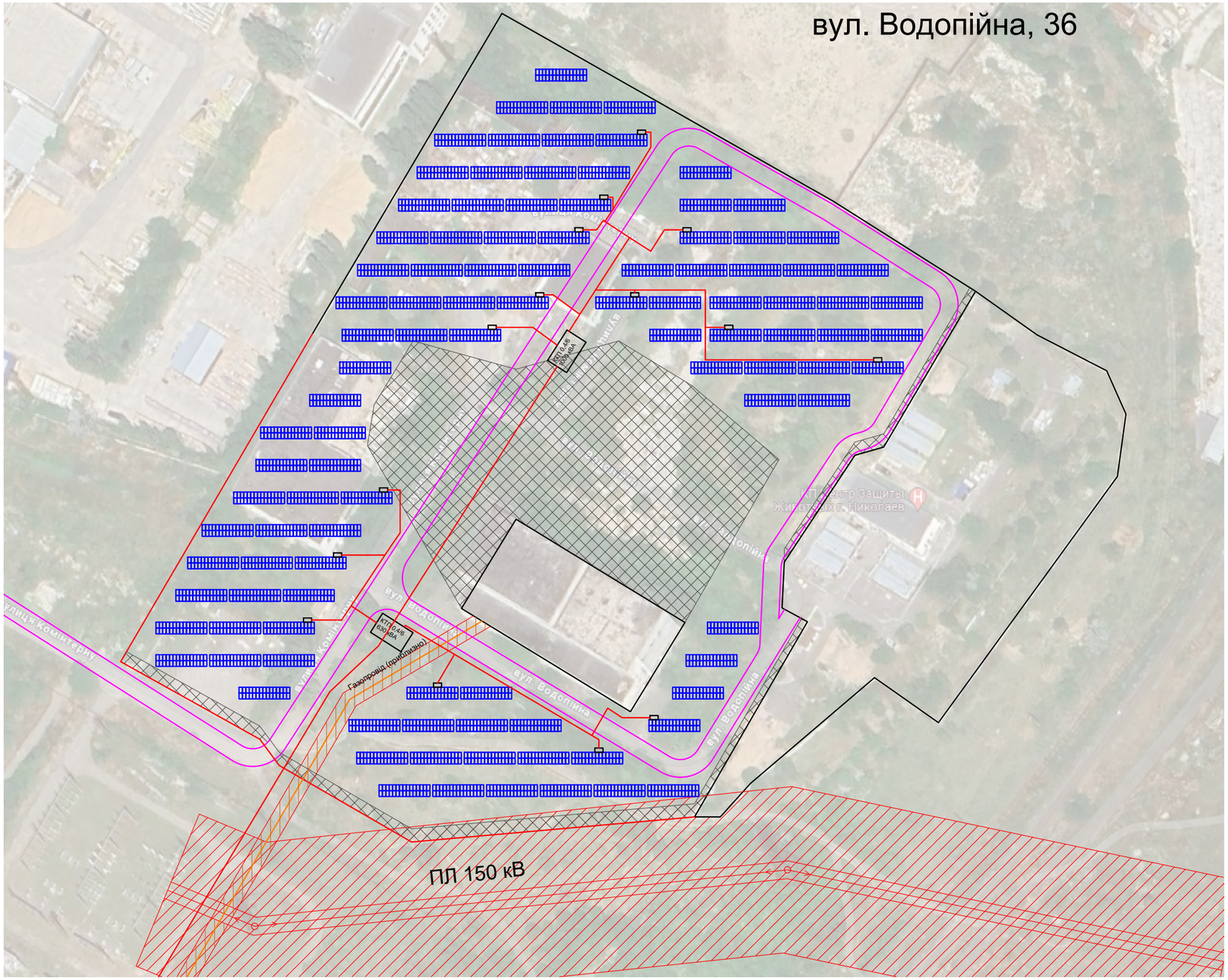
Схема підключення ФЕМ до інверторів



						01/03-24.ТЕО-ТХ	
						Техніко-економічне обґрунтування будівництва сонячної електростанції для ОКП «Миколаївоблтеплоенерго» – м. Миколаїв, вул. Миколаївська, 5-а	
Зм.	Кіл. уч.	Арк.	№ док.	Підп.	Дата		
Розроб.						Техніко-економічне обґрунтування	Стадія: ТЕО; Аркуш: 4; Аркушів: 8
Перевірив							
ГІП							
Н. контр.						Схема електропостачання СЕС. Ділянка №1	

Погоджено

Формат А3



Умовні позначки:

- Паркан існуючий
- Паркан проект.
- Зона затінення
- Охоронна зона
- Дороги
- КЛ проект.
- Інвертор
- Стіл на 30 ФЕМ

Примітки:
3150 шт. ФЕМ 550Вт;
15 шт. Хуавей 100 кВт;
1 шт. КТП 6/0,4 1000кВА;
1 шт. КТП 6/0,4 630кВА;
потужність: 1732,5 (1500) кВт;
довжина нового паркану: 350 м;
довжина КЛ 0,4 кВ: 950 м;
довжина КЛ 6 кВ: 280 м.

Зм.	Кіл. уч.	Арк.	№ док.	Підп.	Дата	01/03-24.ТЕО-ТХ			
						Техніко-економічне обґрунтування будівництва сонячної електростанції для ОКП «Миколаївоблтеплоенерго» – м. Миколаїв, вул. Миколаївська, 5-а			
Розроб.						Техніко-економічне обґрунтування	Стадія	Аркуш	Аркушів
Перевірив							ТЕО	5	8
ГІП									
Н. контр.						План-схема розміщення ФЕМ. Ділянка №2			

Погоджено

Формат А3

Схема підключення ТП1 1000 кВА

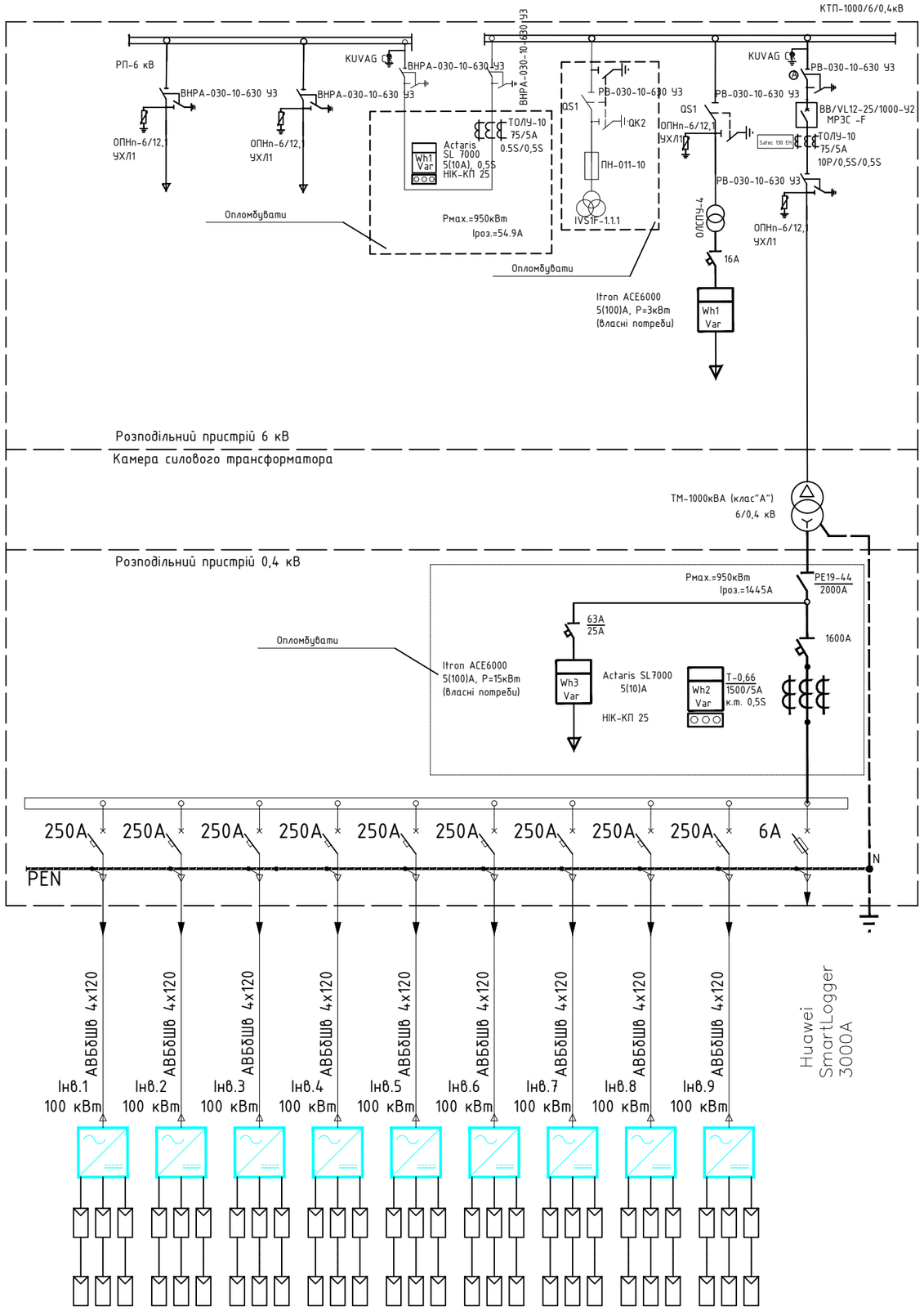
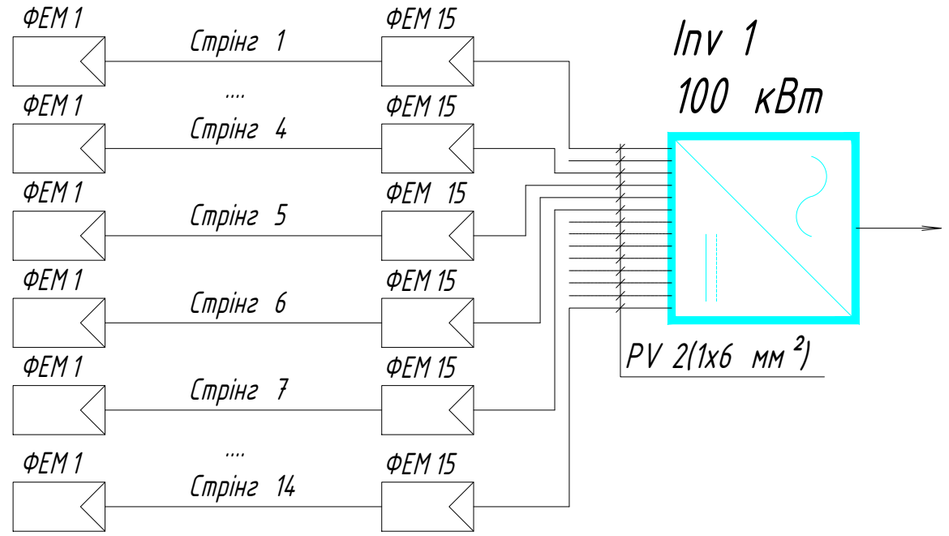


Схема підключення ФЕМ до інверторів



						01/03-24.ТЕО-ТХ	
						Техніко-економічне обґрунтування будівництва сонячної електростанції для ОКП «Миколаївоблтеплоенерго» – м. Миколаїв, вул. Миколаївська, 5-а	
Зм.	Кіл. уч.	Арк.	№ док.	Підп.	Дата		
Розроб.						Техніко-економічне обґрунтування	Стадія: ТЕО; Аркуш: 6.1; Аркушів: 8
Перевірив							
ГІП							
						Схема електропостачання СЕС. Ділянка №2	
Н. контр.							

Погоджено

Н. контр.

Формат А3

Схема підключення ТП2 630 кВА

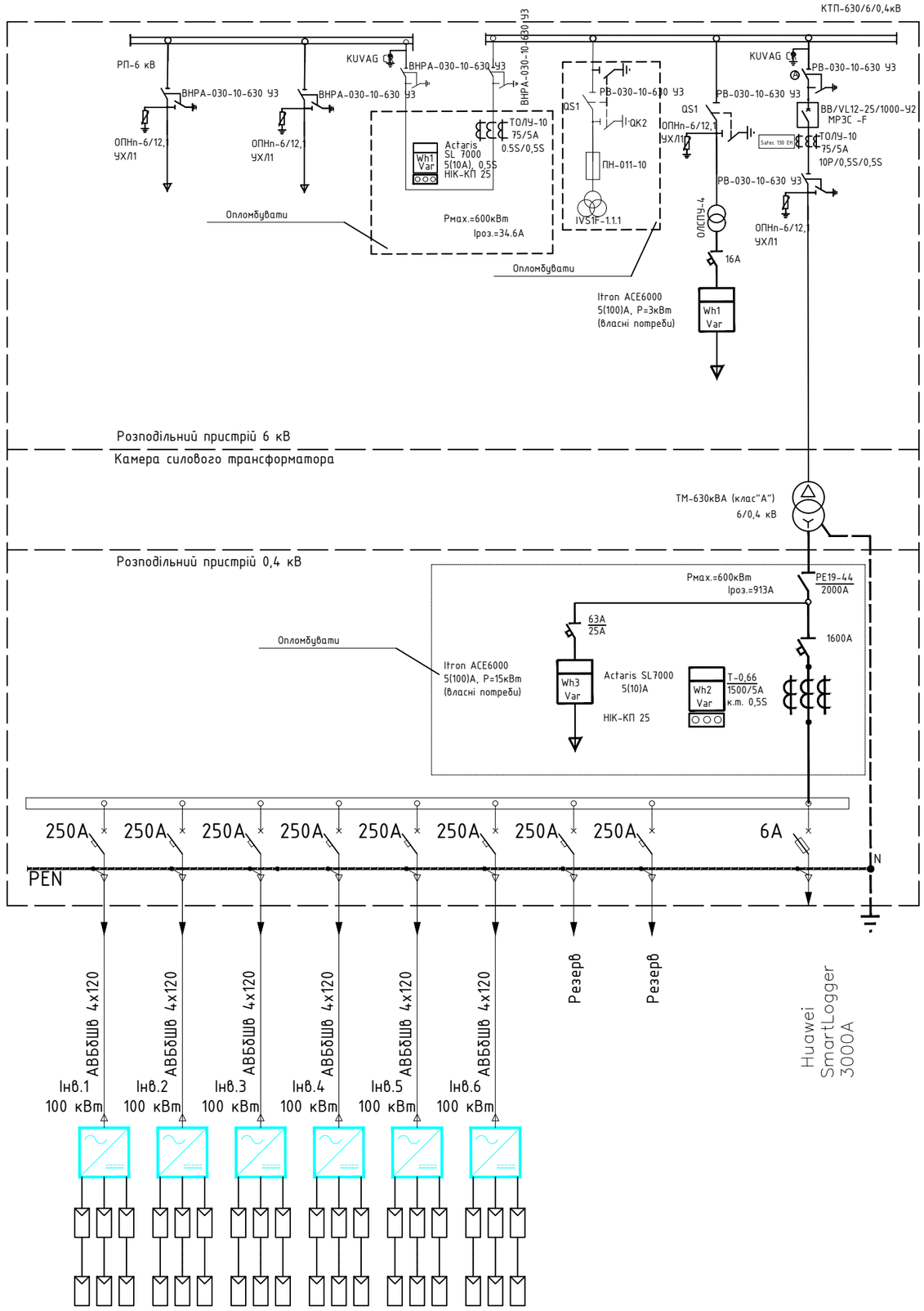
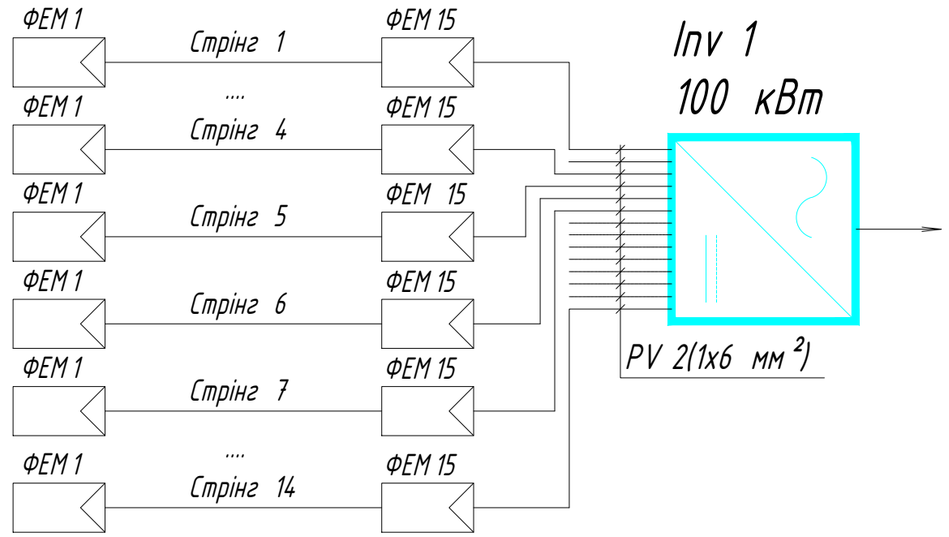


Схема підключення ФЕМ до інверторів



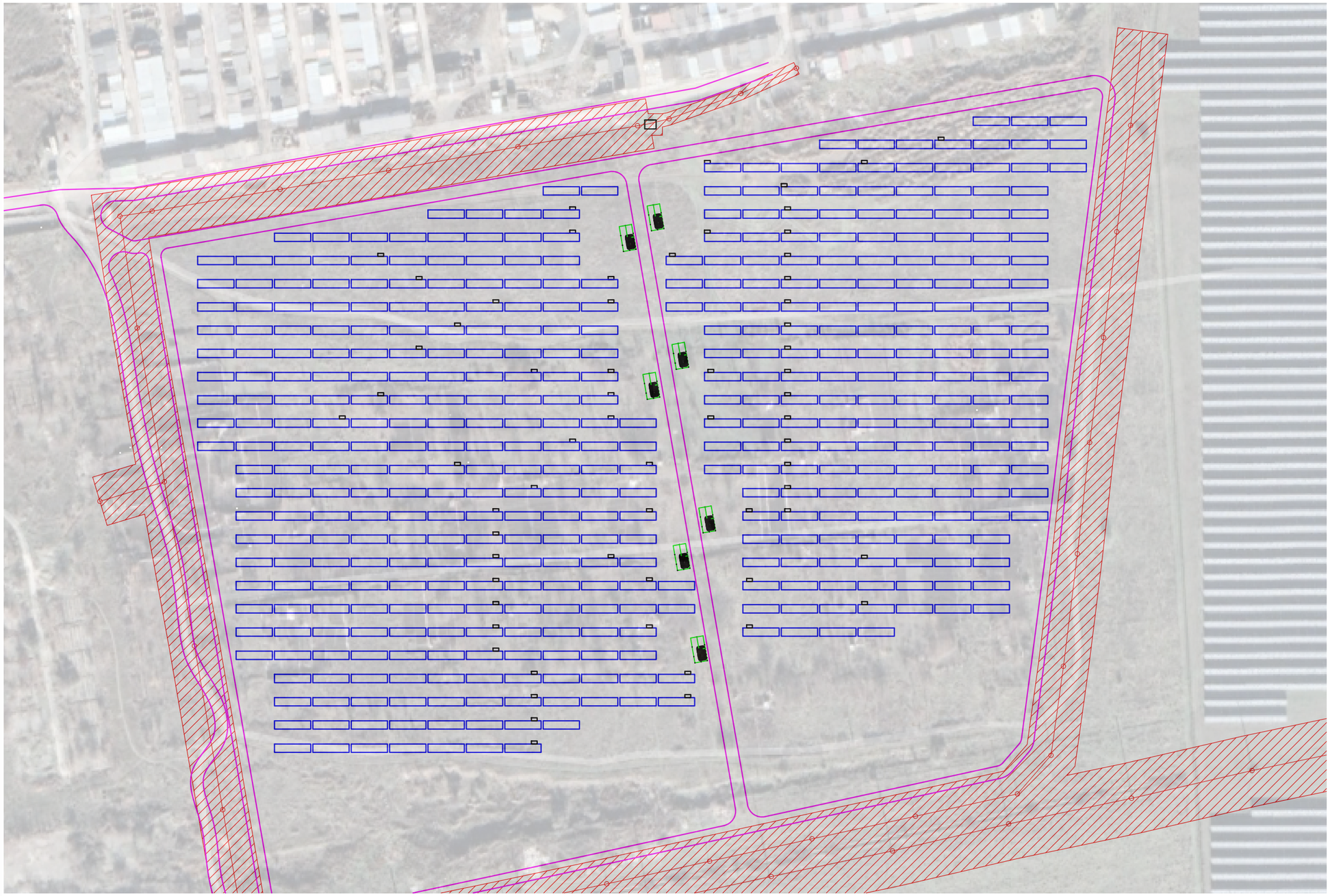
						01/03-24.ТЕО-ТХ	
						Техніко-економічне обґрунтування будівництва сонячної електростанції для ОКП «Миколаївоблтеплоенерго» – м. Миколаїв, вул. Миколаївська, 5-а	
Зм.	Кіл. уч.	Арк.	№ док.	Підп.	Дата		
Розроб.						Техніко-економічне обґрунтування	Стадія: ТЕО; Аркуш: 6.2; Аркушів: 8
Перевірив							
ГІП							
Н. контр.						Схема електропостачання СЕС. Ділянка №2	

Погоджено

Н. контр.

Формат А3

вул. Самойловича, 44



Умовні позначки:

- Паркан існуючий
- Паркан проект.
- Зона затінення
- Охоронна зона
- Дороги
- КЛ проект.
- Інвертор
- Стіл на 30 ФЕМ

Примітки:
13230 шт. ФЕМ 550Вт;
63 шт. Хуавей 100 кВт;
1 шт. КТП 6/0,4 1000кВА;
потужність: 7276,5 (6300) кВт;
довжина нового паркану: 1600 м;
довжина КЛ 0,4 кВ: 4000 м.

Погоджено

Н. контр.

Зм.	Кіл. уч.	Арк.	№ док.	Підп.	Дата
Розроб.					
Перевірив					
ГІП					
Н. контр.					

01/03-24.ТЕО-ТХ

Техніко-економічне обґрунтування будівництва сонячної електростанції для ОКП «Миколаївоблтеплоенерго» – м. Миколаїв, вул. Миколаївська, 5-а

Техніко-економічне обгрунтування	Стадія	Аркуш	Аркушів
	ТЕО	7	8
План-схема розміщення ФЕМ. Ділянка №3			

Формат А3

Схема підключення ТП1 1000 кВА

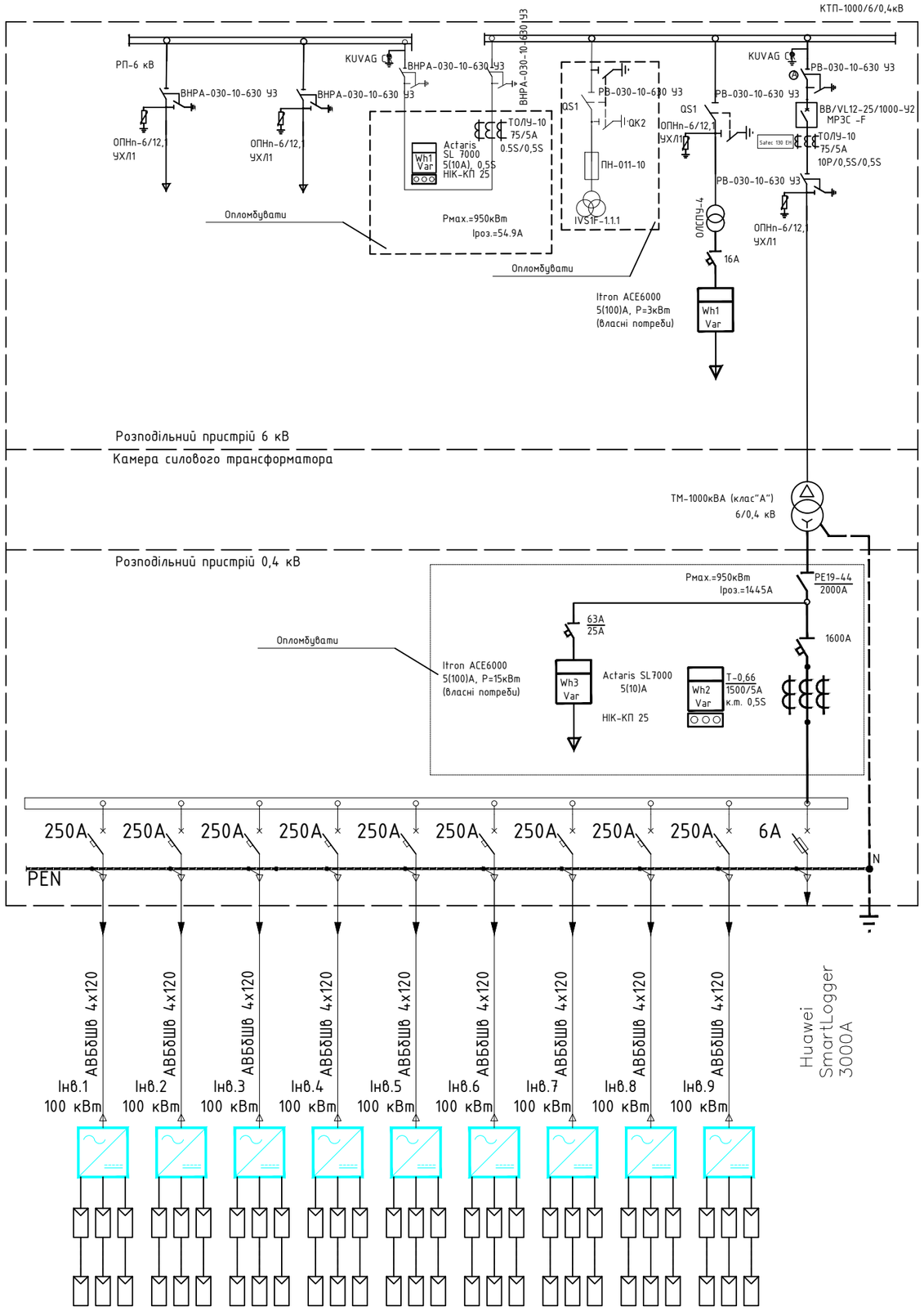
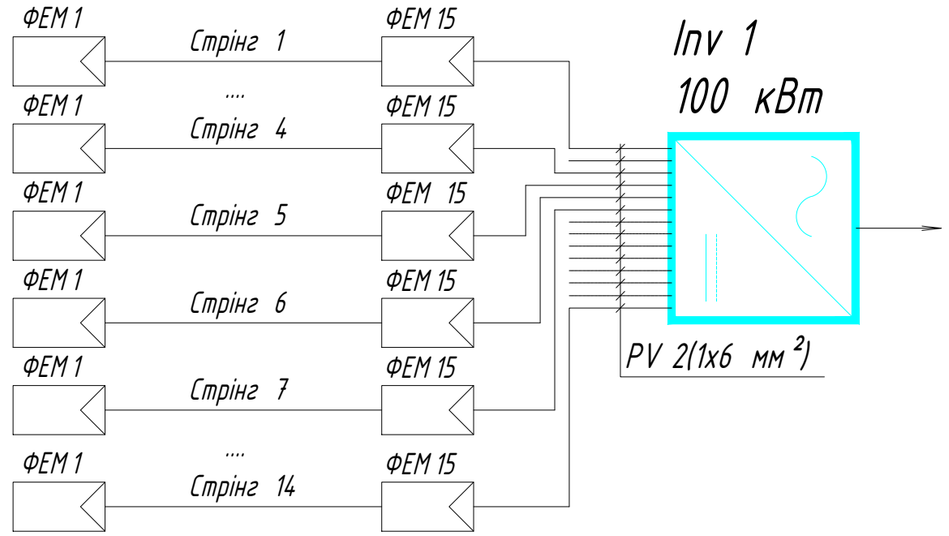


Схема підключення ФЕМ до інверторів



						01/03-24.ТЕО-ТХ	
						Техніко-економічне обґрунтування будівництва сонячної електростанції для ОКП «Миколаївоблтеплоенерго» – м. Миколаїв, вул. Миколаївська, 5-а	
Зм.	Кіл. уч.	Арк.	№ док.	Підп.	Дата		
Розроб.						Техніко-економічне обґрунтування	Стадія: ТЕО; Аркуш: 8; Аркушів: 8
Перевірив							
ГІП						Схема електропостачання СЕС. Ділянка №3	
Н. контр.							

