# REPUBLIC OF TURKEY

## MINISTRY OF ENVIRONMENT AND URBANIZATION (MOEU)

## GENERAL DIRECTORATE OF CONSTRUCTION AFFAIRS (GDCA)

**"Energy Efficiency in Public Buildings Project"**

**Loan No: 9015-TR | Project ID: 162762**

**CONSULTANCY SERVICES FOR**

**ENERGY AUDITS, TECHNICAL DESIGNS AND CONSTRUCTION SUPERVISION SERVICES FOR ENERGY EFFICIENCY RENOVATIONS IN PUBLIC BUILDINGS**

**Reference No:**

**EEPB/WB/MoEU/QCBS-DES&SUP-09**

# TERMS OF REFERENCE

***"For Energy Audit Reports, Detailed Designs and Technical Specifications"***

***Issued on:*** *November 5, 2021*

## I. Introduction

The Ministry of Environment and Urbanization (MoEU) has received financing from the World Bank toward the cost of the Energy Efficiency in Public Buildings Project (EEPBP) and intends to apply part of the proceeds for consulting services.

The project investments will focus primarily on the renovation of central public buildings with high energy consumption and shorter pay-back periods. The proposed project would be implemented through two components: (i) energy efficiency (EE) investments in central government buildings; and (ii) technical assistance (TA) and project implementation support. The General Directorate of Construction Affairs (GDCA) under the MoEU has been delegated to assume overall responsibility for the project. This will include completion of the necessary activities to support project preparation as well as implementation for the six-year project period. In parallel, grant funding has been mobilized from the Clean Technology Fund (CTF) to help analyze the investment needs and potential of the central government buildings.

The GDCA established a project implementation unit (hereinafter called the "Client") to administer all aspects of the project, including selection of the buildings, procurement of the various contractors (e.g. energy audits, technical designs, renovation works, construction supervision, savings verifications, technical assistance or consultancies, etc.), and monitoring.

Through the EEPBP, approximately 500-700 public buildings will be renovated for EE. Investments would include building envelope measures (roofs/wall insulation, windows, doors), heating/cooling systems, water heating, pumps/fans and lighting and some renewable energy (RE) applications (e.g., rooftop solar PV, biomass heating, solar water heating, geothermal heat pumps) to offset the building's electricity/fuel use. A limited amount of funds may be allocated for non-EE/RE measures (e.g., rewiring, minor structural repairs, painting, seismic safety, etc.).

Within the framework of the EEPBP, a consulting firm will be employed to conduct investment grade energy audits, prepare detailed designs and technical specifications of selected public buildings.

## II. Scope of Services

The Consultant will be required to conduct investment grade energy audits for all buildings, prepare the energy performance certificate before the renovations, prepare detailed designs (including architectural, mechanical and electrical designs), and technical specifications, cost estimates and bills of quantities (BoQs) for energy efficiency renovations in public buildings based on energy audit reports. The Consultant shall also identify environmental and social risks associated with the planned renovation works and prepare Environmental and Social Management Plans (ESMPs).

This Terms of Reference covers designs and technical assistance for energy efficiency renovations of selected public buildings in **four (4)** campuses having **275.725,00 m²** total area as listed below in Table 1. The list of buildings given in the annex-1.

**Table 1:** List of the Campuses to be renovated in the scope

| | Name of Campus | Beneficiary Institution | City | Construction Area (m²) |
|---|---|---|---|---|
| 1 | Yıldız Technical University Davutpaşa Campus | Council of Higher Education | Istanbul | 189.480,00 |
| 2 | Boğaziçi University North Campus | Council of Higher Education | Istanbul | 41.154,00 |
| 3 | Boğaziçi University Hisar Campus | Council of Higher Education | Istanbul | 12.817,00 |
| 4 | İstanbul Technical University Ayazağa Campus | Council of Higher Education | Istanbul | 32.274,00 |
| | | | **TOTAL** | **275.725,00** |

Regarding the preparation of the detailed designs and technical specifications, it should be noted that according to the findings in the investment grade audit reports, slight changes may occur in the building list, the number of buildings or locations may be changed with nearby alternatives.