Погоджено

Н. контр.

Формат А3

ANNEX 2 – ENERGY YIELD ASSESSMENT REPORT OF SPP-1

Version 7.4.5

PVsyst - Simulation report

Grid-Connected System

Project: Mykolaiv - SPP

Variant: SPP-1 @ 42 Samoilovycha Street

Sheds on ground

System power: 924 kWp

Mykolaiv - Ukraine

Author

Ramboll Deutschland GmbH (Germany)

PVsyst V7.4.5
VC1, Simulation date:
06/12/24 12:20
with v7.4.5

Project summary

Geographical Site
Mykolaiv
Ukraine

Situation

Latitude	46.92 °N
Longitude	32.05 °E
Altitude	54 m
Time zone	UTC+2

Project settings
Albedo 0.20

Meteo data
Radisnyy Sad
Meteonorm 8.1 (1996-2015), Sat=100% - Synthetic

System summary

Grid-Connected System

Sheds on ground

PV Field Orientation
Fixed plane
Tilt/Azimuth 30 / 0 °

Near Shadings
Linear shadings : Fast (table)

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	1680 units
Pnom total	924 kWp

Inverters

Nb. of units	8 units
Pnom total	800 kWac
Pnom ratio	1.155

Results summary

Produced Energy	1212391 kWh/year	Specific production	1312 kWh/kWp/year	Perf. Ratio PR	83.53 %

Table of contents

General parameters

Grid-Connected System

Sheds on ground

PV Field Orientation

Orientation	
Fixed plane	
Tilt/Azimuth	30 / 0 °

Sheds configuration	
Nb. of sheds	56 units
Sizes	
Sheds spacing	11.2 m
Collector width	4.58 m
Ground Cov. Ratio (GCR)	40.9 %
Shading limit angle	
Limit profile angle	17.6 °

Models used	
Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
Linear shadings : Fast (table)

User's needs
Unlimited load (grid)

PV Array Characteristics

PV module

Manufacturer	JA Solar
Model	JAM72-S30-550-MR
(Original PVsyst database)	
Unit Nom. Power	550 Wp
Number of PV modules	1680 units
Nominal (STC)	924 kWp
Modules	120 string x 14 In series
At operating cond. (50°C)	
Pmpp	848 kWp
U mpp	532 V
I mpp	1593 A

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-100KTL-M1-400Vac
(Original PVsyst database)	
Unit Nom. Power	100 kWac
Number of inverters	8 units
Total power	800 kWac
Operating voltage	200-1000 V
Max. power (=>33°C)	110 kWac
Pnom ratio (DC:AC)	1.16
Power sharing within this inverter	

Total PV power

Nominal (STC)	924 kWp
Total	1680 modules
Module area	4340 m²

Total inverter power

Total power	800 kWac
Max. power	880 kWac
Number of inverters	8 units
Pnom ratio	1.16

Array losses

Array Soiling Losses
Loss Fraction 2.0 %

Thermal Loss factor

Module temperature according to irradiance	
Uc (const)	29.0 W/m²K
Uv (wind)	0.0 W/m²K/m/s

DC wiring losses

Global array res.	5.5 mΩ
Loss Fraction	1.5 % at STC

LID - Light Induced Degradation
Loss Fraction 1.5 %

Module Quality Loss
Loss Fraction -0.8 %

Module mismatch losses
Loss Fraction 1.0 % at MPP

Strings Mismatch loss
Loss Fraction 0.1 %

IAM loss factor
Incidence effect (IAM): User defined profile

0°	30°	50°	65°	70°	75°	80°	85°	90°
1.000	1.000	0.999	0.953	0.910	0.853	0.725	0.448	0.000

PVsyst V7.4.5
VC1, Simulation date:
06/12/24 12:20
with v7.4.5

System losses

Unavailability of the system

Time fraction	1.0 %
	3.7 days,
	3 periods

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage	400 Vac tri
Loss Fraction	1.00 % at STC

Inverter: SUN2000-100KTL-M1-400Vac

Wire section (8 Inv.)	Copper 8 x 3 x 70 mm²
Average wires length	53 m

MV line up to Injection

MV Voltage	6 kV
Wires	Copper 3 x 95 mm²
Length	1500 m
Loss Fraction	0.75 % at STC

AC losses in transformers

MV transfo

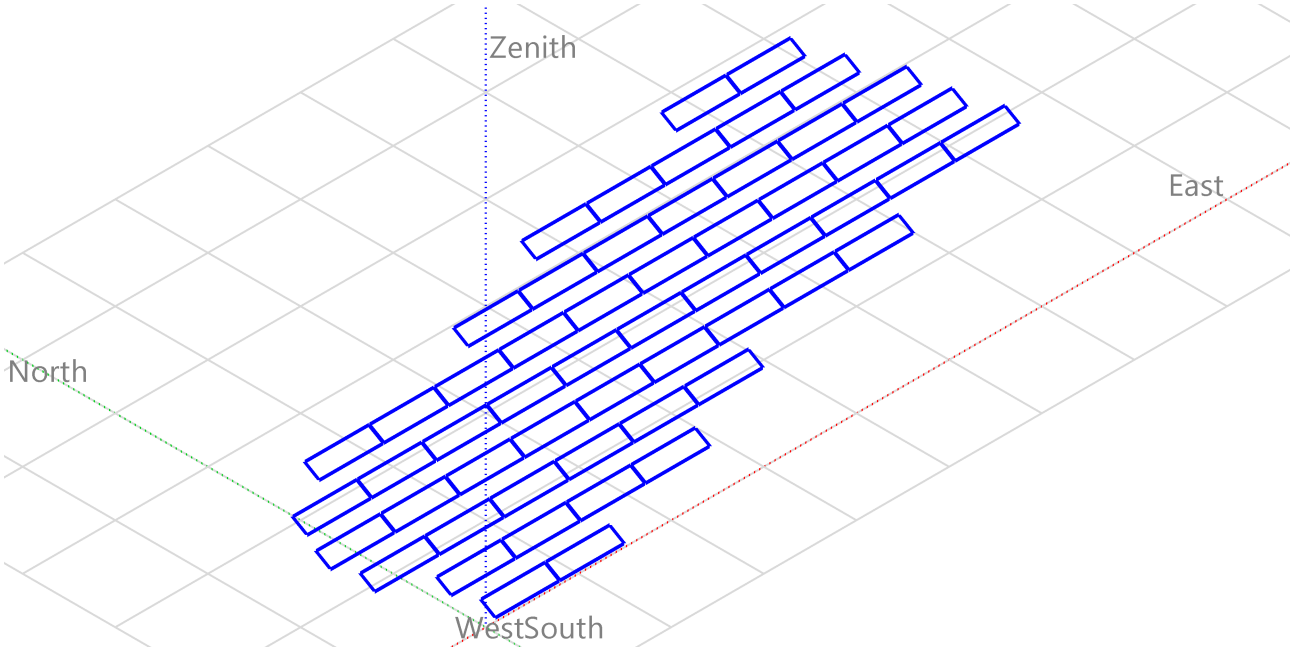
Medium voltage	6 kV

Transformer parameters

Nominal power at STC	906 kVA
Iron Loss (24/24 Connexion)	0.91 kVA
Iron loss fraction	0.10 % at STC
Copper loss	9.06 kVA
Copper loss fraction	1.00 % at STC
Coils equivalent resistance	3 x 1.77 mΩ

Near shadings parameter

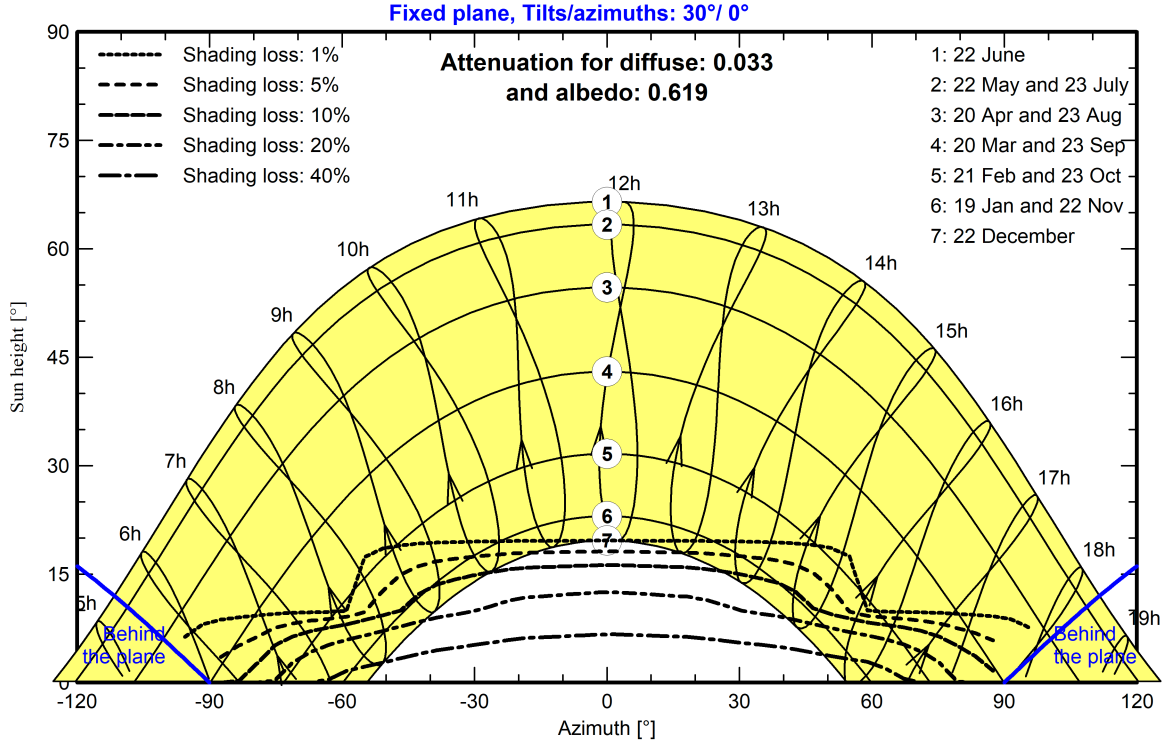
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 30°/ 0°



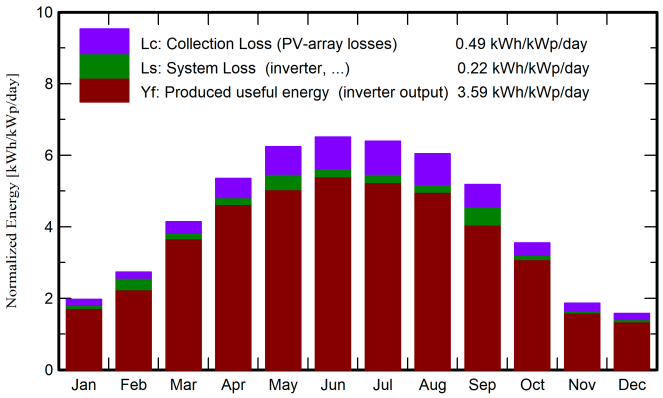
PVsyst V7.4.5
VC1, Simulation date:
06/12/24 12:20
with v7.4.5

Main results

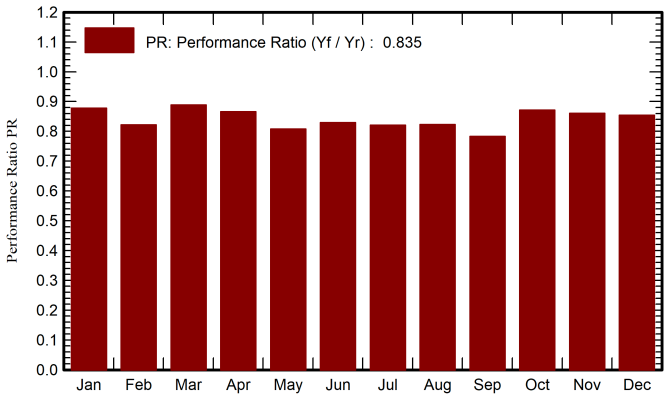
System Production

Produced Energy	1212391 kWh/year	Specific production	1312 kWh/kWp/year
		Perf. Ratio PR	83.53 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

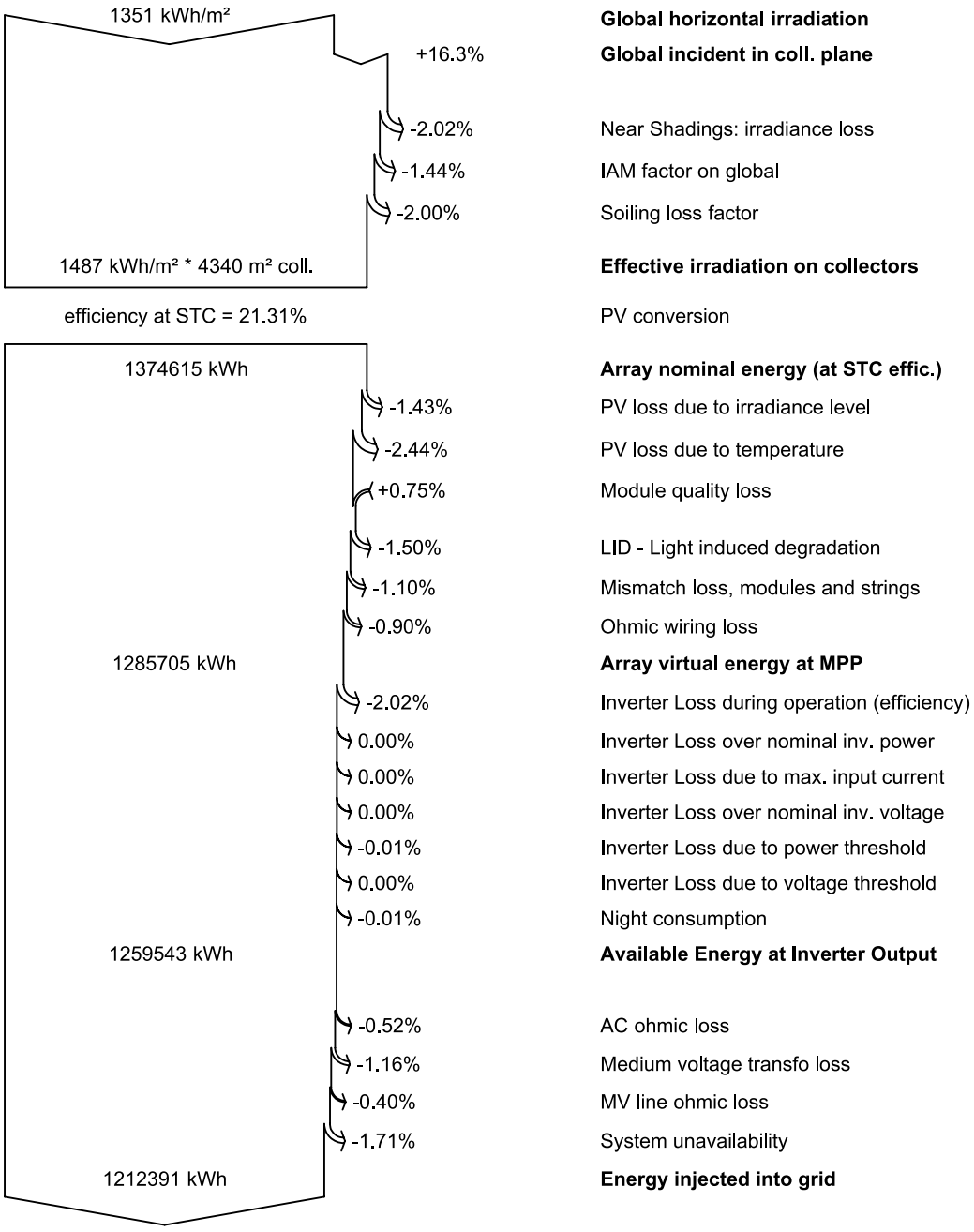
	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	PR ratio
January	35.0	17.81	-1.53	61.1	56.3	51736	49559	0.878
February	53.5	31.48	-0.59	76.5	72.3	66420	58129	0.822
March	100.3	49.57	4.40	128.2	122.0	109508	105263	0.889
April	142.4	70.13	10.75	160.4	152.3	133734	128409	0.866
May	187.2	77.79	17.34	193.5	183.6	156983	144475	0.808
June	197.8	79.79	21.20	195.3	185.2	156287	149794	0.830
July	197.6	79.29	24.07	198.2	188.2	156860	150324	0.821
August	170.3	69.92	23.88	187.3	178.1	148696	142484	0.823
September	122.9	46.80	17.56	155.5	148.2	126739	112479	0.783
October	78.7	41.30	10.75	110.1	104.7	92165	88581	0.871
November	37.3	25.24	5.53	55.7	51.4	46229	44328	0.861
December	28.2	16.93	1.18	48.9	44.2	40349	38565	0.854
Year	1351.2	606.05	11.28	1570.8	1486.6	1285705	1212391	0.835

Legends

GlobHor	Global horizontal irradiation
DiffHor	Horizontal diffuse irradiation
T_Amb	Ambient Temperature
GlobInc	Global incident in coll. plane
GlobEff	Effective Global, corr. for IAM and shadings
EArray	Effective energy at the output of the array
E_Grid	Energy injected into grid
PR	Performance Ratio

PVsyst V7.4.5
VC1, Simulation date:
06/12/24 12:20
with v7.4.5

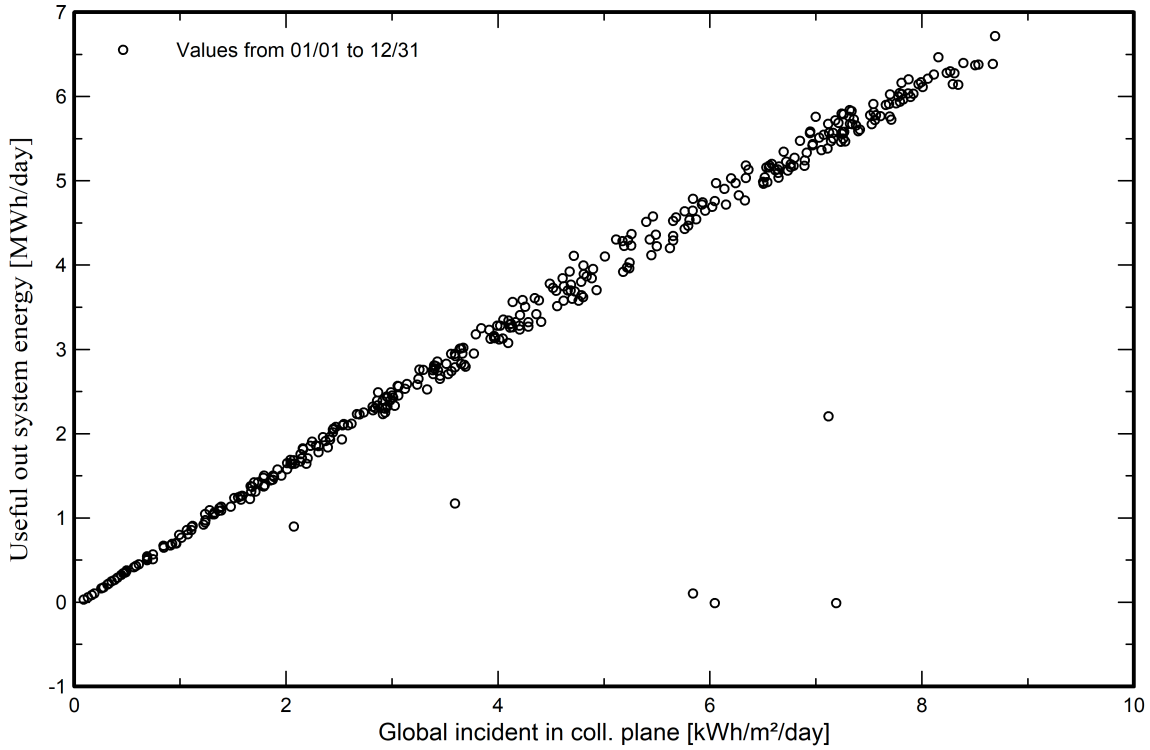
Loss diagram



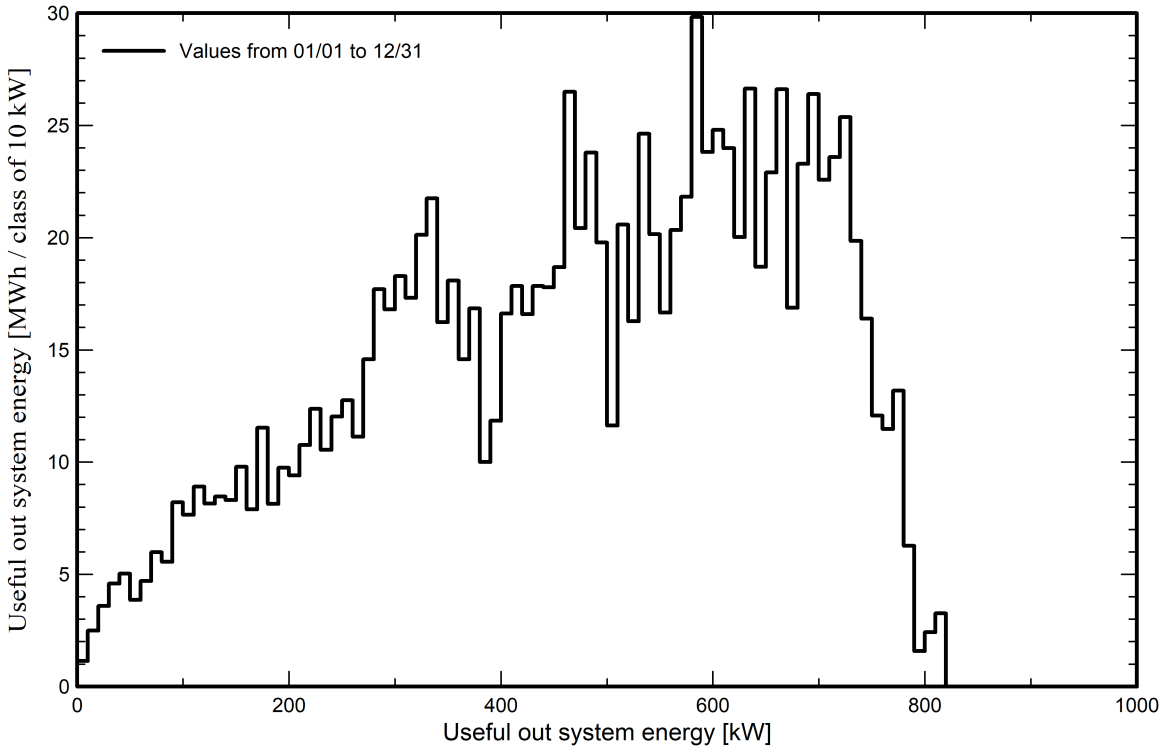
PVsyst V7.4.5
VC1, Simulation date:
06/12/24 12:20
with v7.4.5

Predef. graphs

Daily Input/Output diagram

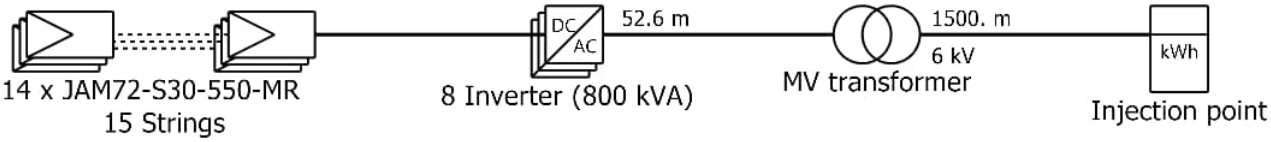


System Output Power Distribution



Single-line diagram

PVsyst V7.4.5
VC1, Simulation date:
06/12/24 12:20
with v7.4.5



PV module	JAM72-S30-550-MR
Inverter	SUN2000-100KTL-M1-400Vac
String	14 x JAM72-S30-550-MR

Mykolaiv - SPP Ramboll Deutschland GmbH (Ger

VC1 : SPP-1 @ 42 Samoilovycha Street

06/20/24

ANNEX 3 - ENERGY YIELD ASSESSMENT REPORT OF SPP-2

Version 7.4.5

PVsyst - Simulation report

Grid-Connected System

Project: Mykolaiv - SPP

Variant: SPP-2 @ 44 Samoilovycha Street

Sheds on ground

System power: 7277 kWp

Mykolaiv - Ukraine

Author

Ramboll Deutschland GmbH (Germany)

PVsyst V7.4.5
VC2, Simulation date:
06/12/24 00:25
with v7.4.5

Project summary

Geographical Site
Mykolaiv
Ukraine

Situation

Latitude	46.92 °N
Longitude	32.05 °E
Altitude	54 m
Time zone	UTC+2

Project settings
Albedo 0.20

Meteo data
Radisnyy Sad
Meteonorm 8.1 (1996-2015), Sat=100% - Synthetic

System summary

Grid-Connected System

Sheds on ground

PV Field Orientation
Fixed plane
Tilt/Azimuth 30 / 0 °

Near Shadings
Linear shadings : Fast (table)

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	13230 units
Pnom total	7277 kWp

Inverters

Nb. of units	56 units
Pnom total	5600 kWac
Pnom ratio	1.299

Results summary

Produced Energy	9504642 kWh/year	Specific production	1306 kWh/kWp/year	Perf. Ratio PR	83.16 %

Table of contents

General parameters

Grid-Connected System

Sheds on ground

PV Field Orientation

Orientation	
Fixed plane	
Tilt/Azimuth	30 / 0 °

Sheds configuration	
Nb. of sheds	407 units
Sizes	
Sheds spacing	11.1 m
Collector width	4.58 m
Ground Cov. Ratio (GCR)	41.2 %
Shading limit angle	
Limit profile angle	17.8 °

Models used	
Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
Linear shadings : Fast (table)

User's needs
Unlimited load (grid)

PV Array Characteristics

PV module

Manufacturer	JA Solar
Model	JAM72-S30-550-MR
(Original PVsyst database)	
Unit Nom. Power	550 Wp
Number of PV modules	13230 units
Nominal (STC)	7277 kWp
Modules	882 string x 15 In series
At operating cond. (50°C)	
Pmpp	6680 kWp
U mpp	570 V
I mpp	11711 A

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-100KTL-M1-400Vac
(Original PVsyst database)	
Unit Nom. Power	100 kWac
Number of inverters	56 units
Total power	5600 kWac
Operating voltage	200-1000 V
Max. power (=>33°C)	110 kWac
Pnom ratio (DC:AC)	1.30
Power sharing within this inverter	

Total PV power

Nominal (STC)	7277 kWp
Total	13230 modules
Module area	34176 m²

Total inverter power

Total power	5600 kWac
Max. power	6160 kWac
Number of inverters	56 units
Pnom ratio	1.30

Array losses

Array Soiling Losses
Loss Fraction 2.0 %

Thermal Loss factor

Module temperature according to irradiance	
Uc (const)	29.0 W/m²K
Uv (wind)	0.0 W/m²K/m/s

DC wiring losses

Global array res.	0.80 mΩ
Loss Fraction	1.5 % at STC

LID - Light Induced Degradation
Loss Fraction 1.5 %

Module Quality Loss
Loss Fraction -0.8 %

Module mismatch losses
Loss Fraction 1.0 % at MPP

Strings Mismatch loss
Loss Fraction 0.1 %

IAM loss factor
Incidence effect (IAM): User defined profile

0°	30°	50°	65°	70°	75°	80°	85°	90°
1.000	1.000	0.999	0.953	0.910	0.853	0.725	0.448	0.000

PVsyst V7.4.5
VC2, Simulation date:
06/12/24 00:25
with v7.4.5

System losses

Unavailability of the system

Time fraction	1.0 %
	3.7 days,
	3 periods

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage	400 Vac tri
Loss Fraction	1.00 % at STC

Inverter: SUN2000-100KTL-M1-400Vac

Wire section (56 Inv.)	Copper 56 x 3 x 70 mm²
Average wires length	47 m

MV line up to Injection

MV Voltage	6 kV
Average each inverter	
Wires	Copper 3 x 95 mm²
Length	2000 m
Loss Fraction	1.12 % at STC

AC losses in transformers

MV transfo

Medium voltage	6 kV

One transfo parameters

Nominal power at STC	1.02 MVA
Iron Loss (24/24 Connexion)	0.91 kVA
Iron loss fraction	0.09 % at STC
Copper loss	11.45 kVA
Copper loss fraction	1.12 % at STC
Coils equivalent resistance	3 x 1.77 mΩ

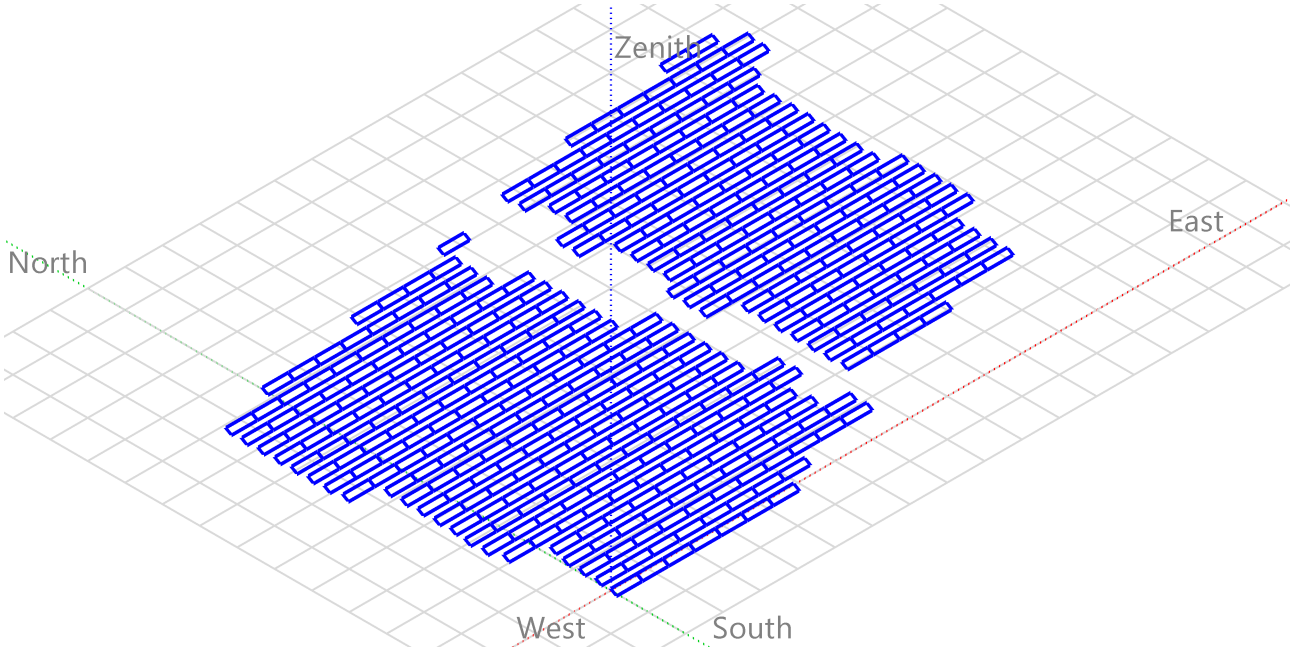
Operating losses at STC (full system)

Nb. identical MV transfos	7
Nominal power at STC	7.13 MVA
Iron loss (24/24 Connexion)	6.35 kVA
Copper loss	80.15 kVA

PVsyst V7.4.5
VC2, Simulation date:
06/12/24 00:25
with v7.4.5

Near shadings parameter

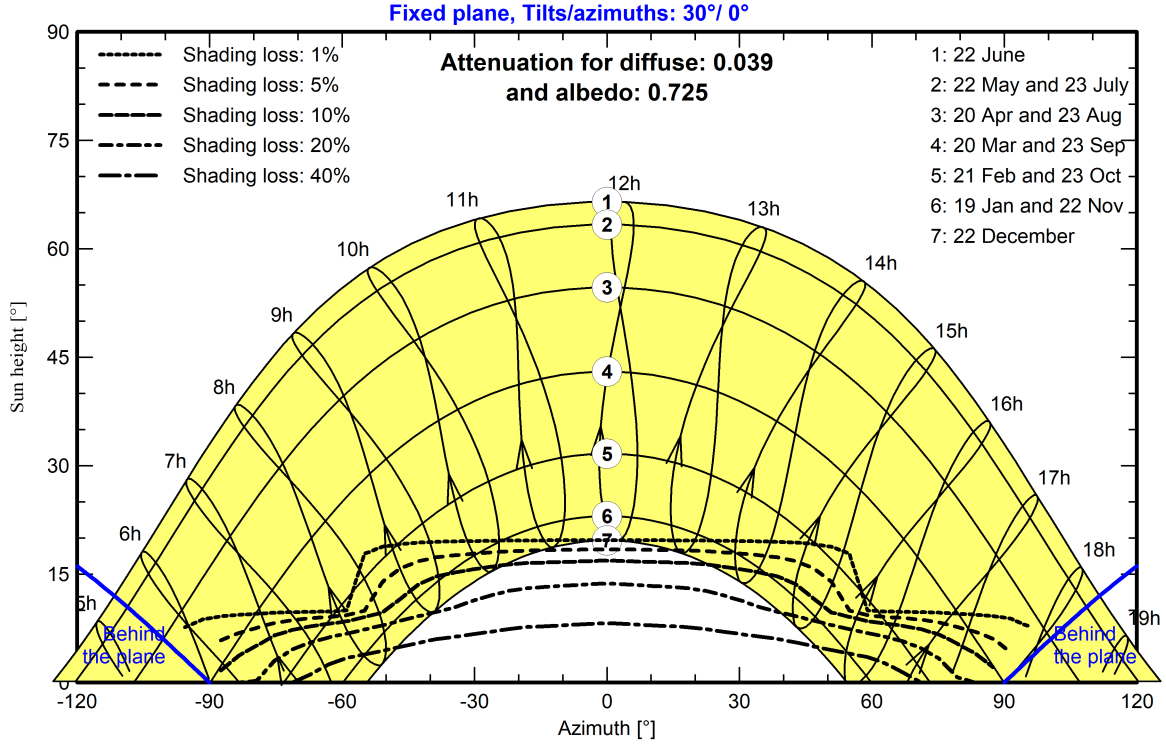
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 30°/ 0°



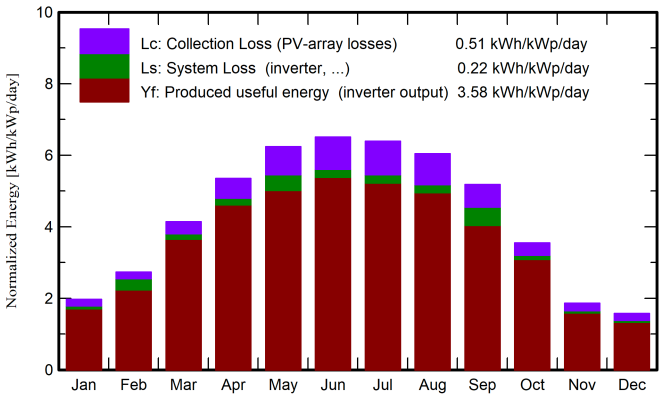
PVsyst V7.4.5
VC2, Simulation date:
06/12/24 00:25
with v7.4.5

Main results

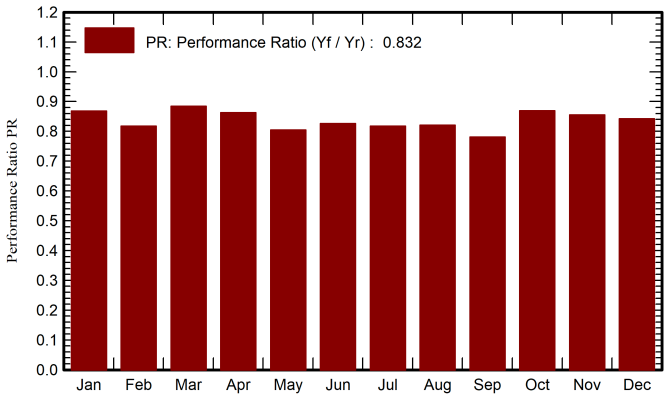
System Production

Produced Energy	9504642 kWh/year	Specific production	1306 kWh/kWp/year
		Perf. Ratio PR	83.16 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

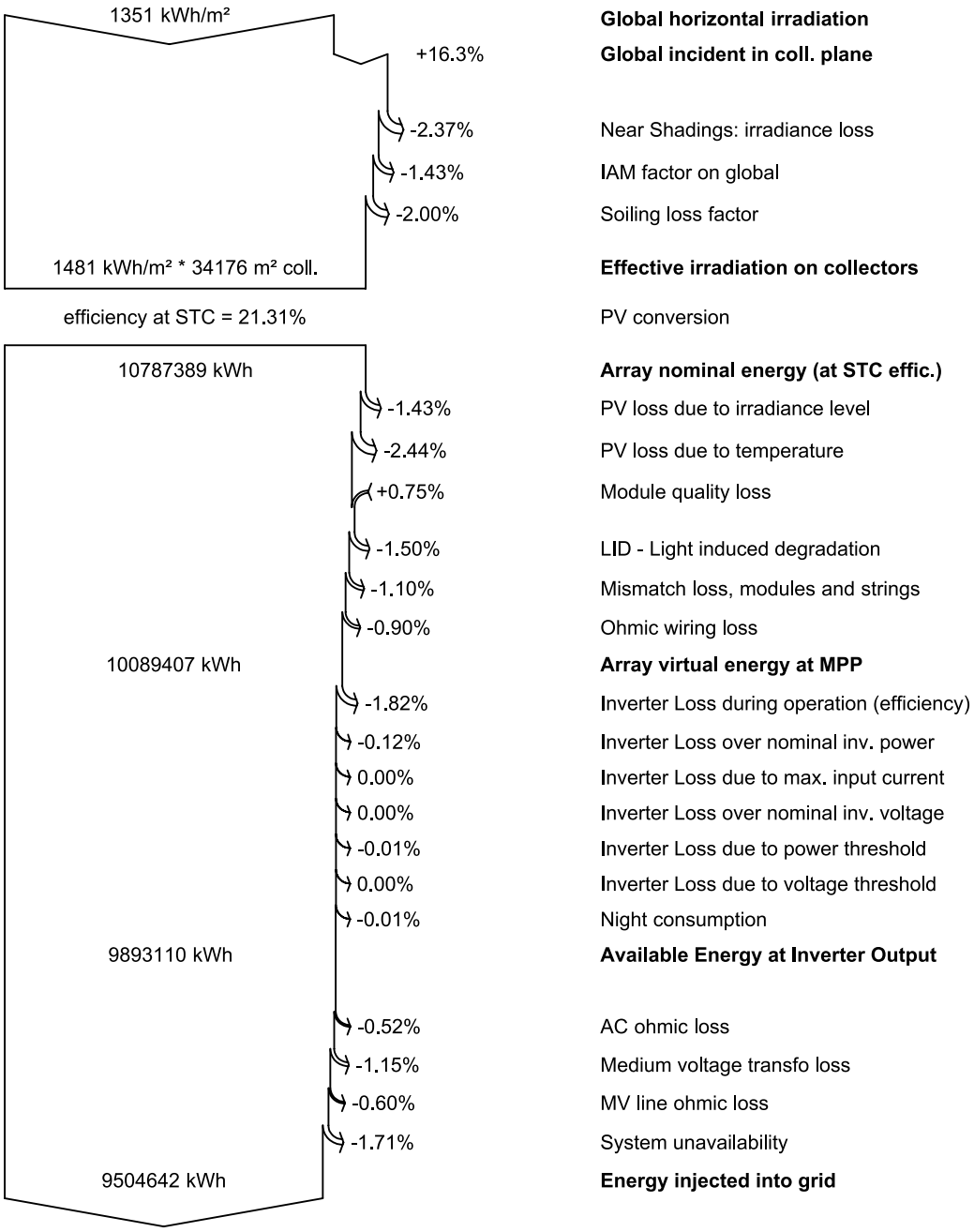
	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	PR ratio
January	35.0	17.81	-1.53	61.1	55.8	403515	386257	0.869
February	53.5	31.48	-0.59	76.5	72.1	520919	455375	0.818
March	100.3	49.57	4.40	128.2	121.6	858647	824870	0.884
April	142.4	70.13	10.75	160.4	151.9	1048263	1006801	0.863
May	187.2	77.79	17.34	193.5	183.1	1230360	1132831	0.805
June	197.8	79.79	21.20	195.3	184.7	1225856	1175160	0.827
July	197.6	79.29	24.07	198.2	187.7	1230531	1178965	0.817
August	170.3	69.92	23.88	187.3	177.7	1167692	1118613	0.821
September	122.9	46.80	17.56	155.5	147.8	993734	883170	0.781
October	78.7	41.30	10.75	110.1	104.4	723777	696136	0.869
November	37.3	25.24	5.53	55.7	51.0	361145	346729	0.855
December	28.2	16.93	1.18	48.9	43.6	313461	299735	0.843
Year	1351.2	606.05	11.28	1570.8	1481.4	10077900	9504642	0.832

Legends

GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		

PVsyst V7.4.5
VC2, Simulation date:
06/12/24 00:25
with v7.4.5

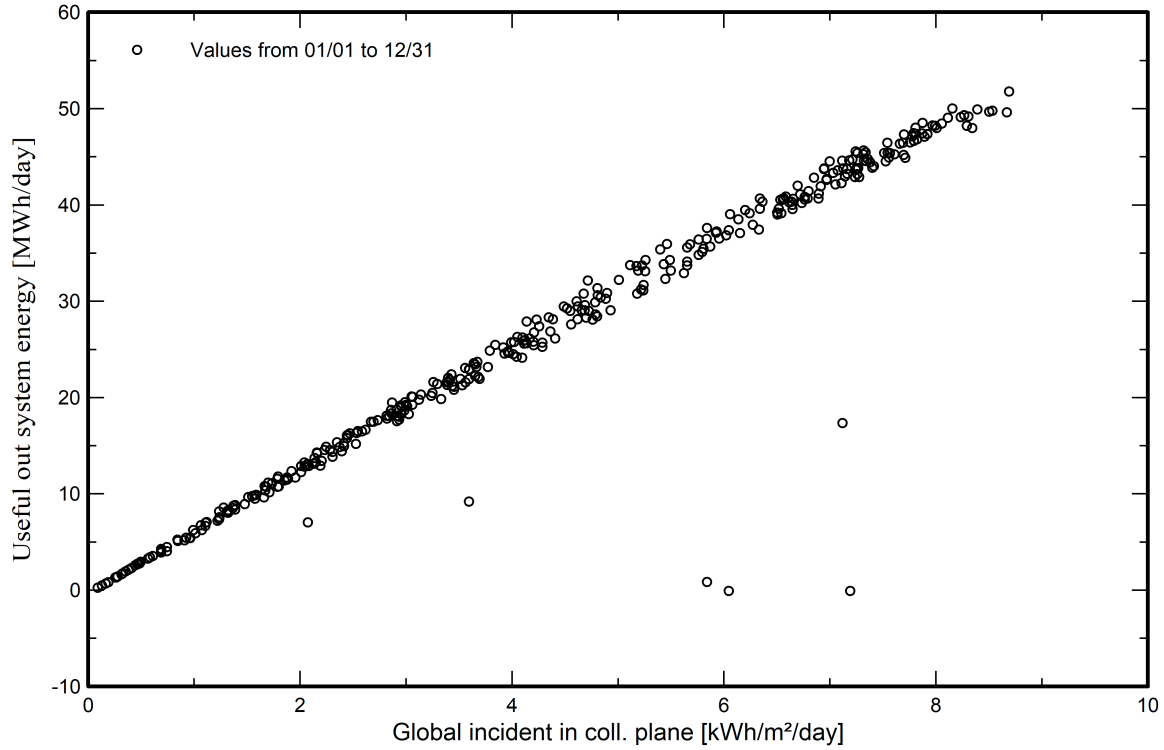
Loss diagram



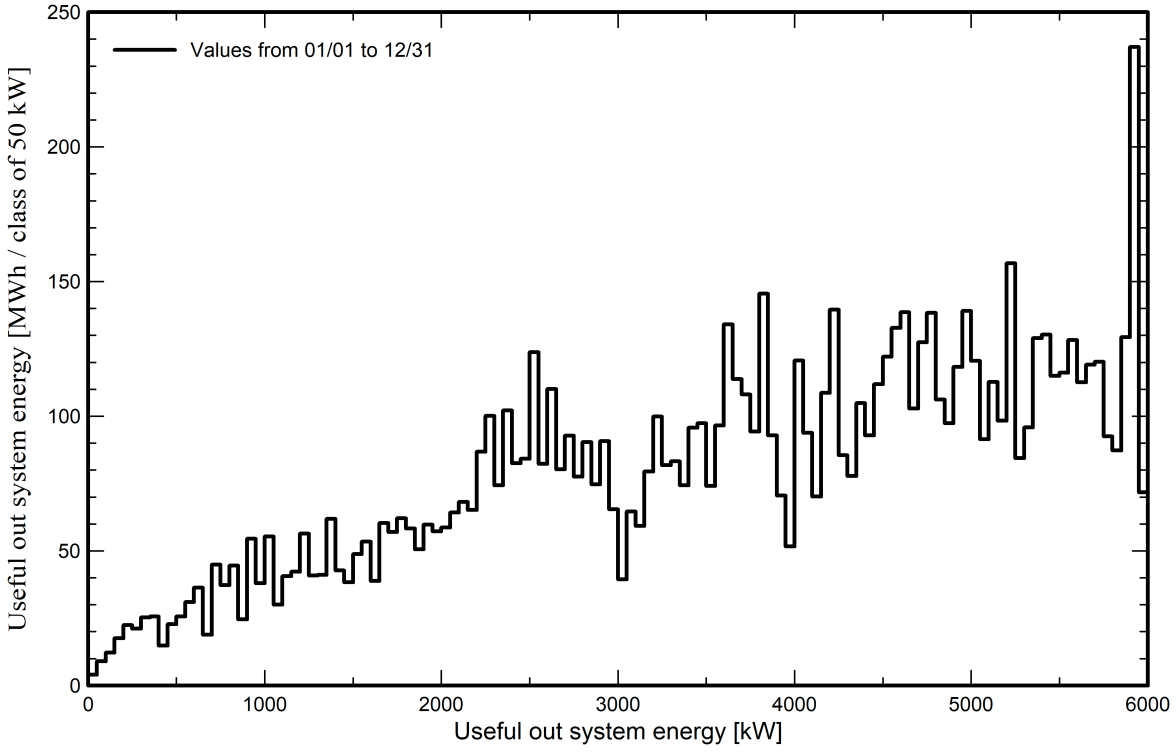
PVsyst V7.4.5
VC2, Simulation date:
06/12/24 00:25
with v7.4.5

Predef. graphs

Daily Input/Output diagram

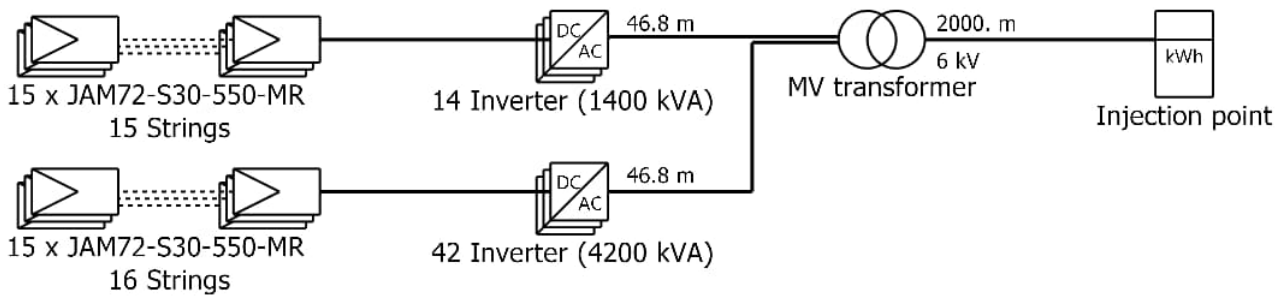


System Output Power Distribution



Single-line diagram

PVsyst V7.4.5
VC2, Simulation date:
06/12/24 00:25
with v7.4.5



PV module	JAM72-S30-550-MR
Inverter	SUN2000-100KTL-M1-400Vac
String	15 x JAM72-S30-550-MR