Some of the buildings may be renovated by an energy service company (ESCO) in the form of Energy Performance Contract (EPC) and similarly, one of the building may be selected to be renovated as nearly zero energy building (nZEB).

The possible buildings to be renovated within an Energy Performance Contract and as an nZEB pilot implementation will be determined after according to the energy audit reports prepared by the Consultant.

The total construction area of the buildings to be renovated under EPCs and as nZEB would be limited to less than 10% of the total square meters.

The Consultant will not be required to prepare the detailed designs and technical specifications of the buildings that are removed from the list for Energy Performance Contract (EPC) and nZEB implementations after the energy audit stage. For the buildings implemented under EPCs or as nZEBs, the detailed designs and technical specifications will be developed by an ESCO or another consultant hired by the Client.

## III. Description of the Consultant's Tasks

### *Task 1: Conduct investment grade energy audit report*

The consultant shall conduct investment grade energy audits of public buildings to identify and recommend energy efficiency measures (EEMs) for implementation of energy efficiency (EE) investments according to the audit template provided in the Annex-2. The activities required to conduct investment grade energy audits include, but may not be limited to, the tasks described in the following sections. The work conducted should comply with the principles and processes described in ISO 50002.

MOEU will review all of the completed energy audits after Task 1. It may be determined that some of buildings, limited to less than 10% of the total square meters, may be reclassified as an ESCO or nZEB contract, in which case these buildings will be removed from the technical designs for Task 2. In this case, the contract will be modified. However, for bidding purposes, the bidders are requested to assume that energy audits and technical designs will be required for all buildings on the list.

**1a) Conduct preliminary reviews:** Perform an initial energy use evaluation by reviewing all utility data and building or system diagrams, which can include architectural plans, electrical plans and cuts, electrical board schemes, thermal systems (production and distribution) plans, equipment lists and catalogues, operation and maintenance logs, and other available facility information.

The initial activities under this task include determining the required scope of work, identifying key personnel (including personnel responsible for Operation and Maintenance (O&M) and energy-related issues); and requesting specific information and data. The data to be requested and collected from the building managers should include, but may not be limited to:

- Meteorological data of the site: Monthly ambient temperature and humidity, heating degree days (HDD) and cooling degree days (CDD) for a 3 consecutive year period
- Energy bills for the past three calendar years; all forms of energy should be included in this analysis
- Online billing data
- Building Management System (BMS) history and data
- Building layout drawings and site plans
- Equipment lists for main energy-using equipment
- Process flow diagrams
- Process and instrumentation drawings (P&IDs) for large energy users
- Operational, weather and other data relevant for energy use (occupancy, weather, production data)
- Copies of any previous energy audits, studies or details of known opportunities for energy efficiency
- Details of upcoming organizational changes or other investment plans that are expected to affect energy efficiency or energy use

Review all available facility documentation with site representatives where possible. Review at least three years of energy data and discuss year-to-year variations and seasonal variations in energy use patterns. Calculate the baseline consumption, i.e., the expected energy consumption under current operating conditions, based on the monthly ambient temperature and the historical consumption data for a selected reference period. If national norms for lighting/heating/cooling are not met in the existing status of the building and current baseline does not represent a fair benchmark for energy use of previous years, an adjusted baseline shall be generated so that energy consumption of the building before and after energy efficiency measures are implemented can be accounted in a fair and correct way. The baseline consumption shall be normalized as defined in ISO 50006 and later be revised using data from site assessments.

**1b) Conduct site assessments:** Further investigate the major energy-consuming processes in the facility. At the end of this task, the buildings and systems descriptions and collection of consumption and other relevant data to propose and describe EEMs should be completed. All relevant findings related to the visual inspections, field measurements, and interviews must be included in the energy audit report. The site assessment shall focus on all passive and active systems available on site and will include, but may not be limited to, the following subtasks:

- Conduct visual inspections
- Develop time plan for field visits and measurements
- Conduct field measurements, i.e., electricity measurements of the main consumption points per floor or per main use (e.g., X-rays in hospitals), internal and ambient temperature and humidity per hour during the period of audits
- Conduct field interviews

**1b.1) Conduct visual inspections:** Conduct visual inspections in a walk through to verify the completeness and accuracy of available documentation. This will include, but may not be limited to:

- Construction details of the building envelope (e.g., walls, roof, windows, doors) and related insulation values
- Heating and cooling production systems (e.g., chillers, boilers) and their capacities, rated efficiency, and maintenance status
- Heating, Ventilation and Air Conditioning (HVAC) distribution system capacities, rated efficiency, and maintenance status
- Electrical motors, their end-use, efficiency data, and maintenance status
- Type of control methods and operation schedules
- Interior and exterior lighting systems and related controls
- Service hot water systems, their storage capacity, efficiency, and maintenance status
- Renewable Energy (RE) generation and integration with building systems
- Other relevant energy consumption drivers

Where relevant, the report should include images to present the current state of the facility, possible shortcomings in the construction or in systems maintenance.

**1b.2) Develop a time plan for field visits and measurements:** Define and agree on a time plan for field visits and measurements with the building supervisor, the O&M team and inform the Client accordingly. The time plan may be revised based on the operational conditions and availability of the building depending on the Covid-19 restrictions.

**1b.3) Conduct field measurements:** Perform all necessary on-site measurements to detail the energy baseline and collect data required for identifying EEMs. Install and operate the necessary energy monitoring equipment on-site suitable for the relevant data collection (e.g., data loggers, flue gas meters, temperature and hygrometer sensors, electric/gas meters, air and water flow meters, thermal cameras). If is not possible to measure the actual performance of systems and equipment (e.g., due to temporary malfunction, or out of season audit), performance of the systems and equipment shall be simulated based on theoretical and inspection data.

Field measurements should include, but may not be limited to:

a) Building envelope: Windows, doors and insulation
    - Outside and inside surface temperatures
    - Thermal image for energy loss/gain and surface temperature
    - Insulation layer thickness
    - Glazing details/thickness
b) Heating/cooling production and distribution system
    - Input values like electrical instantaneous and continuous power consumption for electrical based systems (e.g., chillers, fan, pumps)
    - Enthalpy measurements for chillers and boilers
    - Output values like airflow, water flow, air and water temperatures
c) Efficiency of boilers and other heat-generating equipment
    - Flue gas temperature and chemical composition (O2, CO2)
    - Fuel/gas instantaneous consumption
d) Electrical consumption of lighting systems
    - Electrical instantaneous and continuous power consumption for sample circuits
    - Lighting level (lux) in sample representative locations
e) Motors (including fans, pumps) and other plugged systems
    - Electrical instantaneous and continuous power consumption for sample circuits.
f) Other energy consumption systems and equipment.

During the field measurement phase, the client or building personnel should provide the corresponding relevant variables, e.g., operating parameters, production data, occupation data. Additional measuring points, appropriate measuring equipment, associated processes and feasibility of installation may be identified during field measurements.

**1b.4) Conduct field interviews:** Interview key stakeholders (e.g., building manager, O&M staff, and users) to assess O&M routines, potential changes in user patterns (e.g., number of users or changes in user behavior), and comfort levels (e.g. indoor temperature, air quality, lighting levels) and to collect/confirm other relevant information. Interviews shall consider data collected during the previous tasks and aim at obtaining relevant information to explain seasonal and year-to-year changes in historical energy consumption, identifying current energy management practices and improvement potential, and identifying the feasibility of potential EEMs.