	Mykolaiv - SPP	Ramboll Deutschland GmbH (German
	VC2 : SPP-2 @ 44 Samoilovycha Street	06/20/24

ANNEX 4 - ENERGY YIELD ASSESSMENT REPORT OF SPP-3

Version 7.4.5

PVsyst - Simulation report

Grid-Connected System

Project: Mykolaiv - SPP

Variant: SPP-3 @ 36 Vodopiina Street

Sheds on ground

System power: 1733 kWp

Mykolaiv - Ukraine

Author

Ramboll Deutschland GmbH (Germany)

PVsyst V7.4.5
VC0, Simulation date:
06/12/24 12:19
with v7.4.5

Project summary

Geographical Site
Mykolaiv
Ukraine

Situation

Latitude	46.92 °N
Longitude	32.05 °E
Altitude	54 m
Time zone	UTC+2

Project settings
Albedo 0.20

Meteo data
Radisnyy Sad
Meteonorm 8.1 (1996-2015), Sat=100% - Synthetic

System summary

Grid-Connected System

Sheds on ground

PV Field Orientation
Fixed plane
Tilt/Azimuth 30 / 0 °

Near Shadings
Linear shadings : Fast (table)

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	3150 units
Pnom total	1733 kWp

Inverters

Nb. of units	15 units
Pnom total	1500 kWac
Pnom ratio	1.155

Results summary

Produced Energy	2279801 kWh/year	Specific production	1316 kWh/kWp/year	Perf. Ratio PR	83.77 %

Table of contents

General parameters

Grid-Connected System

Sheds on ground

PV Field Orientation

Orientation	
Fixed plane	
Tilt/Azimuth	30 / 0 °

Sheds configuration	
Nb. of sheds	102 units
Sizes	
Sheds spacing	11.2 m
Collector width	4.58 m
Ground Cov. Ratio (GCR)	40.9 %
Shading limit angle	
Limit profile angle	17.6 °

Models used	
Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
Linear shadings : Fast (table)

User's needs
Unlimited load (grid)

PV Array Characteristics

PV module

Manufacturer	JA Solar
Model	JAM72-S30-550-MR
(Original PVsyst database)	
Unit Nom. Power	550 Wp
Number of PV modules	3150 units
Nominal (STC)	1733 kWp
Modules	210 string x 15 In series
At operating cond. (50°C)	
Pmpp	1590 kWp
U mpp	570 V
I mpp	2788 A

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-100KTL-M1-400Vac
(Original PVsyst database)	
Unit Nom. Power	100 kWac
Number of inverters	15 units
Total power	1500 kWac
Operating voltage	200-1000 V
Max. power (=>33°C)	110 kWac
Pnom ratio (DC:AC)	1.16
Power sharing within this inverter	

Total PV power

Nominal (STC)	1733 kWp
Total	3150 modules
Module area	8137 m²

Total inverter power

Total power	1500 kWac
Max. power	1650 kWac
Number of inverters	15 units
Pnom ratio	1.16

Array losses

Array Soiling Losses
Loss Fraction 2.0 %

Thermal Loss factor

Module temperature according to irradiance	
Uc (const)	29.0 W/m²K
Uv (wind)	0.0 W/m²K/m/s

DC wiring losses

Global array res.	3.4 mΩ
Loss Fraction	1.5 % at STC

LID - Light Induced Degradation
Loss Fraction 1.5 %

Module Quality Loss
Loss Fraction -0.8 %

Module mismatch losses
Loss Fraction 1.0 % at MPP

Strings Mismatch loss
Loss Fraction 0.1 %

IAM loss factor
Incidence effect (IAM): User defined profile

0°	30°	50°	65°	70°	75°	80°	85°	90°
1.000	1.000	0.999	0.953	0.910	0.853	0.725	0.448	0.000

System losses

Unavailability of the system

Time fraction	1.0 %
	3.7 days,
	3 periods

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage	400 Vac tri
Loss Fraction	1.00 % at STC

Inverter: SUN2000-100KTL-M1-400Vac

Wire section (15 Inv.)	Copper 15 x 3 x 70 mm²
Average wires length	53 m

MV line up to Injection

MV Voltage	6 kV
Average each inverter	
Wires	Copper 3 x 95 mm²
Length	1000 m
Loss Fraction	0.47 % at STC

AC losses in transformers

MV transfo

Medium voltage	6 kV

One transfo parameters

Nominal power at STC	849 kVA
Iron Loss (24/24 Connexion)	0.85 kVA
Iron loss fraction	0.10 % at STC
Copper loss	8.49 kVA
Copper loss fraction	1.00 % at STC
Coils equivalent resistance	3 x 1.88 mΩ

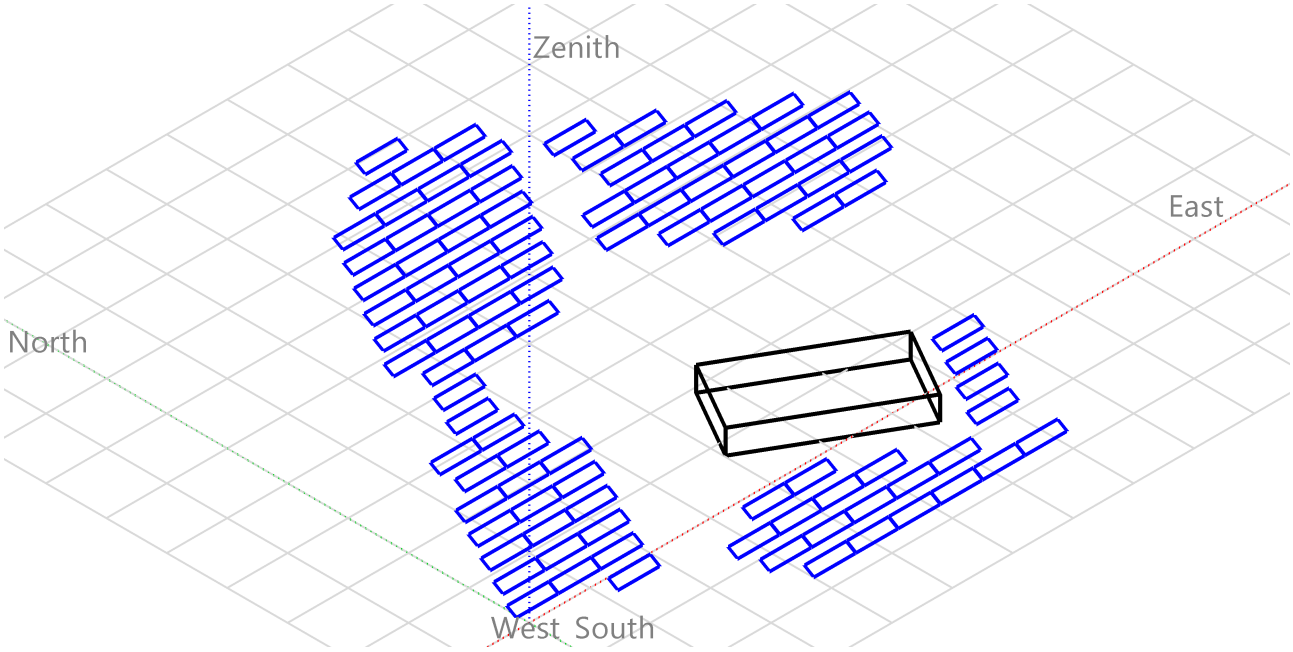
Operating losses at STC (full system)

Nb. identical MV transfos	2
Nominal power at STC	1.70 MVA
Iron loss (24/24 Connexion)	1.70 kVA
Copper loss	16.99 kVA

PVsyst V7.4.5
VC0, Simulation date:
06/12/24 12:19
with v7.4.5

Near shadings parameter

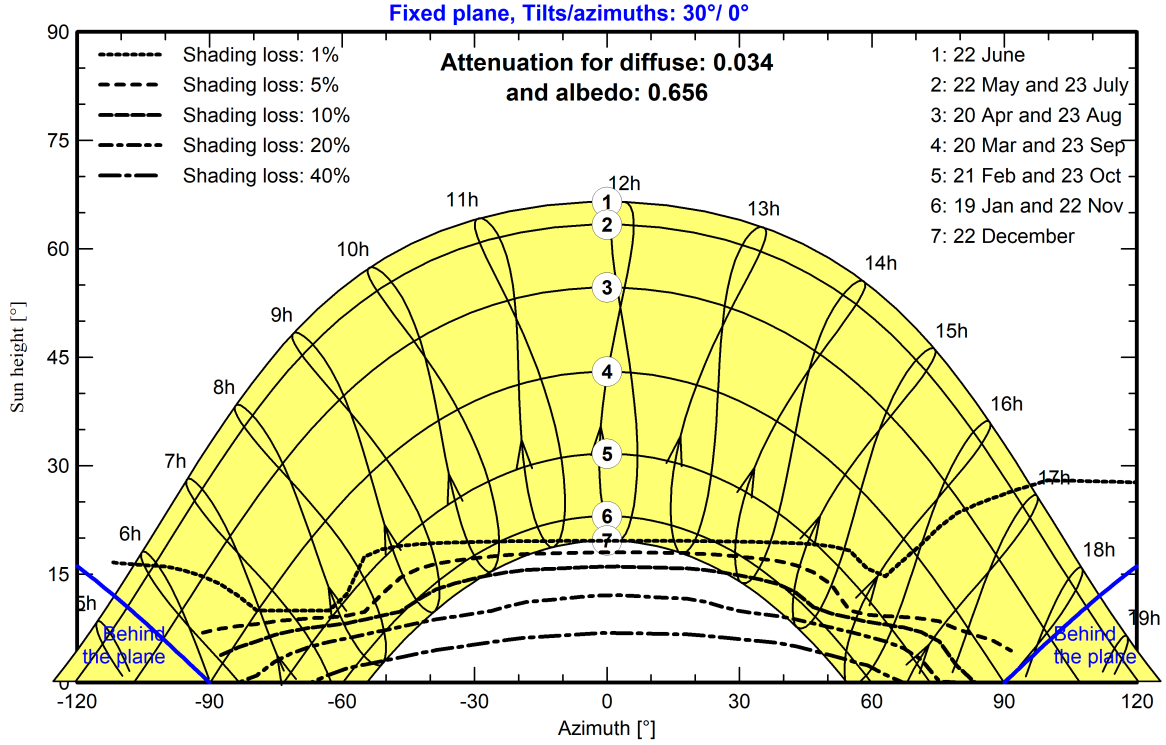
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 30°/ 0°



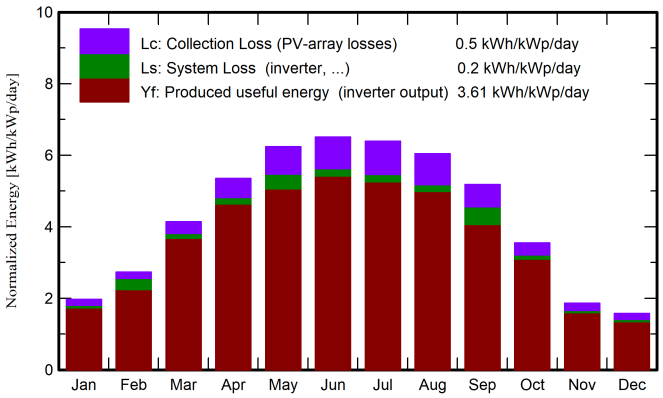
PVsyst V7.4.5
VC0, Simulation date:
06/12/24 12:19
with v7.4.5

Main results

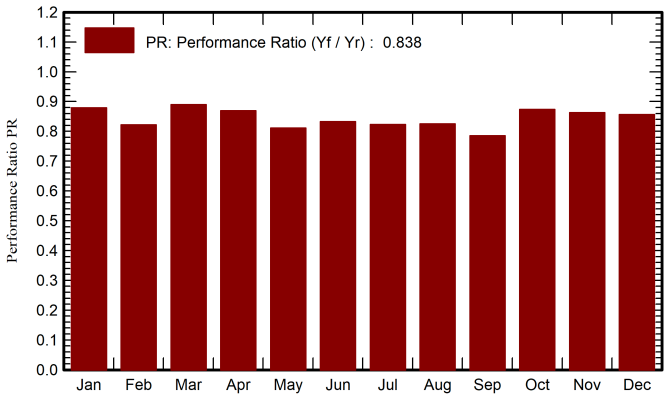
System Production

Produced Energy	2279801 kWh/year	Specific production	1316 kWh/kWp/year
		Perf. Ratio PR	83.77 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

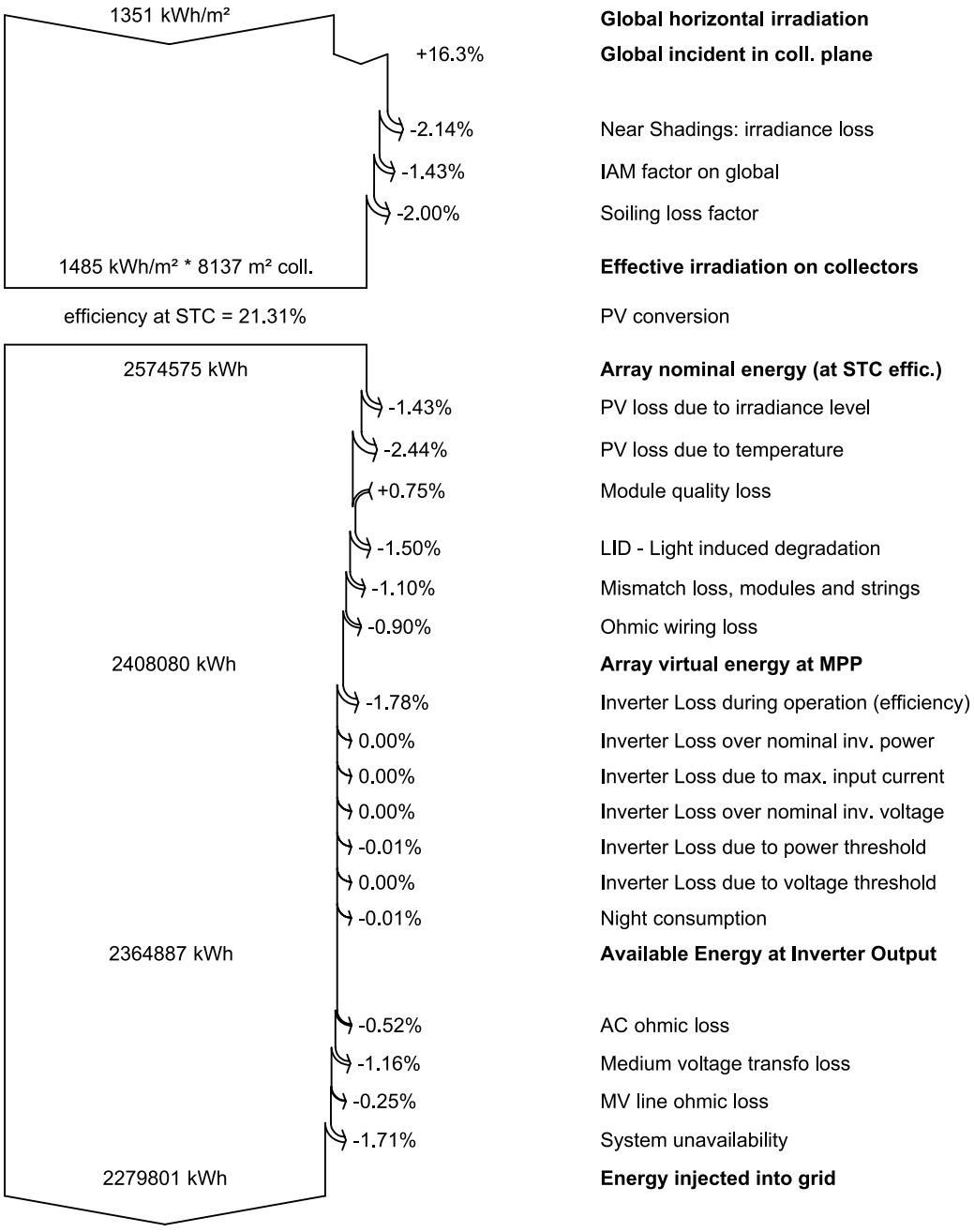
	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	PR ratio
January	35.0	17.81	-1.53	61.1	56.3	97032	93080	0.879
February	53.5	31.48	-0.59	76.5	72.3	124418	109041	0.822
March	100.3	49.57	4.40	128.2	121.8	205035	197716	0.890
April	142.4	70.13	10.75	160.4	152.1	250411	241521	0.869
May	187.2	77.79	17.34	193.5	183.4	293985	271913	0.811
June	197.8	79.79	21.20	195.3	185.0	292704	281871	0.833
July	197.6	79.29	24.07	198.2	188.0	293764	282730	0.823
August	170.3	69.92	23.88	187.3	177.9	278426	267949	0.826
September	122.9	46.80	17.56	155.5	148.0	237275	211610	0.786
October	78.7	41.30	10.75	110.1	104.6	172587	166541	0.873
November	37.3	25.24	5.53	55.7	51.4	86664	83296	0.863
December	28.2	16.93	1.18	48.9	44.2	75779	72533	0.856
Year	1351.2	606.05	11.28	1570.8	1484.9	2408080	2279801	0.838

Legends

GlobHor	Global horizontal irradiation
DiffHor	Horizontal diffuse irradiation
T_Amb	Ambient Temperature
GlobInc	Global incident in coll. plane
GlobEff	Effective Global, corr. for IAM and shadings
EArray	Effective energy at the output of the array
E_Grid	Energy injected into grid
PR	Performance Ratio

PVsyst V7.4.5
VC0, Simulation date:
06/12/24 12:19
with v7.4.5

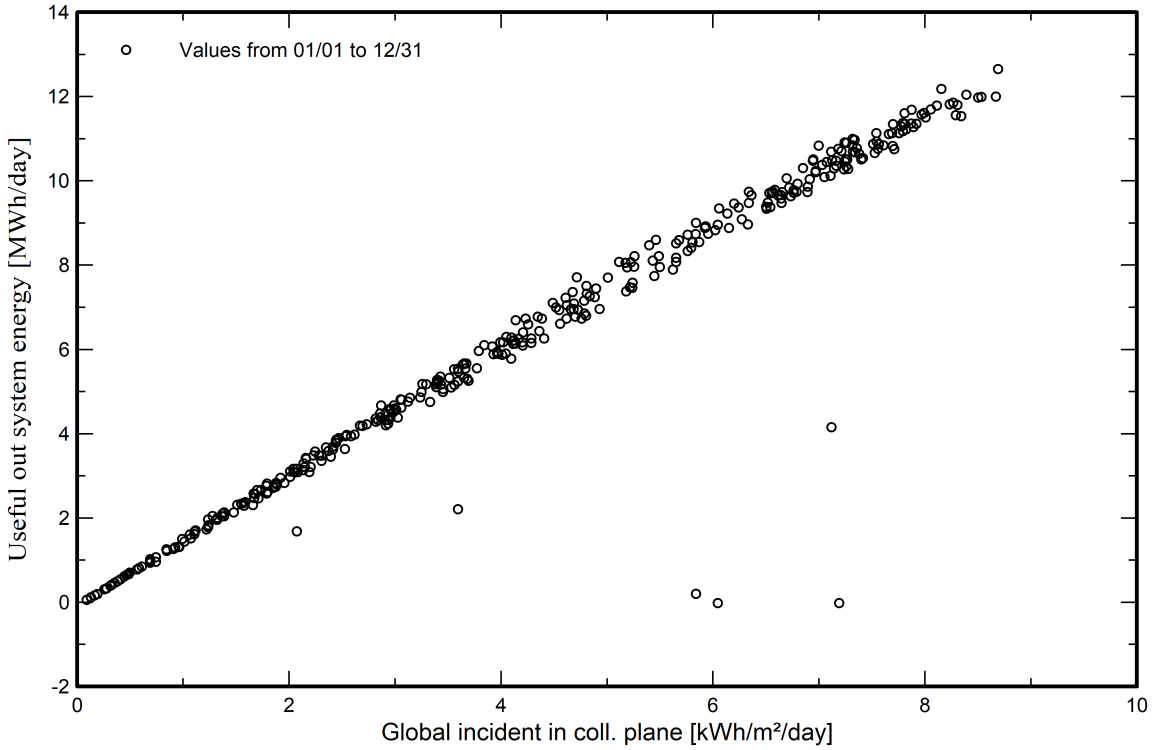
Loss diagram



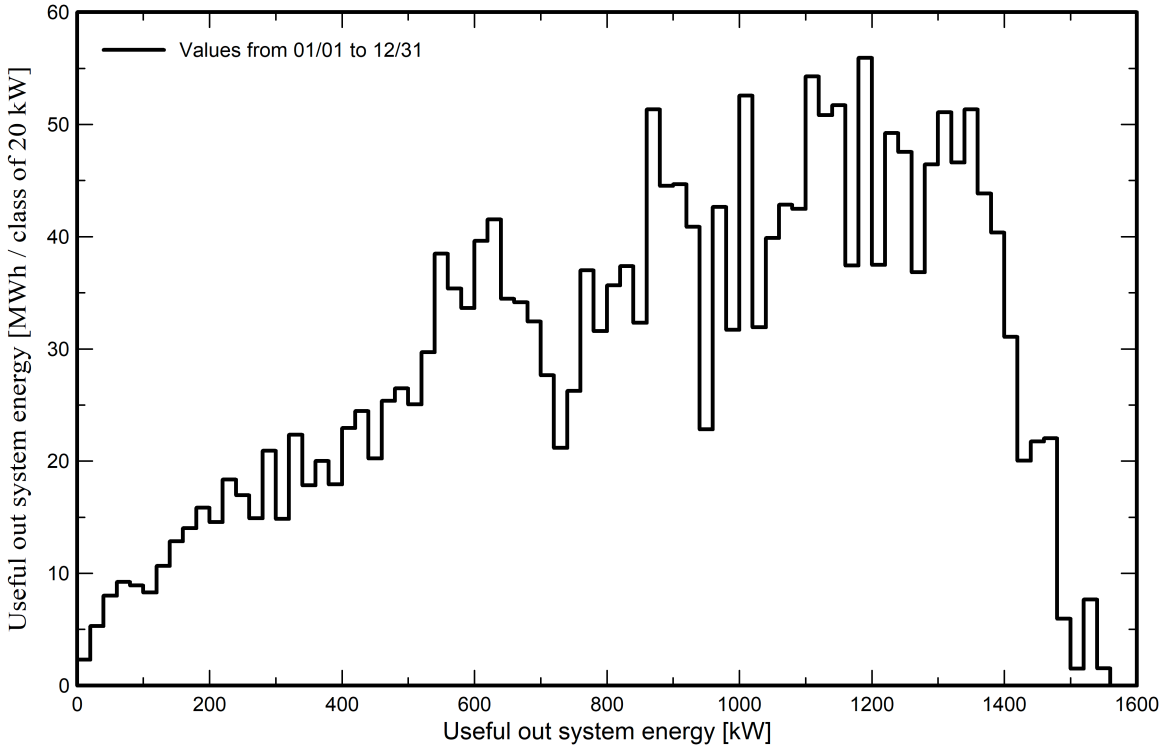
PVsyst V7.4.5
VC0, Simulation date:
06/12/24 12:19
with v7.4.5

Predef. graphs

Daily Input/Output diagram

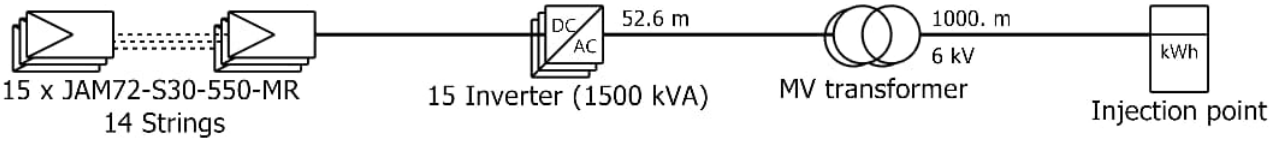


System Output Power Distribution



Single-line diagram

PVsyst V7.4.5
VC0, Simulation date:
06/12/24 12:19
with v7.4.5



PV module	JAM72-S30-550-MR
Inverter	SUN2000-100KTL-M1-400Vac
String	15 x JAM72-S30-550-MR

Mykolaiv - SPP	Ramboll Deutschland GmbH (German
VC0 : SPP-3 @ 36 Vodopiina Street	06/20/24

ANNEX 5- BASIC VALUATION OF THE COMPANY

BASIC VALUATION OF THE COMPANY

1. Brief Technical Overview of the Company

The Company is the largest heat supplier in Mykolaiv. It provides heat to 60% of the City's consumers. The Company's customers include residents (86.8%), state-financed organizations (12.2%), and other customers (1%). Additionally, the Company uses purchased heat energy from the Agroindustrial Company Eugroil LLC for the needs of its consumers.

The company provides round-the-clock district heating during the heating season, and there is no centralized hot water supply. The standard duration of the heating season and the standard design temperature of the season shall be approved in accordance with the standard plans for the next heating season by the city council.

The Company structure consists of 7 heating network districts in Mykolaiv: Ochakiv district, heating networks, centralized repair shop, operation and repair shop for instrumentation electrical equipment and motor transport shop, heat inspection and distribution service, gas equipment operation and repair service, measuring equipment operation and repair service, chemical water treatment and pipeline protection service.

The Company operates 123 boiler houses with a total capacity of 628 Gcal/hour and 70 central heating substations. The Company also operates 13 (thirteen) modular biofuel (agre pellets) boiler houses of 0.5 MW each with a total capacity of 6.5 MW; two 350 kW boiler houses and one 500 kW boiler house fired by wood logs. Six modular boiler houses of 0.8 MW each on agro pellets with a total capacity of 4.8 MW are also under manufacturing and delivery. Therefore, the Company has equipped almost all small heat generation sources with biofuel boiler houses.

The Company operates 209 km of heating networks in double-pipe length, including 156 km of heating pipelines in double-pipe length, 43 km of hot water supply pipelines in single-pipe length, and pipelines that transport heat to PJSC Mykolaivska CHP: 25 km of heating pipelines in double-pipe length and 11 km of hot water supply in single-pipe length. The main staff includes 1,172 employees during the heating season and 734 during the off-season.

The creation of a full-fledged technology and production base allowed the company to actively pursue a policy of capacity development since 2000 by taking over departmental municipal heat and power facilities, and converting boiler houses from solid and liquid fuels to burning natural gas and modern alternative fuels.

At the same time, the heat supply scheme is being optimized by decommissioning unprofitable boiler houses and connecting the load to more efficient heat sources.

Particular attention is paid to the introduction of automation systems and modern engineering equipment as one of the energy-saving areas.

The detailed analisys provided in Annex 6 – Technical Basline

The following tables provide information on the key performance indicators of the Company.

Table 1 General indicator for the heating seasons 2017-2023

Heating season	Start-end (dates)	Duration, days	Average temperature
2017/2018	24.10.2017–03.04.2018	162	2.4
2018/2019	05.11.2018–06.04.2019	153	1.6
2019/2020	31.10.2019–08.04.2020	161	4.8

Heating season	Start-end (dates)	Duration, days	Average temperature
2020/2021	06.11.2020–12.04.2021	158	2.0
2021/2022	01.11.2021–29.03.2022	149	2.5
2022/2023	09.11.2022–24.03.2023	136	3.5

Table 2:Total energy consumption in the Company by type of energy carriers and total heat production for 6 years

Indicator/year	2018	2019	2020	2021	2022
Natural gas consumption, thousand m3	61,492.111	52,315.971	51,936.662	59,157.040	48,005.181
Water consumption, thousand m^3	141.302	137.605	113.364	116.328	107.944
-Including for feeding, thousand m^3	96.922	89.416	70.366	86.803	75.712
Electricity consumption, thousand kWh	16,298.439	15,800.504	15,086.971	14,736.007	11,270.008
Heat generation, thousand Gcal	441.4	383.1	386.0	432.7	361.1

Table 3: Key energy indicators for energy production and sales for 5 years

Indicator/year	2018	2019	2020	2021	2022
Heat production for district heating, thousand m3 Gcal	440.7	382.3	385.5	432.4	360.7
Heat production for hot water supply, thousand Gcal	0.1	0.2	0	0	0
Heat supply for district heating, thousand Gcal	378.3	333.5	336.3	371.2	317.2
Heat for hot water supply, thousand Gcal	0.1	0.2	0	0	0
Supply of steam heat, thousand Gcal	0.6	0.6	0.5	0.3	0.4
Steam generation (if any)	0.6	0.6	0.5	0.3	0.4
Specific gas consumption per 1 Gcal of heat energy	165.4	162.7	161.2	163.4	159.6
Specific electricity consumption per 1 Gcal of heat energy	23.4	25.4	25.10	23.0	21.6
Specific electricity consumption per 1 Gcal of heat energy produced	33.09	35.32	10.79	6.64	5.12

Indicator/year	2018	2019	2020	2021	2022
Specific electricity consumption for transportation 1 Gcal	1.16	2.25	17.49	16.49	16.01

Table 4: Consumer structure for each of the heating districts

Heating district	Number of personal accounts, pcs.			Population size
	Population	Budget	Other	
1	11.002	38	41	20,865
2	804	21	15	1,297
3	8,036	37	30	13,547
4	1,514	16	9	3,073
5	18,044	44	68	36,458
6	17,375	63	77	37.198
7	8,087	23	31	16.935
8	21,368	31	67	42.502
Snihurivka	-	1	-	-
Total	**86.230**	**274**	**337**	**171.875**

Table 5: Information on consumers

Number of personal accounts	2018	2019	2020	2021	2022
Population	84,442	84,585	84,965	85,291	86,732
Budget	317	322	316	314	330
Other	443	423	416	400	419
Total	85,202	85,330	85,697	86,005	87,481

2. Overview of the Financial situation of the Company

2.1. General Information

2.1.1. Activities and licenses of the Company

The principal activities of the Company are:

- Heat energy production (HEP);
- Transportation and supply of heat energy;
- District heating and hot water supply;

The company holds licenses for the following activities:

- production of heat energy at thermal power plants and cogeneration units;
- production of heat energy (except for heat energy production at thermal power plants, combined heat and power plants, nuclear power plants and cogeneration plants and plants using non-conventional or renewable energy sources), transportation of heat energy through main and local (distribution) heating networks, supply of heat energy.

The company was founded by Mykolaiv City Council.

2.1.2. Company Organization - Structural Units

Information on the main structural units (divisions) of the company and the number of employees is presented in Table 6.

Table 6 Structural units and staffing

Structural unit	Staffing as of 31.12.2022		Staffing as of 31.12.2023		Share, %
	According to the staff list	Actual	According to the staff list	Actual	
Heating districts	535.30	473.50	540.40	471.50	45%
Services (water treatment and pipeline protection, emergency control room, operation and repair of metering equipment, operation and repair of gas equipment, heating networks, maintenance of water supply systems)	185.95	141.00	221.00	155.00	19%
Workshops (electrical equipment operation and repair, instrumentation and automation, centralized repair, and motor transport)	191.50	162.00	214.60	165.00	18%
Energy sales service	67.00	64.00	67.00	62.00	6%
Others (electrical measurement laboratory, repair and construction department, economic security service (other activities), economic service group (service))	19.55	18.20	10.65	9.10	1%
Commercial metering service and replacement sector, business services group)	12.00	0.00	16.00	6.00	1%
Management (Production and Technical Department, Planning and Economic Development Department)	13.00	9.00	13.00	10.00	1%
Total production	**1,024.30**	**867.70**	**1,082.65**	**878.60**	**91%**

Structural unit	Staffing as of 31.12.2022		Staffing as of 31.12.2023		Share, %
	According to the staff list	Actual	According to the staff list	Actual	
General production (occupational health and safety department, procurement department, warehouse group, business services group, motor vehicle shop)	20.65	21.65	22.65	23.65	7%
Administrative (management, motor vehicle shop (admin), economic security service, business services group)	78.50	71.80	81.50	70.00	2%
Total	**1,123.45**	**955.5**	**1,189.3**	**969.5**	

As of December 31, 2023, the number of employees amounted to 1,189, which is 4 fewer than as of December 31, 2022. The actual number of employees was 82-85% of the staff.

The largest share of the total number of employees is occupied by the personnel of heating districts and services, namely 45% and 25%, respectively. The share of administrative and management personnel is 2%.

2.2. Income and Expenses

The following tables present the financial statements for the periods ended 31 December 2021, 31 December 2022 and 31 December 2023.

Table 7: Income statement

in thousand UAH	31.12.2021	31.12.2022	31.12.2023
Revenue	**609,878**	**692,164**	**660,942**
Cost of goods sold	**746,780**	**770,287**	**1,232,279**
Direct costs include	**741,272**	**764,723**	**1,222,977**
Fuel Costs	514,058	495,039	454,714
Electricity	47,887	51,237	59,738
Water	1,784	804	4,466
Purchased heat energy	8,838	4,333	2,288
Labor Costs	93,216	120,436	140,737

in thousand UAH	31.12.2021	31.12.2022	31.12.2023
Depreciation and amortization	22,037	31,345	446,127
Other	53,452	61,528	114,906
General production costs	**5,508**	**5,564**	**9,302**
Administrative expenses	22,245	26,509	31,227
Other operating income	327,453	154,285	192,761
Other operating expenses	189,116	224,089	77,635
Results of core business activities	**-20,810**	**-174,436**	**-487,438**
Financial income	53	51,706	7,359
Financial expenses	6,541	13,715	36,342
Other income	10,013	23,684	400,808
Other expenses	3,820	37,550	12,792
Income tax		7,986	67,089
Net income (loss)	**-21,105**	**-142,325**	**-61,316**

In 2023, the Company's net loss amounted to UAH 61,316,000.00; in 2022, the net loss amounted to UAH 142,235,000.00.

2.2.1. Revenues

Detailed information on the Company's revenues from operating activities is presented in the table below.

Table 8 Company revenues by type of activity

in thousand UAH	31.12.2021	31.12.2022	31.12.2023	Share, %
Revenue	**609,878**	**692,164**	**660,942**	
Revenue from the production of fuel and energy (boiler houses)	480,374	492,450	459,413	69.5%
Income from transportation of fuel and energy	38,904	119,120	114,750	17.4%

in thousand UAH	31.12.2021	31.12.2022	31.12.2023	Share, %
Income from transportation of fuel and energy from CHP	49,980	45,291	40,289	6.1%
Income from the supply of fuel and energy	25,112	2,790	1,894	0.3%
Revenue from subscriber services	4,803	28,866	29,265	4.4%
Maintenance of water booster pumps (water booster)	8,248	9,735	14,730	2.2%
Other and adjustments	2,457	-6,086	601	0.1%

During 2021-2023, the company revenues did not change significantly, namely, they increased by 8.3%. The company sales structure by customer group in 2023 was as follows:

- Households - 77%.
- Budget organizations - 21%.
- Other clients accounted - 2%.

During 2021-2023, the relevant tariffs were approved by the following decisions of the Executive Committee of Mykolaiv City Council (MCC):

- Decision No. 983 of 13.10.2021 as amended (Decision of the Executive Committee of MCC No. 1116 of 24.11.2021)
- Decision of the Executive Committee of MCC No. 565 of 25.10.2022.
- Decision of the Executive Committee of MCC No. 1028 of 25.10.23[1].

Information on the collection of payments for 2022-2023 is provided in the table below.

Table 9: Collecting payments by customer groups

thousand UAH	2022			2023		
	Invoices issued	Paid	Collected Level, %	Invoices issued	Paid	Collected Level, %
Households	484,499	409,920	84.6	463,617	433,270	93.5
Budget organizations	135,629	135,608	100	126,812	127,437	100.5
Housing organizations	66	67	102	29	35	121.3
Other consumers	16,110	13,337	82.8	15,099	15,255	101
TOTAL, excluding VAT:	**636,304**	**558,932**	**87.8**	**605,557**	**575,997**	**95.1**
TOTAL INCL. VAT	**763,565**	**670,718**	**87.8**	**726,669**	**691,197**	**95.1**

[1] Detailed information on the decisions of the Executive Committee of Mykolaiv City Council on the approval of tariffs can be found at https://mkrada.gov.ua/documents/41632.html.

In 2023, the collection rate improved to an average of 95.1%, and for households it improved from 84.6% in 2022 to 93.5% in 2023.

2.2.2. Costs

Direct expenses of the Company for 2021-2023 and the corresponding cost structure are shown in Table 10

Table 10: Structure of the company's direct expenses

thousand UAH	2021	2022	2023	Share, %
Direct costs, including	**741,272**	**764,723**	**1,222,977**	
Fuel Costs	514,058	495,039	454,714	37.2%
Electricity	47,887	51,237	59,738	4.9%
Water	1,784	804	4,466	0.4%
Purchased heat energy	8,838	4,333	2,288	0.2%
Labor Costs	93,216	120,436	140,737	11.5%
Depreciation and amortization	22,037	31,345	446,127	36.5%
Other	53,452	61,528	114,906	9.4%

The largest share of the company's direct costs is made up of fuel, electricity, labour and depreciation.

Fuel Costs

In 2023, fuel costs were UAH 454,714,000.00 or 37.2% of direct costs. The main fuel used for heat production in 2021-2023 was natural gas, which accounted for 99.9% in 2023. In addition to natural gas, coal was used for heat production.

Natural gas consumption and related costs are shown in the table below.

Table 11: Consumption and expenditures - fuel (including indirect costs)

	2021	2022	2023
Natural gas			
Natural gas (NG) consumption, m3	59,157,040	48,005,181	45,862,996
Fuel costs, "000" UAH (excluding VAT)	513,912,827	494,714,358	452,474,018
Average fuel price (NG), UAH per "000" m3	8,687	10,305	9,866
calorific value of natural gas, Kcal/"000" m3	8,205	8,257	8,274
Equivalent fuel consumption, "000" tons	69,340,50	56,625,54	54,210,06
Price of equivalent fuel, UAH	7,411.44	8,736.59	8,346.68

Electricity Costs

Electricity costs in 2023 and 2022 amounted to UAH 51,237,000.00 and UAH 59,738,000.00, respectively.

Detailed information on electricity consumption and related costs (for heat production, transportation and supply of heat and hot water) is provided in the table below.

Table 12: Electricity costs (excluding VAT)

	2021	2022	2023
Electricity for heat production			
Electricity costs, UAH thousand	9,078,951	8,262,350	8,786,558
Electricity consumption (MWh)	2,805,315	1,814,823	1,553,544
Average annual price, UAH/kWh (excluding VAT)	2,957	4,598	5,587
Average price change, %	27	55	21
Electricity for transportation and supply of heat and hot water			
Electricity costs, UAH thousand	35,547,713	38,399,214	43,429,400
Electricity consumption (MWh)	10,793,185	8,459,032	7,822,418
Average annual price, UAH/kWh (excluding VAT)	2,957	4,598	5,587
Average price change, %	27	55	21
Total, thousand UAH	**44,626,664**	**46,661,564**	**52,215,958**

The increase in electricity costs was driven by changes in electricity supply prices and distribution tariffs.

Water Expenses

Water expenses (water and sanitation) amounted to UAH 804,000.00 in 2022 and UAH 4,466,000.00 thousand in 2023 with a share of 0.4% in the structure of direct expenses. Information on water consumption and costs is provided in the table below.

Table 13: Water costs (including indirect costs)

	2021	2022	2023
Production, transportation and supply of heat energy			
Water costs, thousand UAH excl. VAT	1,807,080	852,450	4,475,130
Consumption, "000" m3	116,328	51,956	195,089
Including (if there is a breakdown by area)			
Production	3,082	1,377	5,169
Transportation	113,222	50,568	189,880
Supply	*24*	*11*	*40*
Average price, UAH/m3	15.53	16.41	22.94
TOTAL expenses, UAH thousand excl. VAT	**1,807,080**	**852,450**	**4,475,130**

Labor Costs

The actual average number of employees involved in the production, transportation, supply of heat energy, and provision of heating and hot water supply services was 735 in 2023 and 703 in 2022, respectively. In 2023, labour costs for personnel involved in the production, transportation, supply of heat energy, and provision of heating and hot water supply services amounted to UAH 140,737 ,000.00, which is UAH 120,436 ,000.00 or 17% more than in 2022. The increase in labour costs was driven by an increase in minimum state and industry guarantees and the number of employees.

Detailed information on labour and personnel costs is provided below.

Table 14: Labor and personnel costs (direct costs)

	2021	2022	2023
Average number of employees	669	703	735
Number of employees at the end of the period	810	868	879
Average monthly salary, UAH	11,611	14,276	15,957
Salary, UAH thousand	93,216	120,436	140,737

	2021	2022	2023
Compulsory social contributions, UAH thousand	18,267	23,664	28,131

Revenue

- Losses in 2023 decreased compared to 2022. In 2023, the Company's net loss amounted to UAH 61,316,000.00.
- The Company sells heat energy to consumers, provides heat energy supply and hot water supply services in accordance with the tariffs approved by the Executive Committee of Mykolaiv City Council. The company has two-rate tariffs for heat energy and heat supply services.
- The structure of the company's sales by customer groups in 2023 was as follows: 1) Households - 77%, Budget organizations - 21%, Other customers - 2%.
- In 2023, the collection rate improved and averaged 95.1%.

Costs

- The largest share of the company's direct costs is made up of fuel, electricity, labour and depreciation.
- The main fuel used for heat production in 2021-2023 was natural gas. Its share in 2023 was more than 99%. In addition to natural gas, coal was used for heat production.
- In 2022-2023, there was a significant increase in electricity costs, while consumption decreased. The increase in electricity costs was driven by changes in electricity supply prices and distribution tariffs.
- Purchases of heat energy are insignificant.
  The average annual price of electricity increased by 21% in 2023 and by 55% in 2022.
- The actual average number of employees involved in the production, transportation, supply of heat energy, and provision of heating and hot water supply services was 735 in 2023 and 703 in 2022, respectively.
- In 2023, labour costs for personnel involved in the production, transportation, supply of heat energy, and provision of heating and hot water supply services amounted to UAH 140,737,000.00, which is UAH 120,436,000.00 or 17% more than in 2022. The increase in labour costs was driven by an increase in minimum state and industry guarantees and the number of employees.

2.3. Statement of Financial Position and Cash Flows

Detailed information on the Company's assets and liabilities for 2021-2023 is provided in the table below.

Table 15: Statement of financial position

in thousand UAH	31.12.2021	31.12.2022	31.12.2023
Fixed assets	173,076	1,654,027	1,796,154
Intangible assets	361	797	612
Investment assets	-	-	-
Capital investments in progress	396,782	343,568	211,655
Other non-current assets	-	11,502	37,600
Long-term receivables	8,074		
Non-current assets	**578,293**	**2,009,894**	**2,046,021**
Inventory	17,143	38,292	125,374
Trade receivables	235,949	309,726	344,813
Accounts receivable from the state, including advance income tax	76,412	74,750	49,254
Cash and cash equivalents	14,921	87,341	87,629
Receivables for accrued income	-	-	
Other current receivables	58,940	7,144	6,109
Deferred expenses	64	158	4
Other current assets	50,483	75,715	102,697
Current assets	**453,912**	**593,126**	**715,880**
TOTAL ASSETS	**1,032,205**	**2,603,020**	**2,761,901**
Authorized capital	176,157	298,661	298,661
Additional capital	50,000	360	360
Retained earnings (accumulated loss)	-134,722	-278,519	-342,167
Equity in revaluations		1,142,106	1,140,507
Equity capital	**91,435**	**1,162,608**	**1,097,361**
Other non-current liabilities	459,502	682,532	643,619
Deferred tax liabilities	-	242,890	175,801
Targeted financing	-	33,838	165,655
Long-term liabilities	**459,502**	**959,260**	**985,075**
Trade and other payables	363,311	395,686	577,217
Labor liabilities	5,697	32	-

in thousand UAH	31.12.2021	31.12.2022	31.12.2023
Accounts payable to the budget	28,408	-	-
Current security	10,633	16,849	21,796
Deferred income	2	2	2
Other current liabilities	73,217	68,583	80,450
Current liabilities	**481,268**	**481,152**	**679,465**
Total liabilities	**1,032,205**	**2,603,020**	**2,761,901**

Information on the company's long-term liabilities is presented in the table below.

Table 16: Long-term liabilities of the Company

in thousand UAH	31.12.2022	31.12.2023
Long-term borrowings in foreign currency	630,562,81	610,011,33
Other non-current liabilities (debt restructuring)	51,970,19	33,608,03
Deferred tax liabilities	242,890,07	175,801,42
Total	**925,423,07**	**819,420,78**

In 2023, long-term liabilities decreased by 11.5% compared to 2022, and deferred tax liabilities by 27.6%.

During 2023, there was a significant increase in targeted funding (grants) from UAH 33,838,000.00 as of 31.12.2022 to UAH 165,655,000.00 as of 31.12.2023.

Information on the company's current liabilities is presented in the table below.

Table 17: Current liabilities of the Company

in thousand UAH	31.12.2021	31.12.2022	31.12.2023	Structure, %
Accounts payable for goods, works and services	307,999	340,892	531,262	88.7%
Remuneration (including provisions for leave and pension obligations)	16,330	16,849	21,796	3.6%
Tax payables	28,408			
Current portion of non-current liabilities	50,464	50,219	39,884	6.7%
Liabilities for advance payments received	4,848	4,575	6,071	1.0%
Total	**408,049**	**412,535**	**599,013**	

In 2023, there was a significant increase in accounts payable for goods, works, and services by UAH 190,370,000.00 or 55.8% compared to 2022. The share of accounts payable for goods, works, and services in the structure of current liabilities amounted to 88.7% as of 31.12.2023.

The information on the Company's largest creditors is presented in the table below.

Table 18: The Company's largest creditors as of December 31, 2023 (UAH thousand)

Supplier / Creditor	Type (Procurement item)	Procurement in 2023	Debt as of December 31, 2023	Share in accounts payable
Gas Supply Company Naftogaz Trading LLC	natural gas	413,828	476,107	90.3%
Mykolaiv Electricity Supply Company LLC	electricity	52,780	12,856	2.4%
Mykolaiv Branch of Gas Distribution Networks of Ukraine LLC	gas distribution	32,344	10,795	2.0%
ENERTEKS REPRESENTATIVE OFFICE	contract work		8,117	1.5%
COMPANY ENERTEX	contract work		7,248	1.4%
JOINT STOCK COMPANY MYKOLAIVOBLENERGO	electricity distribution	20,030	5,475	1.0%
Other		26,348	6,516	1.2%
Total accounts payable to major creditors		**545,330**	**527,114**	

As of 31.12.2023, the largest payables were to Gas Supply Company Naftogaz Trading LLC in the amount of UAH 476,107,000.00, which amounted to 90.3% of the debt to the Company's largest creditors or 89.6% of accounts payable for goods, works, and services.

The detailed information on the Company's cash flows for 2021-2023 is presented in the table below.

Table 19: Statement of cash flows

in thousand UAH	31.12.2021	31.12.2022	31.12.2023
Cash balance	**14,921**	**87,341**	**87,629**
Receipts	932,989	922,007	954,553
Cash receipts from customers	662,872	730,547	741,057
Subsidies and other special funding received	264,861	190,037	198,365
Other income	5,256	1,423	15,131
Outflow of funds	941,828	879,568	819,334
Cash paid to suppliers			

in thousand UAH	31.12.2021	31.12.2022	31.12.2023
Expenses for payment for goods (works, services)	787,000	635,004	577,728
Remuneration	88,734	116,338	131,076
Taxes related to salary	22,070	34,721	35,502
Advances paid		21,794	346
Taxes and fees	20,366	57,596	39,336
Other outflows	23,658	14,115	35,346
Net cash flows from operating activities	**-8,839**	**42,439**	**135,219**
Cash flows from investing activities			
Other income		4,605	
Acquisition of non-current assets	165,421	60,250	
Other outflows			48,912
Net cash flows from investing activities	-165,421	-55,645	-48,912
Cash flows from financing activities			
Proceeds from increase in authorized capital	55,000	72,864	
Proceeds from borrowings	110,020	58,979	
Other outflows	37,014	47,685	86,716
Net cash flows from financing activities	128,006	84,158	-86,716
Net cash flows	**-46,254**	**70,952**	**-409**
Cash and cash equivalents as of January 1	**56,951**	**14,921**	**87,341**
Cash and cash equivalents at the end of the period	10,697	85,873	86,932
Impairment	4,224	1,468	697
Cash balance	**14,921**	**87,341**	**87,629**

Subsidies and other special financing received amounted to UAH 190,037,000.00 in 2022 and UAH 198,365,000.00 in 2023, or about 21% of cash receipts. The cash balance as of 31 December2023, remained virtually unchanged at UAH 87,629,000.00 as of 31 December 2023.

3. Conclusions and Highlights

- As of December 31, 2023, the Company's equity amounted to UAH 1,097,361,000.00, which is UAH 65,247,000.00 or 5.6% less than as of December 31, 2022. The decrease in equity was due to losses incurred in 2023.
- In 2023, long-term liabilities decreased by 11.5% compared to 2022, and deferred tax liabilities by 27.6%.
- In 2023, there was a significant increase in accounts payable for goods, works, and services.
- As of 31.12.2023, the largest payables were to Gas Supply Company Naftogaz Trading LLC, which accounted for 89.6% of payables for goods, works, and services.
- Subsidies and other special financing received amounted to UAH 190,037,000.00 in 2022 and UAH 198,365,000.00 in 2023, or about 21% of cash receipts.
- The cash balance as of 2023 remained virtually unchanged.

ANNEX 6 – TECHNICAL BASELINE

Designed for
NEFCO

Document type
Annex

Date
May 2024

SCOPING AND PROJECT PROPOSAL FOR ESTABLISHMENT OF BIOFUEL HEAT GENERATING CAPACITY IN MYKOLAIV CITY

ANNEX 8 — TECHNICAL BASELINE ASSESMENT

/Logo: RAMBOLL/

DOCUMENT CHECKLIST

Project name	**Scoping and Project Proposal for establishment of biofuel heat generating capacity in Mykolaiv city, Ukraine**
Project No.	**1100057552**
Recipient	**NEFCO**
Document type	**Annex**
Version	**0A**
Date	**May 10, 2024**
Prepared by	**Kateryna Shyshka**
Checked by	**Andriy Zinchenko**
Approved	**Ivan Zhuchenko**
Description	**Basic Technical Analysis**

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ABBREVIATIONS

Boiler house	BH
Central Heat Substation	CHS
Combined Heat and Power Plant	CHPP
District heating	DH
Technical Expert Commission	TEC
Heating Plant	HP
Hot water boilers	HWB
Hot tap water	HTW
Individual Heat Substations	IHS
Induced draft fan	ID fan
Oblasne Public Utility Mykolaivoblteploenergo	Mykolaivoblteploenergo OPU or the Company
The National Commission for State Regulation of Energy and Public Utilities	NEURC
Wholesale electricity market of Ukraine	WEM

1. INTRODUCTION

1.1 The city of Mykolaiv

Mykolaiv is a city in the south of Ukraine, the administrative center of Mykolaiv region, Mykolaiv district and Mykolaiv city community. It is one of the largest economic centers in southern Ukraine. Prior to the full-scale invasion of the Russian Federation in February 2022, Mykolaiv had a population of about 500,000 people, and as of May 2023, the city's pre-war population has almost recovered. The city is located in the Northern Black Sea region, at the confluence of the Southern Bug and Inhul rivers.