**1c) Data analysis:** Revise the baseline energy consumption using data collected in previous tasks. If national norms for lighting/heating/cooling are not met in the existing status of the building and current baseline does not represent a fair benchmark for energy use of previous years, an adjusted baseline shall be generated so that energy consumption of the building before and after energy efficiency measures are implemented can be accounted in a fair and correct way. Identify EEMs and their investment costs, energy savings, and cost benefit. Develop scenarios for different combinations of EEMs with consideration of cross-effects between different EEMs. The audit report should document methodology, assumptions, and supporting calculations. This task will include, but may not be limited to, the following subtasks:

1) Describe audit scope
2) Review energy baseline and conduct EEM calculations
3) Determine investment costs
4) Establish different investment scenarios
5) Conduct financial analysis
6) Determine energy performance class

**1c.1) Describe audit scope:** Describe buildings and systems analyzed in the energy audit (e.g., areas/buildings covered, building envelope, heating/cooling, lighting and RE, alternatives to fossil fuel-based heating).

**1c.2) Review energy baseline and conduct EEM calculations:** Review the preliminary assessment of the energy consumption baseline using data collected in the previous tasks, including:

a) Use measurement data to explain the consumption behavior of the main users and refine the energy consumption baseline.
b) Compare energy consumption with specific energy use values of similar buildings if available (local and international experience)
c) Identify Best Available Techniques (BAT) at international level
d) Study the historical pattern of energy performance and establish relationships between energy performance and the relevant variables (e.g., heating/cooling degree days, occupation)
e) Assess existing energy performance indicators, e.g., kWh/m2, kWh/occupant, kWh/bed, and additional energy performance indicators, e.g., kWh/HDD or CDD

If there is insufficient quality data for setting up the baseline, dependencies and correlations between historical data, field data and other variables (e.g. weather-related variables, occupancy, events, documented equipment malfunctions, etc) should be used to establish a suitable baseline. If national norms for lighting/heating/cooling are not met in the existing status of the building and current baseline does not represent a fair benchmark for energy use of previous years, an adjusted baseline shall be generated so that energy consumption of the building before and after energy efficiency measures are implemented can be accounted in a fair and correct way. This process has to be documented in the report.

The field measurements and the catalogue/historical data must be used for the calculation to simulate the future energy performance with the proposed EEMs. If deemed necessary by the Consultant, several software tools may be used for baseline and EEM simulation calculation (not exhaustive): *Trace* for life cycle analysis; *Energy Plus*, *IESV* or *Carrier HAP* for energy modelling. Software tools to be used to simulate the level of service and envelope requirements may include: *Dialux* for lighting levels; *TS 825 Heat Insulation Standard* for insulation requirements.

EEMs shall be developed based on the specific building analysis, but typical measures that should be considered include:

- New or improved building envelope insulation
- Renewal of window and doors
- Heating boiler renewal
- Boiler burner adjustment
- Boiler waste heat recovery integration

- Renovation of cooling/chiller systems
- Variable speed circulation pumps and fans
- Piping and duct insulation
- Thermostatic valve usage in heating/cooling circuit
- Lighting ballast type renewal
- LED lighting systems
- Movement sensor integration to lighting systems
- Building automation systems
- Energy monitoring system
- Upgrade of electric motors with high-efficiency models
- Cogeneration/Trigeneration
- Photovoltaic (PV) systems
- Solar water heating (SWH)
- Biomass or other alternatives to fossil fuel-based energy
- Heat pumps

In all cases, the main energy-consuming vectors have to be addressed in the EEM proposal. The RE generation should be carefully detailed, with simulation production, grid connection point and relevant construction requirements, if any. No-cost measures, e.g., energy management and O&M, shall be stated but not included in the financial analysis.

The indirect effects of the EEM implementation have to be considered:

- Repairs or operational changes required for the EEM to be effective
- Impact on O&M procedures and cost
- Impacts on occupant health, comfort or safety, as well as non-energy benefits, especially improvements to health, safety and environment, changes in equipment run time, and maintenance labor hours
- Commissioning requirement

**1c.3) Determine investment costs:** Accurate investment cost need to be determined for the financial analysis by gathering equipment, installation and construction costs from a sample of vendors and contractors. Costs should include any specific considerations for the particular facility and all indirect costs needed for implementation (e.g., dismantling, transport, scrapping, recycling, scaffolding, pipe accessories, civil construction works, electrical connections, changes in electrical boards). O&M costs, commissioning, and reinvestment cost have to be included in the financial analysis.