The city consists of 4 districts:

- "Tsentralnyi" is located in the northwest of the city. It includes the historic center of the city, Raketne Urochyshche, areas Soliany, Pivnichnyi (Northern), Ternivka (with its own village council), Matviivka, and Varvarivka;
- "Zavodskyi" is located in the west part and includes a significant industrial area. It also includes residential districts: Namyv, Lisky, and Lisky-2;
- "Inhulskyi" is located in the east part. It includes, among others, the areas of PTZ (UTZ), Novyi Vodopii and Staryi Vodopii. This district also includes bus and train stations, and a Zoo;
- "Korabelnyi" is located in the south part. It includes the following areas: Shyroka Balka, Bohoiavlenskyi (Vitovka), Balabanivka, and Kulbakyne.

The City's district heating supply is provided by two heat supply companies. The most powerful heat supply company in the city of Mykolaiv is Mykolaivoblteploenergo OPU, hereinafter the Company. It provides heat to 60% of the city's consumers. The Company's customers by consumption level include: population (86.8%), state-owned organizations (12.2%), and other customers (1%). Additionally, the company supply purchased heat energy from APC Eugroil LTD for the consumers needs.

To provide heat supply to critical infrastructure facilities, the Kingdom of Denmark, represented by UNOPS, purchased 13 modular pellet boilers houses with a total capacity of 6.5 MW (0.5 MW unit capacity). The modular boiler houses with a 25-ton fuel bunker each, operate unattended and automatically for 72 hours at full load.

During the heating season, district heating is provided to consumers around the clock, hot tap water is not supplied.

Gas supply in Mykolaiv is operated by LLC "Mykolaiv Electricity Supply Company"; Gas Distribution Networks Operator is Mykolaiv branch of Gas Distribution Networks of Ukraine.

1.2 History and ownership of Mykolaivoblteploenergo OPU

Municipal Public Utility "Mykolaivoblteploenergo" OPU, which provides heat to 60% of the city's consumers: 86,220 subscriber accounts, 1,236 residential buildings, 47 educational institutions, 42 kindergartens, and 22 medical institutions.

The Company includes 8 Heating Districts, which divide the city into sectors of heating networks and boiler houses maintenance, centralized repair department, emergency dispatch service, department for the operation and repair of electrical installations of instrumentation and automation, gas equipment operation and repair service, etc.

Company has the following assets: 23 central and 129 individual heat substations, 96 boiler houses with installed 343 boilers, with an total installed capacity of 502.57 Gcal/h, , + 12 biofuel pellet modular BH. Thermal energy is supplied through 236.889 km of heat networks (trench length).

Connected load 261.12 Gcal/h, including heating – 260.94 Gcal/h, steam – 0.16 Gcal/h, ventilation – 0.02 Gcal/h

Additionally, Company solves the problems of providing drinking water to the City inhabitants by using a water purification system with installed reverse osmosis filters with preliminary filtration, as since May 2022, due to the damage to the Dnipro-Mykolaiv water supply system, Mykolaiv has been remained without drinking water. For these purposes, a separate water supply system maintenance service was created, which currently operates 79 reverse osmosis stations with a total capacity of 170 m3 of drinking water per hour. About 200,000 people are provided with drinking water.

To provide heat supply to critical infrastructure facilities, the Kingdom of Denmark, represented by UNOPS, purchased 13 modular pellet boilers with a total capacity of 6.5 MW (0.5 MW unit capacity). The modular boiler houses with a 25-ton fuel bunker operate unattended and automatically for 72 hours at full load.

These boiler houses provide heat to:

3 modules — Snihurivka Central District Hospital,
5 modules — Municipal Non-Commercial Enterprise "City Hospital No. 3" of the Mykolaiv City Council, In May 2024, 2 modules will be transferred to the Municipal Non-Commercial Enterprise "Mykolaiv Regional Center of Treatment of Infectious Diseases" of the Mykolaiv Regional Council,
2 modules — Municipal Non-Commercial Enterprise "City Hospital No. 1" of the Mykolaiv City Council,
1 module is in reserve.

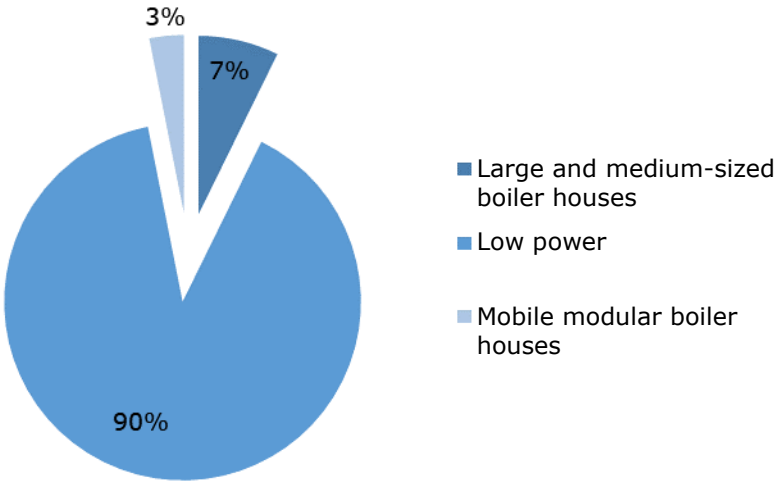

Figure 1-1 Installed capacity of heat supply facilities

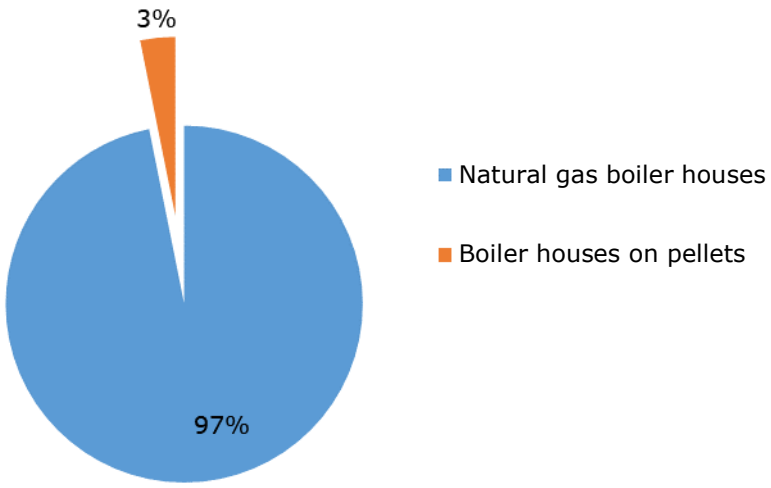

Figure 1-2 Fuel type at heat supply facilities

Below are the values for the Company's heat generation facilities:

Table 1.1 Generalized values for the Company's heat generation facilities

Heat source	Installed capacity, Gcal/h	Connected capacity, Gcal/h
Natural gas boiler houses*	497.407	259.289
Boiler houses on pellets	5.16	1.829
TOTAL	502.567	261.118

** – one boiler house is partly equipped with solid fuel(coal) boilers, actually works using only gas boilers.*

Table 1.2 Total Company consumption of resources and total heat production for 6 years

Value/year	2018	2019	2020	2021	2022	2023
Natural gas consumption, thousand Nm^3	61,492.111	52,315.971	51,936.662	59,157.040	48,005.181	45,862.996
Water consumption, thousand m^3	141.302	137.605	113.364	116.328	107.944	98.243
- Including for feeding, thousand m^3	96.922	89.416	70.366	86.803	75.712	68.770
Electricity consumption, thousand kWh	16,298.439	15,800.504	15,086.971	14,736.007	11,270.008	10,727.194
Heat generation, thousand Gcal	441.4	383.1	386.0	432.7	361.1	344.6
Electricity generation, thousand kWh	-	-	-	-	-	-

Table 1.3 Production and supply of heat energy for district heating, hot tap water, steam (for a period of 5 years)

Value/year	2018	2019	2020	2021	2022	2023
Heat production for DH, th. Gcal	440.7	382.3	385.5	432.4	360.7	344.1
Heat production for HTW, th. Gcal	0.1	0.2	0	0	0	0
Heat sale for DH, th. Gcal	378.3	333.5	336.3	371.2	317.2	300.0
Heat sale for HTW, th. Gcal	0.1	0.2	0	0	0	0
Steam production (if any)	0.6	0.6	0.5	0.3	0.4	0.5
Supply of steam, th. Gcal	0.6	0.6	0.5	0.3	0.4	0.5

The territory of Mykolaiv region is classified as a steppe zone due to its natural conditions. The climate is temperate continental with mild, dry winter and hot, dry summer. The average temperature in January is -4.5°C, in July is +22.2°C. Annual precipitation ranges from 330 mm in the south to 450 mm in the north of the region. The snow cover is 9–11 cm high.
According to the climatic zoning (DSTU-N B V.1.1-27:2010 Building climatology), the territory of Mykolaiv is located in the 2nd (southeastern) climatic region.
According to the weather data, the design ambient temperature for heating is -20 ºC (average for the heating period is -1.1 ºC) with a wind speed of 3.7 m/s. The heating season lasts 178 days. Below are the main indicators of the heating seasons over the past 6 years:

Table 1.4 Duration and average temperature of heating seasons over the past 6 years

Heating season	Start-end (dates)	Duration, days	Average temperature
2017/2018	24.10.2017–03.04.2018	162	2.4
2018/2019	05.11.2018–06.04.2019	153	1.6
2019/2020	31.10.2019–08.04.2020	161	4.8
2020/2021	06.11.2020–12.04.2021	158	2.0
2021/2022	01.11.2021–29.03.2022	149	2.5
2022/2023	09.11.2022–24.03.2023	136	3.5

The following table shows the connected heat load by consumer category:

Table 1.5 Connected heat load, Gcal/h

Type	Connected heat load,	
	Gcal/h	%
Heat supply	260.94	99.93
HTW	-	-
Ventilation	0.02	0.01
Steam	0.16	0.06
Total	261.12	100

2. CONSUMERS

Table 2.1 Information on consumers

Number of personal accounts	2018	2019	2020	2021	2022	2023
Population	84,442	84,585	84,965	85,291	86,732	86,241
Budget	317	322	316	314	330	333
Other	443	423	416	400	419	407
Total	85,202	85,330	85,697	86,005	87,481	86,981

The largest group of heat energy consumers in the city are households, which consume 99% of the heat energy produced by the Company.

Table 2.2 Consumer structure for each of the Heating Districts

Heating District	Number of personal accounts, pcs.				Number of registered persons (population)
	Population	Budget	Other	Religion	
1	11,002	38	40	1	20,865
2	804	21	15	-	1,297
3	8,036	37	30	-	13,547
4	1,514	16	9	-	3,073
5	18,044	44	68	-	36,458
6	17,375	63	77	-	37,198
7	8,087	23	31	-	16,935
8	21,368	31	67	-	42,502
Snihurivka	-	1	-	-	-
Total	**86,230**	**274**	**337**	**1**	**171,875**

Housing stock

According to data (http://mykolayiv.local.softpro.ua/ua/zhyt_fund), as of March 2021, the housing stock of Mykolaiv amounted to 42,484 households, of which:
- 39,045 manor type houses;
- 35 houses belong to departmental housing stock;
- 3,407 of multiapartment buildings.

Table 2.3 Number of single- and multi-storey buildings in the city, total heating area

Year	Number of houses	Heating area, m^2
2018	1,239	4,046,719.53
2019	1,238	4,042,836.05
2020	1,239	4,047,687.21
2021	1,239	4,047,634.17
2022	1,257	4,120,043.23
2023	1,235	4,058,204.21

Table 2.4 Information on connection to district heating system for the last 6 years

Year	Population			State-owned organizations			Other		
	Total connected ($м^2$)	Consumers, pcs	Gcal/h	Total connected (m^2)	Consumers, pcs	Gcal/h	Total connected (m^2)	Consumers, pcs	Gcal/h
2018	15,458.69	334	1.010560	-	-	-	-	-	-
2019	7,060.50	215	0.388270	859	1	0.06149	10.5	1	0.00080
2020	20,836.30	438	1.262900	651.8	2	0.05290	900.0	3	0.13081
2021	15,569.47	357	0.882250	1,124.43	2	0.10087	35.9	1	0.00421
2022	81,391.20	1,576	5.115610	5,057.7	2	0.45166	1,508.1	1	0.12834
2023	69.30	1		0	0	0	0	0	0
Total	**140,385.46**	**2,921**	**8.65959**	**7,692.93**	**7**	**0.66692**	**2,454.5**	**6**	**0.26416**

Table 2.5 Information on disconnection of the population consumers from district heating system for the last 6 years

Year	Disconnection (m^2)	Number of apartments	Gcal/h
2018	11,292.93	221	-
2019	2,610.75	49	-
2020	1,560	28	-
2021	1,336.60	26	-
2022	485.9	7	-
2023	22,137.49	481	
Total	**39,423.67**	**812**	**-**

Table 2.6 Information on disconnection of state-owned consumers from district heating system for the last 6 years

Year	Total disconnected (m^2)	Voluntary disconnection (m^2)	Disconnection (transition to autonomous heating systems) (m2)	Forced disconnection (m^2)	Gcal/h
2018	883.7	883.7	-	-	0.08117
2019	3,538.61	3,538.61	-	-	0.24537
2020	1,077.8	1,077.8	-	-	0.10792
2021	7,167.38	7,167.38	-	-	0.63288
2022	18,806.16	18,806.16	-	-	2.51155
2023	1,926.70	1,926.70			0.17603
Total	**33,400.35**	**33,400.35**	**-**	**-**	**3.75492**

Table 2.7 Information on disconnection of other consumers from district heating system for the last 6 years

Year	Total disconnected (m2)	Voluntary disconnection (m2)	Disconnection (transition to autonomousheating systems) (m2)	Forced disconnection (m2)	Gcal/h
2018	654.6	654.6	-	-	0.04136
2019	3,564.4	3,564.4	-	-	0.29463
2020	3,823.4	3,823.4	-	-	0.29268
2021	7,725.57	7,725.57	-	-	0.63653
2022	2,249.16	2,249.16	-		0.19718
2023	5,086.38	5,086.38	-	-	0.49112
Total	**23,103.51**	**23,103.51**	**-**	**-**	**1.95350**

Table 2.8 Supply of HTW to consumers by different consumers groups over the past 6 years

Year	Population, %	State-owned, %	Other, %
2018	0.03	There is no HTW	There is no HTW
2019	0.06	There is no HTW	There is no HTW
2020	There is no HTW	There is no HTW	There is no HTW
2021	There is no HTW	There is no HTW	There is no HTW
2022	There is no HTW	There is no HTW	There is no HTW
2023	There is no HTW	There is no HTW	There is no HTW
Total:	**-**	-	-

2.1 Heat production – General information

There are 8 Heating Districts in the city + the Snihurivka town . The main consumers of heat energy is the population, and the main heat load is a heating of residential buildings.

The main part of the city's boiler houses are belong to Mykolaivoblteploenergo OPU, which owns 96 boiler houses, 23 central and 129 individual heat substations. The installed capacity of the boiler houses is 502.57 Gcal/h, the connected capacity is 261.12 Gcal/h, of which heating is 260.94 Gcal/h, steam production is 0.16 Gcal/h, ventilation is 0.02 Gcal/h), 343 boilers + 12 pellet modular BH. In total, the capacity of the installed boilers exceeds the connected heat load by about 39%.

Natural gas is mainly used as the main fuel in the heating equipment.

Table 2.9 Number and structure of Heating Districts

Heating District	Number of boiler houses	Number of Central Heat Substations	Number of Individual Heat Substations
Heating District 1	9	-	1
Heating District 2	18	1	-
Heating District 3	10	7	10
Heating District 4	15	8	-
Heating District 5	11	1	25
Heating District	7	6	94

6			
Heating District 7	14	-	-
Heating District 8	12	-	-
Snihurivka town, Central District Hospital	1	-	-

Table 2.10 Indicators for certain heat generation facilities of the Company

No.	Address of the boiler house	Boiler house output, Gcal/h					Type of fuel
		Installed	Connected				
			Heat supply	Steam	Ventilation	Total	
1	boiler house at 43-K Kosmonavtiv St.	1.07	0.27299			0.27299	gas
2	boiler house at 10-k Teatralna St.	1.576				0	gas
3	boiler house at 34b Mykolaivska St. (mcd.)	32.5	24.5335			24.5335	gas
4	boiler house at Peredova St.	3.475	2.62718			2.62718	gas
5	boiler house at 2k Poliarnyi prov.	4.558	3.08625			3.08625	gas
6	boiler house at 2-K Znamenska St.	7.8	7.0479			7.0479	gas
7	boiler house at 75/1-K 295th Strelkovoi Dyvizii St.	0.344	0.23338			0.23338	gas
8	boiler house at 75-a 295th Strelkovoi Dyvizii St.	0.279	0.13537			0.13537	gas
9	boiler house at 38-k Vilna St.	1.539	0.53999			0.53999	gas
10	boiler house at 13 1st Slobodska St.	0.332	0.5595			0.5595	gas
11	boiler house at 54/56 V. Morska St.	0.78	0.11879			0.11879	gas
12	boiler house at 27/1 Admiralska St.	1.351	0.96499			0.96499	gas
13	boiler house at 4-k Admiralska St.	0.8255	0.92475			0.92475	gas
14	boiler house at 34-A Nikolska St.	0.43006	0.48146			0.48146	gas
15	boiler house at 45-a V. Morska St.	0.91	0.23272			0.23272	gas
16	boiler house at 96/7 Prospect Tsentralnyi	0.653	0.66773			0.66773	gas
17	boiler house at 25/1 Naberezhna St.	1.68	0.86315			0.86315	gas
18	boiler house at 22-v Potomkinska St.	0.421	0.27708			0.27708	gas
19	boiler house at 5/11 Naberezhna St.	0.230	0.10438			0.10438	gas

No.	Address of the boiler house	Boiler house output, Gcal/h					Type of fuel
		Installed	Connected				
			Heat supply	Steam	Ventilation	Total	
20	boiler house at 31-K Admiralska St.	0.620	0.62129		0.0199	0.64119	gas
21	boiler house at 9a Nikolska St.	0.304	0.16009			0.16009	gas
22	boiler house at 2 Sadova St.	0.504	0.14789			0.14789	gas
23	boiler house at 46 Spaska St.	1.395	0.41415			0.41415	gas
24	boiler house at 55 Spaska St.	0.304	0.19792			0.19792	gas
25	boiler house at 66-k Spaska St.	0.196	0.15514			0.15514	gas
26	boiler house at 81/3 Potomkinska St.	0.538	0.41451			0.41451	gas
27	boiler house at 14-v Korabeliv St.	0.968		0.09441		0.09441	gas
28	boiler house at 1-k Sportyvna St.	37.900	27.9266			27.92661	gas
29	boiler house at 6/1 Nikolska St.	0.315	0.45635			0.45635	gas
30	boiler house at 6/2 Transportnyi Lane	2.610	2.27958			2.27958	gas
31	boiler house at 24-k Prospect Tsentralnyi	0.930	0.40249			0.40249	gas
32	boiler house at 1/1 Chornomorska St.	0.258	0.14187			0.14187	gas
33	boiler house at 2/1 Oleksandra Matrosova St.	0.172	0.18363			0.18363	gas
34	boiler house at 14/1 Hastello St.	0.279	0.2709			0.2709	gas
35	boiler house at 7/1 Moldavska St. (the village of M. Korenykha)	0.498	0.29453			0.29453	gas
36	boiler house at 78/1 M. Morska St.	0.236	0.18018			0.18018	gas
37	boiler house at 4-i 2nd Ekipazhna St.	5.000	3.23939			3.23939	gas
38	boiler house at 91-v Bezimenna St.	3.280	1.62015			1.62015	gas
39	boiler house at 117-k Kotelna St.	0.125	0.18706			0.18706	gas
40	boiler house at 5/1 2nd Ekipazhna St.	1.060	0.32393	0.06455		0.38848	gas
41	boiler house at 8/1 3rd Voienna St.	0.147	0.11815			0.11815	gas
42	boiler house at 42/2 5th Voienna St.	0.073	0.05272			0.05272	gas

No.	Address of the boiler house	Boiler house output, Gcal/h					Type of fuel
		Installed	Connected				
			Heat supply	Steam	Ventilation	Total	
43	boiler house at 2 Admiralteiska Square	0.538	0.16255			0.16255	gas
44	boiler house at 96 Pohranychna St.	0.680	0.37108			0.37108	gas
45	boiler house at 242-A/1 Pohranychna St.	1.983	0.99732			0.99732	gas
46	boiler house at 150/9-A Pohranychna St.	0.458	0.25622			0.25622	gas
47	boiler house at 209 Chkalova St.	1.118	0.55923			0.55923	gas
48	boiler house at 130/10 Kuznetska St.	0.380	0.15823			0.15823	gas
49	boiler house at 8/1 Kotelna St.	1.333	0.83695			0.83695	gas
50	boiler house at 48 6th Slobidska St.	0.618	0.16603			0.16603	gas
51	boiler house at 48-a 6th Slobidska St.	0.525	0.16935			0.16935	gas
52	boiler house at 1 11th Pozdovzhnia St.	0.240	0.17193			0.17193	gas
53	boiler house at 11-v 8th Pozdovzhnia St.	3.550	1.05679			1.05679	gas
54	boiler house at 2-K Kazarskoho St.	5.000	2.9077			2.9077	gas
55	boiler house at 48a Novozavodska St. (135th mcd.)	25.800	33.6372			33.63722	gas
56	boiler house at 1-k Lystopadova St.	3.360	2.53946			2.53946	gas
57	boiler house at 40k Khersonske shose	3.870	3.62815			3.62815	gas
58	Mobile modular boiler house at 79/1 Kosmonavtiv St.	1.720	0.573			0.573	pellets
59	Mobile modular boiler house at 91 Kosmonavtiv St.	2.150	0.19582			0.19582	pellets
60	boiler house at 70-v Oleksandra Yanaty St.	0.458	0.22701			0.22701	gas
61	boiler house at 7a Kytoboiv St. (114th mcd.)	32.5	22.1621			22.16211	gas
62	boiler house at 2-B Dmytra Yavornytskoho St.	0.62	0.60688			0.60688	gas

No.	Address of the boiler house	Boiler house output, Gcal/h					Type of fuel
		Installed	Connected				
			Heat supply	Steam	Ventilation	Total	
63	boiler house at 5-A Dunaiskoi Flotylii prov.	1.106				0	gas
65	boiler house at 72/1 Metalurhiv St.	0.525				0	gas
66	boiler house at 325/4-1 Prosp. Bohoiavlenskyi	1.116				0	gas
67	boiler house at 91-k Rybna St.	1.860				0	gas
68	boiler house at 124/1 Hetmana Sahaidachnoho St.	0.325				0	coal
69	boiler house at 42a Samoilovycha St. (MGZ)	130.068				0	gas
70	boiler house at 97/1 Metalurhiv St.	0.51				0	gas
71	boiler house at 21A-1 Prosp. Heroiv Ukrainy	19.500	10.496			10.49595	gas
72	boiler house at 12 Prosp. Heroiv Ukrainy	1.400	1.16407			1.16407	gas
73	Boiler house at 72-A Prosp. Heroiv Ukrainy	11.100	7.83745			7.83745	gas
74	boiler house at 1-B Malko-Tyrnivska St.	6.075	5.44758			5.44758	gas
75	boiler house at 10g Arkhitektora Starova St.	0.420	0.55747			0.55747	gas
76	boiler house at 91-K Prosp. Heroiv Ukrainy	2.236	1.94726			1.94726	gas
77	boiler house at 1-B Lisova St.	1.720	0.70077			0.70077	gas
78	furnace room at 22 Kurchatova St.	0.172	0.20972			0.20972	gas
79	furnace room at 267 Sylikatna St.	0.172	0.14185			0.14185	gas
80	boiler house at 13e Prosp. Heroiv Ukrainy	0.930	0.41103			0.41103	gas
81	boiler house at 4e Arkhitektora Starova St.	0.721	0.45806			0.45806	gas
82	boiler house at 4zh Arkhitektora Starova St.	0.990	0.36434			0.36434	gas
83	boiler house at 101 Prosp. Heroiv Ukrainy	1.674	0.84688			0.84688	gas
84	boiler house at 1/1 Henerala Karpenka St.	0.215	0.1256			0.1256	gas

No.	Address of the boiler house	Boiler house output, Gcal/h					Type of fuel
		Installed	Connected				
			Heat supply	Steam	Ventilation	Total	
85	boiler house at 5 Abrykosova St.	1.182	0.7637			0.7637	gas
86	boiler house at 7-B Dachna St.	4.810	2.68785			2.68785	gas
87	boiler house at 29/4 Sportyvna St.	0.258	0.1308			0.1308	gas
88	boiler house at 20-A Henerala Karpenka St.	5.005	4.07952			4.07952	gas
89	boiler house at 8-3 Henerala Karpenka St.	0.930	1.20831			1.20831	gas
90	boiler house at 71 Bila St.	42.700	35.4199			35.41991	gas
91	boiler house at 11a Kurortna St. (25th mcd.)	29.900	16.612			16.61195	gas
92	boiler house at 51a Henerala Karpenka St. (18th mcd.)	17.000	8.93457			8.93457	gas
93	boiler house at 8 Levanevtsiv St.	0.534	0.15281			0.15281	gas
94	boiler house at 10 Levanevtsiv St.	0.757	0.44359			0.44359	gas
95	boiler house at 45a Ozerna St.	10.000	3.89481			3.89481	gas
96	Mobile modular boiler house in Central District Hospital, 1 Zhovtneva, Snihurivka	1.290	1.06012			1.06012	pellets
	Total	502.57	260.94	0.16	0.02	261.12	

More detailed information on boiler equipment for each of the boiler houses is provided in Annex 1.

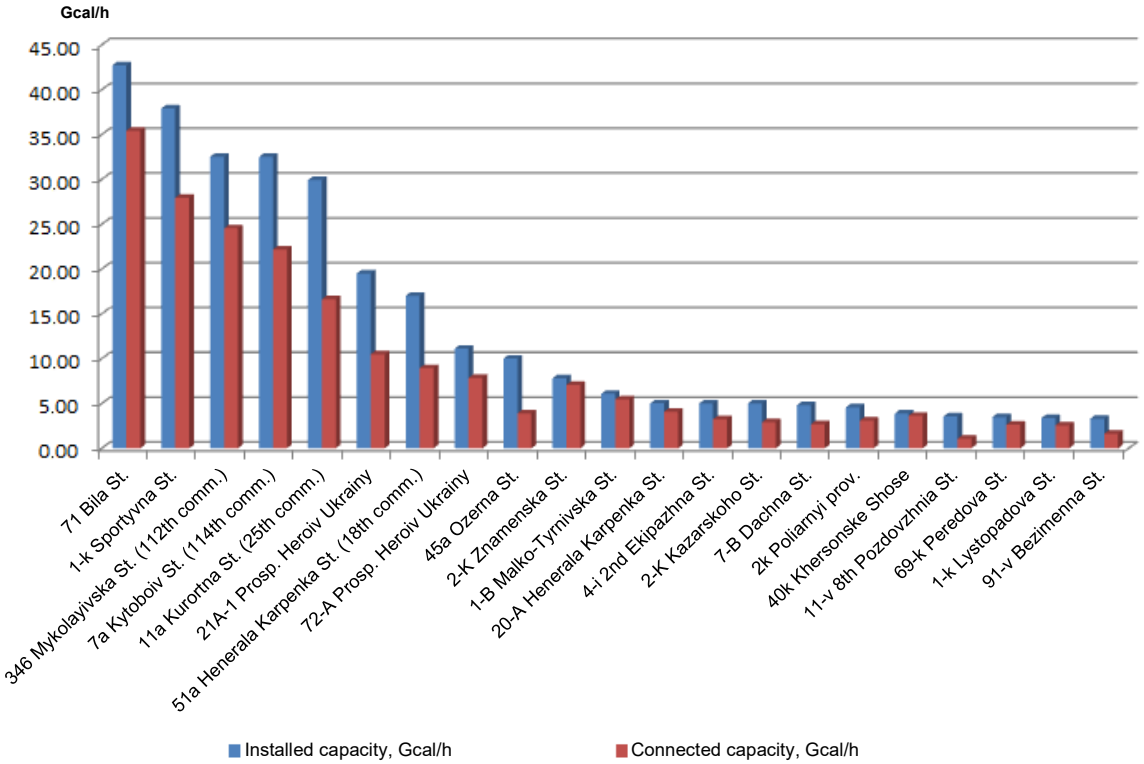

Figure 2-1 Diagram comparing the installed and connected heat load for the largest boiler houses in Mykolaiv (with an installed capacity of more than 3 Gcal/h)

Table 2.11 List of the most common boiler equipment

Boiler type	Quantity, units	Year of manufacture	Modernized, units
NIISTU-5	115	1980-2005	56
MN120 "Bernard"	47	2001-2014	2
KV-G, KV-GM	26	1982-2006	13
Module 105 G	17	2001-2010	7
AOGV	16	2006-2014	
Module AF 105	13	2007-2010	6
PetroNick 500 kW	12	2023	
Buderus Logomax plus GB162-100	10	2014	
Viessmann	9	2009-2023	
Protherm SOR-120	8	2003	
Universal	8	1965-1976	
TVG	7	1980-1996	3
Colvi VPM-192	6	2011	
FERROLI Pegasus F2 N 102T	6	2009	
KBN-G-2.5	6	1987-1997	
Rivneterm-96	6	2004	
ICI Caldai REX	5	2008-2023	
KEO	5	2014	
APVE-90	4	2019	
KGB-100	4	2001	
Colvi	4	2006-2008	

Boiler type	Quantity, units	Year of manufacture	Modernized, units
Riello RTQ-10000T	3	2023	
AMNK-108	3	2011	
Radan RD-14	2	2006	
Bogdan	2	2009-2010	
Buran	2	2014	
Kva-1.0gn "Fakel-G"	2	1991-1999	
KSV	2	2000-2001	

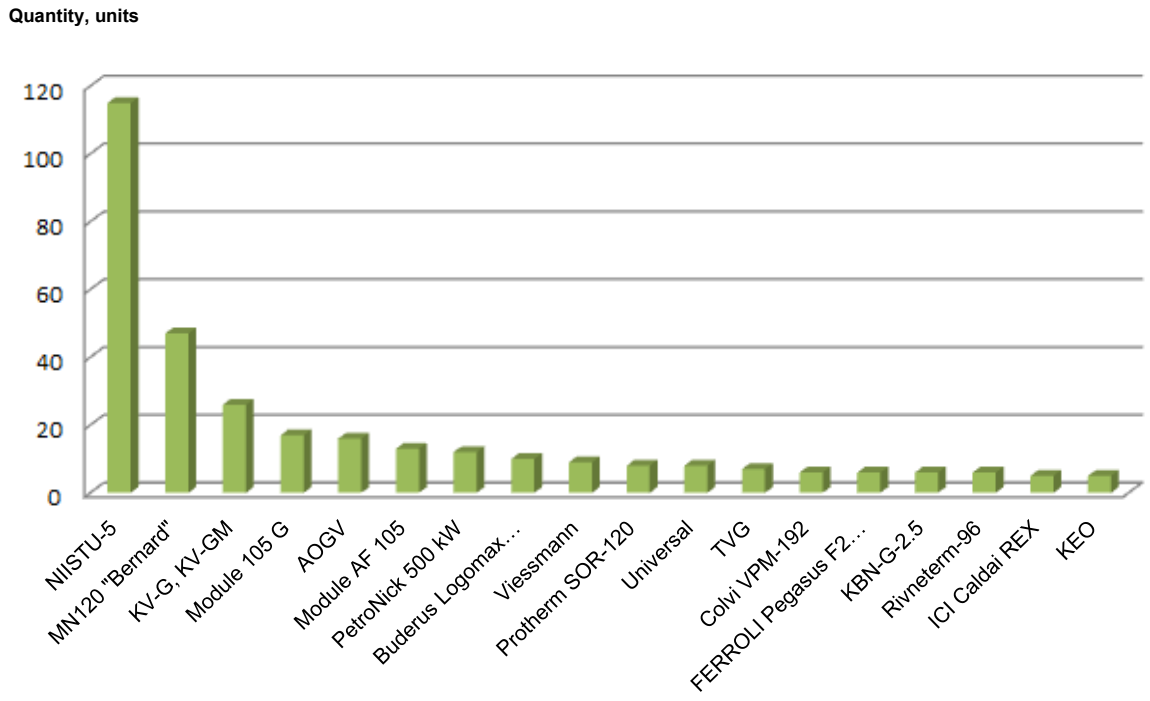

Figure 2-2 Diagram comparing the number of installed boilers by type in Mykolaiv

The most common types of boilers installed in the city's boiler houses are NIISTU-5 and MN120 "Bernard". The share of these boilers is 45.6% of the total number of installed boilers. It should be noted that there is a wide variety of types of installed boiler equipment, with about 24% of boilers being commissioned after 2010.

In the district heating system, the heating needs of consumers in Mykolaiv are met by 23 Central Heat Substations (CHS), of which 14 CHS have a total installed capacity of about 43.2 Gcal/h (there is no centralized hot water supply in the city).

3. DISTRICT HEATING NETWORKS

As of 2023, the length of the district heating networks is 237.2124 km (trench length), of which about 40% are laid in ducts, and about 44% are above ground. On average, about 61% of the pipelines have a service life of less than 5 years, 32% have a service life of 5 to 20 years, and only 7% have a service life of more than 20 years.

At the end of 2023, the total number of damages of the heating system pipelines amounted to 104.

Mykolaiv's district heating system also includes 23 Central Heat Substations (CHS) and 129 Individual Heat Substations.

Table 3.1 General data on heating networks in Mykolaiv

Pipelines			Service life							
Technology	Length		< 5 years		5 – 20 years		20 – 50 years		> 50 years	
	km	Type of insulation	km	%	km	%	km	%	km	%
In ducts	186.708	Mineral wool	100.684	53.93	62.4001	33.42	23.6239	12.65	-	-
Pre-insulated pipe in the ducts	5.0779	Polyurethane foam	2.9672	58.43	1.7768	35.00	0.3339	6.57	-	-
Ductless pre-insulated pipe	25.0791	Polyurethane foam	5.3701	21.41	15.8269	63.11	3.8821	15.48	-	-
Above ground	210.3047	Mineral wool	169.639	80.66	40.337	19.18	0.3287	0.16	-	-
Above ground Pre-insulated pipe	37.7314	Polyurethane foam	6.8711	18.21	30.3076	80.32	0.5527	1.47	-	-
Other	9.5237	other	5.007	52.57	3.899	40.94	0.6177	6.49	-	-
Total	**474.4248**								-	-

Table 3.2 Distribution of heating networks by diameter

Diameter of heating networks	Main heating networks, m		Local heating networks, m	
	Total	Including pre-insulated	Total	Including pre-insulated
21			6	
25			54	
32			66	
34			1,994	156
36			24	
38			128	
40			195	56
42			134	
45			1,833	64
57			46,641.7	2,026.1
63			551.8	551.8
71			4,224	130
76			34,354.3	4,580
89			44,685.3	6,001.2
108			79,666.3	7,302.61
133			33,513.4	6,729.36
140			174	
159			49,315.6	8,271.51
219	2,715.9	2,715.9	41,185.6	7,345.94
273	6,232.7	6,232.7	34,975.7	2,715.58
325	4,905.9	1,582.1	11,318	
377	5,749.1	5,138.3	18,099.2	
426	19,918.7	1,281.1		
480	8,102.8			
530	22,714.5	4,154.8		
630	186	93		
720	760.4	760.4		
Total, m	**71,286**	**21,958.3**	**403,138.8**	**45,930.1**

Table 3.3 Data on network replacement for the last 6 years

Year	Total number, km,	Type of pipe			
		Steel pre-insulated, km	Insulated with mineral wool, km	Plastic pre-insulated, Km	Uninsulated steel, km
2018	2.75	1.412	1.338	-	-
2019	6.909	3.3858	3.5232	-	-
2020	3.2738	1.345	1.9288	-	-
2021	4.36694	2.0009	2.366	-	-
2022	13.08684	11.42284	1.664	-	-
2023	7.962	0.902	7.06		
Total	**38.3486**	**20.4685**	**17.88**	-	-

Table 3.4 Data on heating network damages per year for the last 5 years

Year	Number of damages
2018 – 2019	165
2019 – 2020	135
2020 – 2021	117
2021 – 2022	130
2022 – 2023	104

4. DEMAND SIDE

4.1 Heat Substations

Most of the buildings with heat supply from the boiler houses of Mykolaivoblteploenergo OPU are connected by the direct scheme (there is no hot water supply in the city) at buildings input points with jet pumps connection (temperature schedule of the heat supply source is 95/55 °C) or through throttle devices (temperature schedule of the heat source is 80/55 °C). In addition, part of the buildings is connected to the heat supply source by 219 automated Individual Heat Substations equipped with circulation pumps, of which 155 are direct connection, 64 are indirect.

Table 4.1 Data on heat meters with distribution by consumer groups for the last 6 years

Equipment	2018		2019		2020		2021		2022		2023		Type of heat meter
	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%	
Population	1,230	95.04	1,230	95.45	1,230	95.69	1,230	95.69	1,251	96.62	1,274	98	Mechanical, ultrasonic
Budget	205	87.34	203	87.19	209	89.95	209	89.95	211	90.90	195	84	
Other	75	80.00	74	79.73	56	75.00	56	75.00	57	76.00	47	63	
Religion	1	100	1	100	1	100	1	100	1	100	1	100	

5. RESOURCES USED

Table 6.1 shows the data on fuel and energy consumption and heat production for the heat supply company for the period of 2018-2023. The main fuel for heat production is natural gas. To provide heat supply to critical infrastructure facilities, the Kingdom of Denmark, represented by UNOPS,

purchased 13 modular pellet boilers with a total capacity of 6.5 MW (0.5 MW unit capacity) in 2023. According to the Methodology for the Development of Heat Supply Schemes for Settlements in Ukraine, an efficient district heating system is one that uses at least 50% renewable energy. Thus, the modernization of the district heating system involves a phased replacement of natural gas consumption to reach the target value.

Table 5.1 Data on heat production and consumption of fuel and resources

Value/year	2018	2019	2020	2021	2022	2023
Natural gas consumption, thousand Nm^3	61,492.111	52,315.971	51,936.662	59,157.040	48,005.181	45,862.996
Consumption of pellets, tons	-	-	-	-	-	421.1
Water consumption, thousand m^3	141.302	137.605	113.364	116.328	107.944	98.243
Electricity consumption, thousand kWh	16,298.439	15,800.504	15,086.971	14,736.007	11,270.008	10,727.194
Heat energy produced, thousand Gcal	441.4	383.1	386.0	432.7	361.1	344.6

Table 5.2 Production and sale of heat energy for DH, HTW, steam (for a period of 6 years)

Value/year	2018	2019	2020	2021	2022	2023
Heat production for DH, thousand Gcal	440.7	382.3	385.5	432.4	360.7	344.1
Heat production for HTW, thousand Gcal	0.1	0.2	0	0	0	0
DH sale, thousand Gcal	378.3	333.5	336.3	371.2	317.2	300.0
HTW sale, thousand Gcal	0.1	0.2	0	0	0	0
Steam sale, thousand Gcal	0.6	0.6	0.5	0.3	0.4	0.5
Steam production (if any)	0.6	0.6	0.5	0.3	0.4	0.5

Table 5.3 Specific consumption of gas and electricity per 1 Gcal of heat energy for 6 years

Value/year	2018	2019	2020	2021	2022	2023
Specific gas consumption per 1 Gcal of heat production	165.4	162.7	161.2	163.4	159.6	160.8
Specific electricity consumption per 1 Gcal of heat production	23.4	25.4	25.10	23.0	21.6	22.28

Table 5.4 Hourly gas consumption at the enterprise for the three coldest days of 2022-2023, or other years (without emergency shutdowns due to lack of EE):

Date	Average daily outdoor air temperature	Hourly natural gas consumption, thousand m^3/h
18.01.2021	-18.1	28.461

19.01.2021	-14.1	28.251
17.02.2021	-11.4	24.481

During the non-heating season, the company operates one process boiler house to produce steam for the needs of the City Emergency Hospital. Hourly gas consumption is 0.155 thousand m^3/h

Table 5.5 Specific electricity consumption for heat generation and transportation separately for 5 years

Value/year	2018	2019	2020	2021	2022	2023
Specific electricity consumption per 1 Gcal of heat produced	33.09	35.32	10.79	6.64	5.12	4.59
Specific electricity consumption for transportation of 1 Gcal	1.16	2.25	17.49	16.49	16.01	15.86

ANNEX 1 – LIST OF BOILER HOUSES AND BOILERS

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	43-K Kosmonavtiv St.	NIISTU-5	1992	2023	90	0.23	1.07	0.27299			0.27299	25.51	80-55	0.0122	gas	54,267.34	20.237
		NIISTU-5	1992	2006	89.7	0.25											
		NIISTU-5 vapor	1993	2006		0.297											
		NIISTU-5 vapor	1993	2006		0.297											
2	10-k Teatralna St.	NIISTU-5	1999		83.8	0.465	1.576				0	0.00	80-55		gas	0.00	3.042
		NIISTU-5	1976		83.2	0.465											
		NIISTU-5	1976		82.2	0.323											
		NIISTU-5	1976		82.9	0.323											
3	34b Mykolaivska St. (112th comm.)	KVG-7.56	1983		87.2	6.5	32.5	24.5335			24.5335	75.49	95-55	0.5059	gas	3,444,652.76	773.800
		KVG-7.56	1982		88.4	6.5											
		KV-G-7.56-150	1993		89.4	6.5											
		KV-G-7.56-150	1993		89.9	6.5											
		KVG-7.56	1982	2023	89.5	6.5											
4	69-k Peredova St.	NIISTU-5mk	2004	2020	89.5	0.84	3.475	2.62718			2.62718	75.60	80-55	0.1010	gas	419,749.57	75.486
		NIISTU-5mk	2004	2020	89.9	0.84											
		NIISTU-5mk	2004		88	0.84											
		NIISTU-5mk	2004		89.3	0.955											
5	2k Poliarnyi prov.	NIISTU-5	1993	2003	87.1	0.907	4.558	3.08625			3.08625	67.71	80-55	0.1058	gas	453,303.38	86.359
		NIISTU-5	1997	2003	89.5	0.907											
		NIISTU-5	1987		83.4	0.465											
		NIISTU-5	1986		83.2	0.465											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		NIISTU-5	1995	2008	89.9	0.907											
		NIISTU-5	1989	2023	89.4	0.907											
6	2-K Znamenska St.	KBN-G-2.5	1990	2023	90.2	2.5	7.8	7.0479			7.0479	90.36	80-55	0.2151	gas	898,772.30	279.425
		KBN-G-2.5	1997	2022	91.2	2.5											
		KBN-G-2.5	1997	2014	91.9	2.5											
		APVE-90	2019			0.0774											
		APVE-90	2019			0.0774											
		APVE-90	2019			0.0774											
		APVE-90	2019			0.0774											
7	75/1-K 295th Strelkovoi Dyvizii St.	KGB-100	2001		87.7	0.086	0.344	0.23338			0.23338	67.84	80-55	0.0063	gas	27,813.15	1.144
		KGB-100	2001		87.7	0.086											
		KGB-100	2001		87.8	0.086											
		KGB-100	2001		87.9	0.086											
8	75-a 295th Strelkovoi Dyvizii St.	MN120 "Bernard"	2001	2022	90.2	0.093	0.279	0.13537			0.13537	48.52	80-55	0.0071	gas	29,960.07	2.614
		MN120 "Bernard"	2001	2023	90.4	0.093											
		MN120 "Bernard"	2001		90.5	0.093											
9	38-k Vilna St.	NIISTU-5m	2001		89.3	0.513	1.539	0.53999			0.53999	35.09	80-55	0.0161	gas	70,050.92	19.870
		NIISTU-5m	1997	2001	89.9	0.513											
		NIISTU-5m	1991	2001	90	0.513											
10	13 1st Slobodska St.	Universal-5	1965		72.8	0.166	0.332	0.5595			0.5595	168.5	80-55	0.0024	gas	15,621.96	2.375
		Universal-5	1965		72.8	0.166											
11	54/56 V. Morska St.	NIISTU-5mk-2f	2004		88.6	0.39	0.78	0.11879			0.11879	15.23	80-55	0.0030	gas	14,282.91	4.896
		NIISTU-5mk-2f	2004		88.2	0.39											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
12	27/1 Admiralska St.	NIISTU-5	1978			0.465	1.351	0.96499			0.96499	71.43	80-55	0.0125	gas	59,826.94	23.764
		NIISTU-5	1979		83.9	0.465											
		Universal-5	1972		84.9	0.421											
13	4-k Admiralska St.	Buderus Logomax plus GB162-100	2014		97.8	0.08126	0.8255	0.92475			0.92475	112.02	80-55	0.0318	gas	99,270.36	20.970
		Buderus Logomax plus GB162-100	2014		97.8	0.08126											
		Buderus Logomax plus GB162-100	2014		97.7	0.08126											
		Buderus Logomax plus GB162-100	2014		97.8	0.08126											
		Buderus Logomax plus GB162-100	2014		97.8	0.08126											
		Buderus Logomax plus GB162-100	2014		97.7	0.08126											
		Buderus Logomax plus GB162-100	2014		97.5	0.08126											
		Buderus Logomax plus GB162-100	2014		97.6	0.08126											
		Buderus Logomax	2014		97.7	0.08126											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		plus GB162-100															
		Buderus Logomax plus GB162-100	2014		97.7	0.08126											
		KEO-6/220v	2014			0.00516											
		KEO-6/220v	2014			0.00516											
		KEO-3.0/220v	2014			0.00258											
14	34-A Nikolska St.	MN120 "Bernard"	2014		90.6	0.103	0.43006	0.48146			0.48146	111.95	80-55	0.0091	gas	25,955.74	2.651
		MN120 "Bernard"	2014		90.6	0.103											
		MN120 "Bernard"	2014		90.4	0.103											
		MN120 "Bernard"	2014			0.103											
		KEO-9/380V	2014			0.00774											
		KEO-12/380V	2014			0.01032											
15	45A V. Morska St.	NIISTU-5mcf	1992	2010	88.6	0.35	0.91	0.23272			0.23272	25.57	80-55	0.0116	gas	49,687.31	19.414
		NIISTU-5	1981	2010	90.2	0.56											
16	96/7 Prospect Tsentralnyi	NIISTU-5mk	2004	2020	88.5	0.653	0.653	0.66773			0.66773	102.26	80-55	0.0250	gas	110,976.36	20.776
		NIISTU-5mk	2004		88.4	0.653											
17	25/1 Naberezhna St.	NIISTU-5mk	2003		89.7	0.84	1.68	0.86315			0.86315	51,38	80-55	0.0274	gas	114,390.15	19.413
		NIISTU-5mk	2003		88.5	0.84											
18	22-v Potomkinska St.	Universal-5	1987			0.421	0.421	0.27708			0.27708	65.81	80-55	0.0069	gas	28,410.51	16.354
		NIISTU-5mk	1987	2009	90.5	0.23											
19		NIISTU-5	2001	2009	88.8	0.115	0.230	0.10438			0.10438	45.38	80-55	0.0047	gas	27,524.95	7.078