**1c.4) Establish different investment scenarios:** Three different scenarios of combination of EEMs shall be presented in the audit report:

a) Base scenario with EEMs that save a minimum of 20%[*] of the baseline consumption and a payback period shorter than 12 years for the combination of EEMs

b) Deep renovation scenario with EEMs that save a minimum of 30%[*] of the baseline consumption and a payback period shorter than 20 years for the combination of EEMs

c) Recommended package of EEMs, which could be a selection of EEMs from the base and deep renovation scenario

[*] Primary energy efficiency improvement percentage may be used for calculating overall energy efficiency calculation of the deep renovation scenario in case on-site electricity production measures are proposed such as cogeneration/trigeneration, etc.)

All EEMs that were considered but not included in any of the scenarios should also be presented in the report.

The scenario construction will depend on the specific circumstances, but some general guidance can be provided in the next paragraphs and in the table below:

a) The base scenario should include retrofitting the insulation and fenestration according to the TS 825 Heat Insulation Standard, basic building-level energy metering, and other EEMs with shorter payback periods.

b) The deep renovation scenario should always include additional insulation and window/door upgrade, include upgrades of EEMs from the base scenario, and include additional EEMs not included in the base scenario. The payback period for the building envelop measure can be longer than 20 years, but the individual payback periods for all other EEMs should be shorter than 20 years.

c) The recommended package can comprise a combination of EEMs from the base or deep renovation scenario but should not include (i) EEMs with payback periods longer than 20 years except for the building envelope measure and (ii) EEMs with payback periods longer than the lifetime of the equipment.

**Table 2:** General guidance on scenario construction

| Existing situation | Base Scenario | Deep Scenario |
|---|---|---|
| Insulation/fenestration not standard | Insulation/fenestration as in TS 825 Heat Insulation Standard | Insulation/fenestration better than TS 825 Heat Insulation Standard |
| Insulation/fenestration as in TS 825 Heat Insulation Standard | - | Insulation/fenestration better than TS 825 Heat Insulation Standard |
| EFFE1 or EFF2 motors | IE3 motors | IE4 motors |
| EFFE1 or EFF2 motors | IE3 motors | Variable Frequency Drive (VFD) with IE3 motors |
| Conventional Boiler | Condensation Boiler | Heat pump or biomass boiler |
| Air-Cooled Chillers | New Air-Cooled Chillers | New Air-Cooled Chillers with VFD |
| Water-Cooled Chillers | New Water-Cooled Chillers with heat recovery | New Water-Cooled Chillers with VFD compressors |
| Stand Alone Split System | New Inverter stand-alone Split System | New Volume Refrigerant Variable centralized system |
| Old Air Handling Units (AHU) | - | New AHU with heat recovery and VFD |
| - | PV Generation with shorter payback (e.g. on the roof) | PV Generation with longer payback (e.g. on a carpark) |
| - | Basic energy monitoring | Full BMS system |
| - | Cogen/Trigeneration with Shorter Payback (e.g. small packaged without chilled water production) | Cogen/Trigeneration with Longer Payback (e.g. full cogen with Abortion chiller) |
| - | Solar Water Heating (e.g. small system with natural convection) | Solar Water Heating (e.g. pump system with storage) |

| Existing situation | Base Scenario | Deep Scenario |
|---|---|---|
| - | Insulation of Fittings, Valves, Piping | - |
| - | Application of Outdoor Air Compensation to Controlling of Boiler | - |
| - | Replacement of Circulation Pumps | Circulation Pumps with VFD pressure controlled |
| - | Application of Motorized Two-Way Valve | - |
| - | Replacement of conventional Luminaires for LED | Replacement of conventional Luminaires for LED and motion automated system |
| - | Efficient belts for fan motors | - |

Some EEMs presented in base, deep, and recommended scenario need to be recalculated for each scenario due to the cross effects that may arise (e.g., piping insulation savings will decrease with better envelope insulation).