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	5/11 Naberezhna St.	NIISTU-5	2001	2009	88.7	0.115											
20	31-K Admiralska St.	NIISTU-5mk	2005		89.9	0.310	0.620	0.62129		0.02	0.64119	103.42	80-55	0.0173	gas	71,992.12	11.175
		NIISTU-5mk	2005		90.5	0.310											
21	9a Nikolska St.	NIISTU-5mcf	1990	2007	87.4	0.152	0.304	0.16009			0.16009	52.66	80-55	0.0070	gas	34,307.74	3.802
		NIISTU-5mcf	1990	2007	86.3	0.152											
22	2 Sadova St.	NIISTU-5	1994	2015	89.4	0.252	0.504	0.14789			0.14789	29.34	80-55	0.0077	gas	31,110.09	1.978
		NIISTU-5	1994	2015	90.6	0.252											
23	46 Spaska St.	NIISTU-5	1977		83.1	0.465	1.395	0.41415			0.41415	29.69	80-55	0.0148	gas	74,364.90	11.439
		NIISTU-5	1964		83.1	0.465											
		NIISTU-5	1964			0.465											
24	55 Spaska St.	Universal-5	1969		83.9	0.152	0.304	0.19792			0.19792	65.11	80-55	0.0085	gas	37,575.54	5.642
		Universal-5	1969		85.6	0.152											
25	66-k Spaska St.	NIISTU-5mk	1987	2007	87.3	0.098	0.196	0.15514			0.15514	79.15	80-55	0.0030	gas	15,112.28	3.895
		NIISTU-5mk	1987	2007	87.6	0.098											
26	81/3 Potomkinska St.	NIISTU-5mk-2f	1998	2006	89.6	0.269	0.538	0.41451			0.41451	77.05	80-55	0.0179	gas	78,101.44	7.188
		NIISTU-5mk-2f	1998	2006	89.4	0.269											
27	14-v Korabeliv St.	NIISTU-5mpe vapor	2005	2022	87.5	0.503	0.968		0.094		0.09441	9.75	80-55	0.0104	gas	47,421.48	1.818
		NIISTU-5mpe vapor	1987	2015	82.8	0.465											
28	1-k Sportyvna St.	TVG-8M	1980	2021	93.5	8.3	37.900	27.9266			27.92661	73.68	95-55	0.5699	gas	3,746,437.91	640.308
		TVG-8M	1980	2019	92.1	8.3											
		TVG-8M	1980	2019	92.8	8.3											
		KVG-7.56	1988	2022	90.8	6.5											
		KVG-7.56	1988	2021	90.4	6.5											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
29	6/1 Nikolska St.	Module 105 G	2003		90.3	0.105	0.315	0.45635			0.45635	144.87	80-55	0.0075	gas	31,698.78	4.097
		Module 105 G	2003		90.1	0.105											
		Module 105 G	2003		90.4	0.105											
30	6/2 Transportnyi prov.	NIISTU-5mcf	2005		88.9	0.84	2.610	2.27958			2.27958	87.34	80-55	0.0738	gas	320,351.36	67.361
		NIISTU-5mcf	2005		88.6	0.84											
		NIISTU-5	1993	2023	91.1	0.465											
		NIISTU-5	1993	2023	83.5	0.465											
31	24-k Prosp. Tsentralnyi	NIISTU-5	1991		83.7	0.465	0.930	0.40249			0.40249	43.28	80-55	0.0125	gas	58,344.13	16.227
		NIISTU-5	1991		82.2	0.465											
32	1/1 Chornomorska St.	AOGV-100E	2011		90.4	0.086	0.258	0.14187			0.14187	54.99	80-55	0.0033	gas	14,537.43	1.942
		AOGV-100E	2011		90.3	0.086											
		AOGV-100E	2011		90.4	0.086											
33	2/1 Oleksandra Matrosova St.	AOGV-100E	2009		89.2	0.086	0.172	0.18363			0.18363	106.76	80-55	0.0057	gas	23,903.67	2.069
		AOGV-100E	2009		89.2	0.086											
34	14/1 Hastello St.	AMNK-108	2011		93.2	0.093	0.279	0.2709			0.2709	97.10	80-55	0.0068	gas	28,867.79	15.579
		AMNK-108	2011		93.3	0.093											
		AMNK-108	2011		93.2	0.093											
35	7/1 Moldavska St. (the village of M. Korenykha)	Rivneterm-96	2004		88.4	0.083	0.498	0.29453			0.29453	59.14	80-55	0.0069	gas	29,673.92	6.672
		Rivneterm-96	2004		88	0.083											
		Rivneterm-96	2004		88	0.083											
		Rivneterm-96	2004		88.1	0.083											
		Rivneterm-96	2004		88	0.083											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		Rivneterm-96	2004		87.8	0.083											
36	78/1 M. Morska St.	Universal-6	1976		82.2	0.118	0.236	0.18018			0.18018	76.35	80-55	0.0063	gas	7,545.08	2.690
		Universal-6	1976		81.3	0.118											
37	4-i 2nd Ekipazhna St.	KBN-G-2.5	1987		90.9	2.5	5.000	3.23939			3.23939	64.79	80-55	0.1145	gas	463,302.27	103.682
		KBN-G-2.5	1987		88.9	2.5											
38	91-v Bezimenna St.	NIISTU-5mk	2003		87.8	0.71	3.280	1.62015			1.62015	49.39	80-55	0.0629	gas	274,187.53	50.306
		NIISTU-5mk	2003		89.7	0.71											
		NIISTU-5	1995	2022	89.8	0.465											
		NIISTU-5	1994	2022	89.6	0.465											
		NIISTU-5	1994			0.465											
		NIISTU-5	1992		81.8	0.465											
39	117-k Kotelna St.	Colvi-Termona KTH 50CE	2008		84.8	0.043	0.125	0.18706			0.18706	150.01	80-55	0.0047	gas	20,953.42	3.354
		Colvi-Termona KTH 50CE	2008		85.4	0.043											
		AVPE.PR115 45 kW	2014			0.0387											
40	5/1 2nd Ekipazhna St.	NIISTU-5mk	1996	2016	90.8	0.23	1.060	0.32393	0.065		0.38848	36.65	80-55	0.0178	gas	75,122.89	15.618
		NIISTU-5mk	1996		89.9	0.25											
		NIISTU-5mkpe-2f vapor	2004	2023	88.4	0.189											
		NIISTU-5mpe vapor	1996			0.39											
42	8/1 3rd Voienna St.	AOGV-50E	2014		89.6	0.043	0.147	0.11815			0.11815	80.37	80-55	0.0041	gas	16,699.09	1.629
41		AOGV-50E	2014		89.8	0.043											
		AOGV-50E	2014		89.7	0.043											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		Buran-6	2014			0.00516											
		Buran-15	2014			0.0129											
42	42/2 5th Voienna St.	Bogdan-55	2009		90.8	0.043	0.073	0.05272			0.05272	72.22	80-55	0.0017	gas	7,781.86	1.096
		Bogdan-40	2010		90.2	0.0301											
43	2 Admiralteiska Square	NIISTU-5	1980	2008	89.2	0.269	0.538	0.16255			0.16255	30.21	80-55	0.0059	gas	26,636.18	12.936
		NIISTU-5	1980	2008	90.5	0.269											
44	96 Pohranychna St.	Protherm SOR-120	2003		88.7	0.085	0.680	0.37108			0.37108	54.57	80-55	0.0100	gas	48,062.02	4.588
		Protherm SOR-120	2003		89	0.085											
		Protherm SOR-120	2003		89.6	0.085											
		Protherm SOR-120	2003		89.5	0.085											
		Protherm SOR-120	2003		89.5	0.085											
		Protherm SOR-120	2003		89.6	0.085											
		Protherm SOR-120	2003		89.5	0.085											
		Protherm SOR-120	2003		89.4	0.085											
45	242-A/1 Pohranychna St.	NIISTU-5mk	1988	2006	87.8	0.653	1.983	0.99732			0.99732	50.29	80-55	0.0432	gas	183,366.76	34.358
		NIISTU-5mk	1990	2006	87.3	0.665											
		NIISTU-5mk	1990	2006	88.7	0.665											
46	150/9-A Pohranychna St.	NIISTU-5	1986	2008	89.4	0.229	0.458	0.25622			0.25622	55.94	80-55	0.0117	gas	51,294.58	14.235
		NIISTU-5	1986	2008	89.3	0.229											
47	209 Chkalova St.	NIISTU-5mk	2003		88.8	0.559	1.118	0.55923			0.55923	50.02	80-55	0.0222	gas	93,370.87	24.710
		NIISTU-5mk	2003		89.8	0.559											
48		NIISTU-5	1980	2008	90.4	0.19	0.380	0.15823			0.15823	41.64	80-55	0.0068	gas	28,983.56	13.501

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	130/10 Kuznetska St.	NIISTU-5	1980	2008	89.3	0.19											
49	8/1 Kotelna St.	Viessmann Vitoplex 100	2009		92.9	0.267	1.333	0.83695			0.83695	62.79	80-55	0.0205	gas	83,567.62	12.577
		Viessmann Vitoplex 100	2009		91.9	0.533											
		Viessmann Vitoplex 100	2009		91.7	0.533											
50	48 6th Slobidska St.	Module AF 105	2010	2022	92.1	0.103	0.618	0.16603			0.16603	26.87	80-55	0.0112	gas	48,112.22	4.777
		Module AF 105	2010	2022	92.1	0.103											
		Module AF 105	2010	2023	88.1	0.103											
		Module AF 105	2010	2023	87.2	0.103											
		Module AF 105	2010		87.8	0.103											
		Module AF 105	2010		87.7	0.103											
51	48-a 6th Slobidska St.	Module 105 G	2010	2022	92.5	0.105	0.525	0.16935			0.16935	32.26	80-55	0.0110	gas	49,364.06	4.562
		Module 105 G	2010	2022	92	0.105											
		Module 105 G	2010	2023	90.2	0.105											
		Module 105 G	2010		89.2	0.105											
		Module 105 G	2010		89.5	0.105											
52	1 11th Pozdovzhnia St.	NIISTU-5mk	1969	2007	90.2	0.12	0.240	0.17193			0.17193	71.64	80-55	0.0072	gas	32,253.10	6.436
		NIISTU-5mk	1977	2023	88.2	0.12											
53	11-v 8th Pozdovzhnia St.	NIISTU-5m	2001		90.4	0.71	3.550	1.05679			1.05679	29.77	80-55	0.0375	gas	158,306.15	30.338
		NIISTU-5m	2001		90	0.71											
		NIISTU-5m	2000		88.9	0.71											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		NIISTU-5mk	2002		89.9	0.71											
		NIISTU-5mk	2002		88.5	0.71											
54	2-K Kazarskoho St.	KV-G-2.9-115SN "Drozd"	2006		92.3	2.5	5.000	2.9077			2.9077	58.15	80-55	0.1156	gas	458,329.52	116.802
		KV-G-2.9-115SN "Drozd"	2006		93.5	2.5											
55	48a Novozavodska St. (135th comm.)	Riello RTQ-10000T	2023		93.3	8.6	25.800	33.6372			33.63722	130.38	95-55	0.7369	gas	4,851,192.97	850.645
		Riello RTQ-10000T	2023		93.5	8.6											
		Riello RTQ-10000T	2023		93.6	8.6											
56	1-k Lystopadova St.	NIISTU-5	1999	2023	89.3	0.84	3.360	2.53946			2.53946	75.58	80-55	0.0939	gas	414,971.32	5.972
		NIISTU-5	1999	2023	90.1	0.84											
		NIISTU-5	1993		84.1	0.84											
		NIISTU-5	1999		88.3	0.84											
57	40k Khersonske Shose	ICI Caldai REX 140	2023		94.5	1.29	3.870	3.62815			3.62815	93.75	80-55	0.1080	gas	423,642.67	8.002
		ICI Caldai REX 140	2023		94.3	1.29											
		Retra-4m	2023		85.7	1.29											
58	Mobile modular boiler house at 79/1 Kosmonavtiv St.	PetroNick 500 kW	2023		78.1	0.43	1.720	0.573			0.573	33.31	80-55	0.0092	pellets	100,200.00	
		PetroNick 500 kW	2023		77.2	0.43											
		PetroNick 500 kW	2023		79	0.43											
		PetroNick 500 kW	2023		78.3	0.43											
59	Mobile modular boiler house at 91 Kosmonavtiv St.	PetroNick 500 kW	2023		78.5	0.43	2.150	0.19582			0.19582	9.11	80-55	0.0029	pellets	80,800.00	
		PetroNick 500 kW	2023		78.3	0.43											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		PetroNick 500 kW	2023		77.7	0.43											
		PetroNick 500 kW	2023		78.1	0.43											
		PetroNick 500 kW	2023		78	0.43											
60	70-v Oleksandra Yanaty St.	NIISTU-5mk-2f	2003		90.2	0.229	0.458	0.22701			0.22701	49.57	80-55	0.0063	gas	27,519.81	7.483
		NIISTU-5mk-2f	2003		90.5	0.229											
61	7a Kytoboiv St. (114th comm.)	KV-G-7.56-150	1995		90.4	6.5	32.5	22.1621			22.16211	68.19	80-55	0.4721	gas	3,234,088.24	5.605
		KVG-7.56	1984		85.8	6.5											
		KVG-7.56	1984		89.6	6.5											
		KVG-7.56	1983	2022	90.7	6.5											
		KVG-7.56	1985	2023	89.5	6.5											
62	2-V Dmytra Yavornytskoho St.	NIISTU-5mk-2	2005		91.3	0.31	0.62	0.60688			0.60688	97.88	80-55	0.0208	gas	89,393.34	20.873
		NIISTU-5mk-2	2005		91.5	0.31											
63	5-A Dunaiskoi Flotylii prov.	NIISTU-5mk	2005		89.8	0.553	1.106				0	0.00	80-55	0.0254	gas	108,420.89	24.892
		NIISTU-5mk	2005		90.9	0.553											
65	72/1 Metalurhiv St.	Module 105 G	2001	2023	91	0.105	0.525				0	0.00	80-55	0.0107	gas	45,153.23	14.747
		Module 105 G	2001	2023	91.2	0.105											
		Module 105 G	2001		90.8	0.105											
		Module 105 G	2001		90.9	0.105											
		Module 105 G	2001		91.3	0.105											
66	325/4-1 Prosp. Bohoiavlenskyi	MN120 "Bernard"	2003		91.2	0.093	1.116				0	0.00	80-55	0.0217	gas	90,472.49	22.222

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		MN120 "Bernard"	2003		90.8	0.093											
		MN120 "Bernard"	2003		90.8	0.093											
		MN120 "Bernard"	2003		90.7	0.093											
		MN120 "Bernard"	2003		91.2	0.093											
		MN120 "Bernard"	2003		90.7	0.093											
		MN120 "Bernard"	2003		90.8	0.093											
		MN120 "Bernard"	2003		90.7	0.093											
		MN120 "Bernard"	2003		90.9	0.093											
		MN120 "Bernard"	2003		90.9	0.093											
		MN120 "Bernard"	2003		90.7	0.093											
		MN120 "Bernard"	2003		90.7	0.093											
67	91-k Rybna St.	NIISTU-5	1987			0.465	1.860				0	0.00	80-55	0.0290	gas	129,194.16	43.623
		NIISTU-5	1987			0.465											
		NIISTU-5	1987		82.9	0.465											
		NIISTU-5	1987		83.3	0.465											
68	124/1 Hetmana Sahaidachnoho St.	NIISTU-5	1971	2019	68.7	0.325	0.325				0	0.00	80-55	0.0058	coal	52,000.00	0.970
69	42a Samoilovycha St. (MGZ)	PTVM-30M-4	1978	2021	93.9	30	130.068				0	0.00	105-55	1.4499	gas	9,571,966.41	1,375.542
		PTVM-30M-4	1978		91.2	30											
		PTVM-30M-4	1979			30											
		Viessmann Vitomax D HW	2023		93.7	20.034											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		Viessmann Vitomax D HW	2023		93.8	20.034											
70	97/1 Metalurhiv St.	FERROLI Pegasus F2 N 102T	2009		90.6	0.085	0.51				0	0.00	80-55	0.0140	gas	58,367.09	9.112
		FERROLI Pegasus F2 N 102T	2009		90.2	0.085											
		FERROLI Pegasus F2 N 102T	2009		89.8	0.085											
		FERROLI Pegasus F2 N 102T	2009		89.6	0.085											
		FERROLI Pegasus F2 N 102T	2009		89.8	0.085											
		FERROLI Pegasus F2 N 102T	2009		89.5	0.085											
71	21A-1 Prosp. Heroiv Ukrainy	KV-G-7.56-150	1993	2022	91.1	6.5	19.500	10.496			10.49595	53.83	95-55	0.1739	gas	1,208,174.67	174.896
		KVG-7.56	1986		87.9	6.5											
		KV-G-7.56-150	1993	2023	90.6	6.5											
72	12 Prosp. Heroiv Ukrainy	NIISTU-5mk	2005		88.4	0.7	1.400	1.16407			1.16407	83.15	80-55	0.0387	gas	161,624.64	28.520
		NIISTU-5mk	2005		88.1	0.7											
73	72-A Prosp. Heroiv Ukrainy	Viessmann Vitomax LW M62C	2023		93.7	3.70	11.100	7.83745			7.83745	70.61	80-55	0.2887	gas	1,186,698.88	249.057
		Viessmann Vitomax LW M62C	2023		93.8	3.70											
		Viessmann Vitomax LW M62C	2023		93.6	3.70											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
74	1-B Malko-Tyrnivska St.	KBN-G-2.5	1989	2023	92.5	2.5	6.075	5.44758			5.44758	89.67	80-55	0.1257	gas	520,505.47	156.135
		KV-G-2.9-115SN "Drozd"	2006	2023	93.1	2.5											
		KVMU-1.25gn	2014		92.8	1.075											
75	10g Arkhitektora Starova St.	Module 105 G	2002	2023	90.3	0.105	0.420	0.55747			0.55747	132.73	80-55	0.0134	gas	55,932.93	4.809
		Module 105 G	2002	2023	90.3	0.105											
		Module 105 G	2002		90.6	0.105											
		Module 105 G	2002		90.5	0.105											
76	91-K Prosp. Heroiv Ukrainy	NIISTU-5mk	2006		88	0.559	2.236	1.94726			1.94726	87.09	80-55	0.0705	gas	310,117.44	71.665
		NIISTU-5mkl	2005		87.4	0.559											
		NIISTU-5mk	2005	2021	87.1	0.559											
		NIISTU-5mk	2006		86.6	0.559											
77	1-B Lisova St.	Kva-1.0gn "Fakel-G"	1991		90.5	0.86	1.720	0.70077			0.70077	40.74	80-55	0.0200	gas	84,443.04	40.508
		Kva-1.0gn "Fakel-G"	1999		90.7	0.86											
78	Furnace room at 22 Kurchatova St.	Colvi KT DUO 100	2006		89.6	0.086	0.172	0.20972			0.20972	121.93	80-55	0.0071	gas	29,737.55	4.731
		Colvi KT DUO 100	2006		89.8	0.086											
79	Furnace room at 267 Sylikatna St.	AOGV-100E "Mayak"	2006		90.6	0.086	0.172	0.14185			0.14185	82.47	80-55	0.0039	gas	16,330.01	2.044
		AOGV-100E "Mayak"	2006		90.3	0.086											
80	13e Prosp. Heroiv Ukrainy	MN120 "Bernard"	2007		90.5	0.093	0.930	0.41103			0.41103	44.20	80-55	0.0118	gas	51,797.94	5.070
		MN120 "Bernard"	2007		90.6	0.093											
		MN120 "Bernard"	2007		90.2	0.093											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		MN120 "Bernard"	2007		90.6	0.093											
		MN120 "Bernard"	2007		90.4	0.093											
		MN120 "Bernard"	2007		90.6	0.093											
		MN120 "Bernard"	2007		90.6	0.093											
		MN120 "Bernard"	2007		90.3	0.093											
		MN120 "Bernard"	2007		90.2	0.093											
		MN120 "Bernard"	2007		90.5	0.093											
81	4e Arkhitektora Starova St.	Module AF 105	2007	2023	91.8	0.103	0.721	0.45806			0.45806	63.53	80-55	0.0125	gas	54,809.43	7.454
		Module AF 105	2007	2023	92	0.103											
		Module AF 105	2007		90.2	0.103											
		Module AF 105	2007		90.2	0.103											
		Module AF 105	2007		90.3	0.103											
		Module AF 105	2007		90.5	0.103											
		Module AF 105	2007		90.4	0.103											
82	4zh Arkhitektora Starova St.	Colvi VPM-192	2011		90.1	0.165	0.990	0.36434			0.36434	36.80	80-55	0.0099	gas	45,930.27	6.234
		Colvi VPM-192	2011		90.5	0.165											
		Colvi VPM-192	2011		90.2	0.165											
		Colvi VPM-192	2011		90.2	0.165											
		Colvi VPM-192	2011		90.1	0.165											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		Colvi VPM-192	2011		90.5	0.165											
83	101 Prosp. Heroiv Ukrainy	MN120 "Bernard"	2003		90.2	0.093	1.674	0.84688			0.84688	50.59	80-55	0.0278	gas	116,542.11	8.116
		MN120 "Bernard"	2003		90.2	0.093											
		MN120 "Bernard"	2003		89.1	0.093											
		MN120 "Bernard"	2003		88.3	0.093											
		MN120 "Bernard"	2003		88.3	0.093											
		MN120 "Bernard"	2003		90.4	0.093											
		MN120 "Bernard"	2003			0.093											
		MN120 "Bernard"	2003			0.093											
		MN120 "Bernard"	2003			0.093											
		MN120 "Bernard"	2003			0.093											
		MN120 "Bernard"	2003			0.093											
		MN120 "Bernard"	2003			0.093											
		MN120 "Bernard"	2003		91.2	0.093											
		MN120 "Bernard"	2003		88.2	0.093											
		MN120 "Bernard"	2003		90.3	0.093											
		MN120 "Bernard"	2003		90.4	0.093											
		MN120 "Bernard"	2003		90.3	0.093											
		MN120 "Bernard"	2003		90.2	0.093											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
84	1/1 Henerala Karpenka St.	AOGV-50E "Mayak"	2014		89.6	0.043	0.215	0.1256			0.1256	58.42	80-55	0.0040	gas	16,675.57	1.873
		AOGV-100E "Mayak"	2014		89.6	0.086											
		AOGV-100E "Mayak"	2014		89.7	0.086											
85	5 Abrykosova St.	NIISTU-5	1986	2015	87.1	0.394	1.182	0.7637			0.7637	64.61	80-55	0.0275	gas	120,594.81	9.899
		NIISTU-5	1980	2015	84.9	0.394											
		NIISTU-5	1986	2015	85.1	0.394											
86	7-B Dachna St.	NIISTU-5	1984	2006	89.8	0.84	4.810	2.68785			2.68785	55.88	80-55	0.0969	gas	432,356.82	56.915
		NIISTU-5	1982	2006	89.5	0.84											
		NIISTU-5	1986	2007	87.4	1.1											
		NIISTU-5	1982	2007	87.5	1.1											
		NIISTU-5	1986		76.5	0.465											
		NIISTU-5	1984		79.1	0.465											
87	29/4 Sportyvna St.	AOGV-100E "Mayak"	2014		89.5	0.086	0.258	0.1308			0.1308	50.70	80-55	0.0056	gas	21,305.27	2.196
		AOGV-100E "Mayak"	2014		89.3	0.086											
		AOGV-100E "Mayak"	2014		89.1	0.086											
88	20-A Henerala Karpenka St.	ICI Caldai REX 240	2008		92.1	2.064	5.005	4.07952			4.07952	81.51	80-55	0.1253	gas	512,866.11	135.670
		ICI Caldai REX 240	2008		92	2.064											
		ICI Caldai REX-100	2011		92.4	0.877											
89	8-3 Henerala Karpenka St.	NIISTU-5	1992		77.3	0.465	0.930	1.20831			1.20831	129.93	80-55	0.0429	gas	196,860.22	28.919
		NIISTU-5	1992		77.2	0.465											
90	71 Bila St.	Viessmann Vitomax D HW	2023		93.4	22.70	42.700	35.4199			35.41991	82.95	95-55	0.7191	gas	4,309,225.14	666.059

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		KV-GM-10	1976	2020	92.6	10											
		KV-GM-10	1990		62.1	10											
91	11a Kurortna St. (25th community)	TVG-8M	1996		90.3	8.3	29.900	16.612			16.61195	55.56	95-55	0.4311	gas	2,977,729.57	754.169
		TVG-8M	1996		91.1	8.3											
		TVG-8M	1995		90.9	8.3											
		KV-G-2.9-115SN "Drozd"	2006		92.3	2.5											
		KV-G-2.9-115SN "Drozd"	2006		92.1	2.5											
92	51a Henerala Karpenka St. (18th community)	TVG-4	1964		90.2	4	17.000	8.93457			8.93457	52.56	95-55	0.1835	gas	1,272,091.60	320.963
		KV-G-7.56-150	1991	2018	88.3	6.5											
		KV-G-7.56-150	1993	2018	86.9	6.5											
93	8 Levanevtsiv St.	Radan RD-14	2006		92.2	0.267	0.534	0.15281			0.15281	28.62	80-55	0.0045	gas	22,910.25	3.668
		Radan RD-14	2006		92.4	0.267											
94	10 Levanevtsiv St.	KSV-0.25 "VK-22"	2000		92.2	0.215	0.757	0.44359			0.44359	58.60	80-55	0.0102	gas	41,954.17	2.961
		KSV-0.63 "VK-34"	2001		93.1	0.542											
95	45a Ozerna St.	KV-GM-5.8-115SN "MVK-5"	2005	2014	92.1	5.0	10.000	3.89481			3.89481	38.95	80-55	0.0410	gas	160,308.68	17.633
		KV-GM-5.8-115SN "MVK-5"	2005	2018	92.2	5.0											
96	Mobile modular boiler house in Central District Hospital, 1	PetroNick 500 kW	2023		77.8	0.43	1.290	1.06012			1.06012	82.18	80-55	0.0242	pellets	240,100.00	
		PetroNick 500 kW	2023		78.2	0.43											

No.	Address of the boiler house	Boiler type (brand)	Year of boiler commissioning	Year of boiler modernization	Thermal efficiency, %	Boiler performance, Gcal/h	Boiler house output, Gcal/h					Load factor, %	Temperature schedule of heat supply, °C	Average annual heat-transfer medium consumption, m³/h	Annual consumption		
							Installed	Connected							Fuel		Electricity, thousand kWh
								Heat supply	vapor	Ventilation	Total				type of fuel	m³, (tons)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Zhovtneva St., town of Snihurivka	PetroNick 500 kW	2023		77.6	0.43											

Appendix 2

Results framework template

Project: Mykolaiv Solar

Project objective and results framework

Project Title			
Outcome			
Outcome indicator			
Baseline	Year		
Target	Year		

Output 1			
Output indicator			
Baseline	Year		
Target	Year 1		
Target	Year 2		

Output 2			
Output indicator			
Baseline	Year		
Target	Year 1		
Target	Year 2		

Output "n"			
Output indicator			
Baseline	Year		
Target	Year 1		
Target	Year 2		

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Securedmail manual for external sender

Technical proposal

How to send a secure message to a Securedmail user procurement@nefco.int:

Go to the website www.securedmail.eu.

Type recipient's email address **procurement@nefco.int** into the field “Send a secure message to a recipient” and click "Send".

Alternatively, you can attach this link to your browser:
https://www.securedmail.eu/message/procurement@nefco.int

A display for composing the secured message opens. Type your own e-mail address in the uppermost field. A delivery confirmation request will be sent to this address to verity your identity.

Type the subject, message and include attachment(s).

You can accept the suggested random password or replace it and enter your own password. The password is delivered automatically to the recipient's mobile phone via SMS.

Click “Send”.

You will receive a confirmation request from the Securedmail server to your e-mail address, and you’ll have to confirm it by clicking a link in the message. **The message will not be sent to the recipient until you have clicked the confirmation!**

In case you do not succeed in sending the proposal though the system, please contact the responsible person at Nefco or procurement@nefco.int or nelly.eriksson@nefco.int for further assistance before the deadline of submission.

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Financial proposal

How to send a secure message to a Securedmail user nelly.eriksson@nefco.int:

Go to the website www.securedmail.eu.

Type recipient's email address **nelly.eriksson@nefco.int** into the field “Send a secure message to a recipient” and click "Send".

Alternatively, you can attach this link to your browser:
https://www.securedmail.eu/message/nelly.eriksson@nefco.int

A display for composing the secured message opens. Type your own e-mail address in the uppermost field. A delivery confirmation request will be sent to this address to verity your identity.

Type the subject, message and include attachment(s).

You can accept the suggested random password or replace it and enter your own password. The password is delivered automatically to the recipient's mobile phone via SMS.

Click “Send”.

You will receive a confirmation request from the Securedmail server to your e-mail address, and you’ll have to confirm it by clicking a link in the message. **The message will not be sent to the recipient until you have clicked the confirmation!**