A basic energy monitoring system should be included in all scenarios, i.e., building-level energy meters, or submeters that can be aggregated to provide building-level energy use data (electricity, natural gas, fuel oil, propane, etc.). Utility-owned meters capable of aggregating base building-level resource use are acceptable. The basic system can be standalone, i.e., without automated report capabilities or software aggregation.

**1c.5) Conduct financial analysis:** Each measure and scenario must include a Cost-Benefit Analysis with the calculation of energy cost savings, simple payback period, NPV and IRR over a 20-year period. The financial analysis must be presented in TRY. (The USD/TRY exchange rate will be fixed for each audit for converting the cost of imported equipment/goods into TRY currency.) If the net life of the measure is lower than the NPV timeframe, re-investment costs need to be included in the analysis. O&M costs and other indirect related costs should be included in the analysis. Investments are made in year 0 (or when re-investments take place) and the savings will start in year 1. Details of the financial analysis are laid out in the audit report template in Annex 2.

**1c.6) Determine the energy performance class:** Determine the energy performance class of the building in the current state by issuing an Energy Performance Certificate (EPC-EKB) so that it can be compared to the performance class after renovation (issuance of an actual energy performance certificate is not required for the building in the current state if the building already has an EPC (EKB) issued by the most recent version of national EPC software, BEP-TR2). The performance class to be achieved has to be calculated using the recommended measures list. Preliminary Calculation Result Report (Ön Hesap Sonuç Raporu) has to be obtained for the building to be achieved with proposed energy efficiency measures by using most recent version of national EPC software, BEP-TR2. In any case, the proposed scenario must achieve at least an Energy Performance Class (EKB) B. After energy efficiency measures are implemented on site and construction works are finalized, a new EPC (EKB) shall be issued for the upgraded form of the building.

**1d) Applications based on green and innovative technologies to enable the behavioral change that support the implementation of energy efficiency measures:**

Meeting the energy efficiency goals will require significant efforts to change consumer and user behaviors. Strategies and targets need to be in line with the motivations of individual building users and owners, and actions need to be easily integrated into daily behaviors to be effective. Changing this daily behaviors is a major challenge, requiring training and awareness activities, as well as feedback measures and incentives to trigger long-term change.

The Consultant shall develop innovative and green solutions derived from the energy efficiency measures applied in the buildings such as; PV powered mobile device and electric vehicle charging station, occupant information screens that shows the current energy consumption data of the building, etc. that can help awareness raising towards energy consumption and have high impact on user behaviors. The proposed innovative visibility technologies shall be building specific and have an impact assessment for each proposal. Additionally, the estimated cost for the proposed innovative technologic solutions shall be calculated and provided in a separate table other than the table prepared for energy efficiency measures.

**1e) Final audit reports:** The report should follow the audit report template given in Annex 2. Changes to the report structure have to be authorized by the Client. The audit report should be prepared both in English and Turkish concise and clearly written; capture all calculations, analyses and assumptions; and discuss difficulties encountered in data collection and field work.

Revisions shall be made by the Consultant, in calculations or other documents in case of any discrepancy or mistake recognized during the Construction Phase. Any problems related to the eligibility of audit reports are binding for the Consultant regardless of when the problem occurs.

**The Consultant cannot proceed to Task, 2 until the detailed audits had been reviewed by the MoEU, the scenarios and package of EE measures agreed and building candidates for EPCs/NZEBs agreed.**

**Deliverables**

1) Investment Grade Energy Audit Report
2) Preliminary Calculation Result Report (Ön Hesap Sonuç Raporu) of the energy performance class (EKB)

***Task 2: Prepare detailed renovation designs and technical specifications (including BoQs and cost estimates)***

**2a) Provide field investigations and all the architectural and engineering design services for preliminary design stage in compliance with energy audit reports:** The Consultant shall conduct site visits and prepare existing building survey drawings /plans reflecting existing situation of selected buildings including actual measures of windows, entrance doors, building envelope, and unheated areas – building roof and basement; detailed description of windows, doors, external walls, and materials of which buildings are made.

The Consultants shall propose detailed temporary measures to be taken during the construction (retrofitting and other studies) and phasing plans in order to minimize disruption of the public services in the buildings and submit a Preliminary Design Stage

Report, indicating the existing situation and supported with the photos and descriptive captions of all building elements and systems, indicating their findings and designs with respect to the services outlined above, for the approval of the Beneficiary and the Client. In terms of the applicability of energy efficiency measures, the report should contain information on the status of the building's existing structural system.

**2b) Prepare detailed renovation designs and technical specifications (including BoQs and cost estimates)**: The technical designs and all tender documents for the construction tender shall be prepared based on the approved energy audit reports and a cost-benefit analysis, using clear energy savings indicators, which then should be monitored and verified upon project completion.

Following the approval of the Preliminary Design Stage Report and the agreement between the Client and the beneficiaries on the EE/RE measures to be included, the Consultant shall prepare the detailed renovation designs and technical specifications for works to be tendered and implemented in the selected public buildings of the buildings. After agreement between the Client and the beneficiaries on the EE/RE measures to be included, the Consultant will prepare detailed renovation designs and technical specifications for works to be tendered and implemented in the selected public buildings. Detailed renovations should include architectural (including comparative drawings clearly showing the revisions/differences/interventions before and after renovation) and engineering services (all mechanical and electrical services, including but not limited to: heating, cooling, ventilation, hot and cold water supply systems, fire protection, electrical supply system, lighting system, gas distribution, power and service sockets, telephone/television/radio, lifts, building management/automation system (if any) etc.) related with renovation and collateral works.

Renovation designs and general and specific technical specifications for all the renovation works shall be prepared in accordance with MoEU's "Construction Works, Civil, Mechanical Works and Electrical Works General Specifications". However, if no proposed interventions are being considered for a particular area (e.g., no lighting or other electrical measures), detailed (e.g., electrical) drawings may not be required.

In case a solar PV installation measure exists in the finally approved EEM list, Consultant shall organize and coordinate the whole Call Letter process (GES Çağrı Mektubu) with the beneficiary and/or building owner institution, electricity distribution grid operator company and/or Turkish Electricity Distribution Grid Operator (TEDAŞ). Consultant shall receive Call Letter at the end of the formal application process. All formal application tax, duties and costs shall be born by the Consultant.

In case a cogeneration /trigeneration measure exists in the finally approved EEM list, Consultant shall carry out the mechanical/electrical design process by keeping in mind that these systems will need an approval from relevant central and regional energy authorities (Ministry of Energy and Natural Resources, Turkish Electricity Distribution Grid Operator (TEDAŞ) or Turkish Electromechanic Industries Co. (TEMSAN)) and regional environment authorities (Environmental Impact Assessment Exemption, etc.). Hence, all provisional design and calculations shall be made based on not only the building's electrical/thermal loads but also the capacity and availability of the connected transformer of local electrical grid, the regional grid operator's feedbacks/opinions.

Design drawings should be presented in such a way that:

- The drawings can easily be understood
- They visually communicate the concept to the beneficiary and the construction

contractor

- They clearly show the renovation interventions before and after renovation so the beneficiary and construction contractor can easily understand what sections/areas/systems/components are to be renovated
- Clear and understandable "General Notes" and "Project Specific/Key Notes" should be embedded in the design plans/drawings so that the beneficiary and construction contractor can easily understand what to be done at which areas/sections/systems/components
- Scope of demolition work and new work shall be clearly identified on the drawings
- They are legible
- All information from previous revisions and updates are included.
- No details will be provided in the areas not subject to any intervention.

The design drawings should include the following aspects:

- Site layout for each building (within the campus, considering the scope of buildings and any other works (if applicable) required outside the buildings.
- Plan views (focusing on the areas related with the renovation works) and system cross-sections and details as necessary from the points of renovation
- Elevations showing scope of demolition and new works. Demolition drawings, plans, section and details as necessary

There will be three sets of technical drawings and details in 1/50 scale, and details including system details (for interventions 1/20, 1/5 scales, 1/1 scale if needed), which have to be compliant with the applicable in force regulations:

(i) **Architectural drawings:** Site layout, floor plans/construction plans with all partition types and details provided for the areas subject to intervention, lighting plan for ceilings, System cross-sections from the points of renovation.

(ii) **Mechanical drawings** (in conformity with the heating zone where the building is located): The mechanical installation drawings should include the components recommended to be replaced by the energy audit. Heating, cooling, ventilation and sanitary plumbing projects and system drawings specific to each project should be prepared according to the obtained energy audit reports in conformity with electrical and architectural designs. Heat insulation calculations and reports should be prepared according to TS 825 Standard.

(iii) **Electrical drawings:** The electrical installation drawings should include the components recommended to be replaced by the energy audit. MV distribution, transformer, generator, UPS, lighting, socket (mains and UPS), mechanical and force distribution, cable transportation, earthing and lightning protection, elevator, table loading tables, strong current column diagram and calculations (lighting, heating, short circuit, voltage drop). Energy efficiency comparisons (comparison of current and new status) should be shown in the corresponding plans. Necessary infrastructure plans should be prepared for the remote monitoring of energy consumption.

(iv) **Structural drawings:** Structural plans, sections and details along with structural calculations based on relevant in force codes/regulations for the works to be done independent of the existing structure (i.e. open parking lot canopies, canopy rooftop PV systems, etc.) Superposition plan of new components and existing structures (i.e.

frame systems supporting rooftop PV system, solar hot water collectors, etc.) Structural design and calculation reports of newly added systems/components in compliance with in force codes/regulations (i.e. structural calculations and reports of the frames supporting the PV panels, solar hot-water collectors, etc.) Structural calculation reports and checks which will verify that the existing structure will be able to safely support the newly added systems (i.e. verification report of the roof being able to safely bear rooftop PV systems, solar hot water collectors, etc.) Seismic calculation and design of the restraints of cogeneration/trigeneration systems and suspended piping network if applicable.

The Compliance of renovation designs with standards and regulations in force in Turkey shall be certified by the Consultant. The specifications shall be prepared in accordance with the Building Code, current By-law Concerning Construction in Planned Areas, By-Law on Building Energy Performance and related Turkish legislation and standards.

Company should also propose measures to be taken in order to meet the national norms, standards and legislations about additional aspects (e.g., indoor air quality, humidity, comfort levels, fire protection measures).

Regarding hospitals, if the Health of Ministry or hospital administrations' request COVID-19 measures for any of its buildings in list, mechanical drawings should include measures to be taken such as modifications in filters or mechanical installations for COVID-19 patient rooms.

The draft renovation design must be submitted to the beneficiary for formal consent, and to any required third parties for review and certification. Any comments provided by the beneficiary, third party auditor or the Client must be taken into account before the designs are finalized.

Within the scope of preparation of technical specifications, Consultant shall;

- Submit final Bill of Quantities (BoQ), all related design calculations, and relevant final cost comparison analysis. Prepare BoQ's in compliance with unit price guidelines of MoEU or other relevant state authorities or market prices. BoQ's prepared by the Consultant should be in compliance with pricing preambles, technical specifications and other relevant parts of the documents to be prepared for tender process. The BoQs and related cost estimation tables shall be prepared by using an accurate and easy-to-use cost estimating software that is approved by the Client.
- As specified above, for the Preliminary Design and Detailed Renovation Design Stage specified above, the Technical Specifications, Bills of Quantities, final designs, system/detailed drawings shall be prepared and submitted to the Client for approval, following the decision of the Client on which parts of these works shall be integrated to the relevant parts of the tender documents.
- The Consultants shall prepare all the deliverables in close cooperation with the Client and with due care and diligence. Any of the items in these documents shall not contradict with each other and all material specifications shall be in accordance with the specifications of the first quality materials satisfying the Turkish Standards, or otherwise international standards.

The Consultant, before finalizing and submitting the technical designs and tender documents to the Client, shall present the detailed renovation designs of the buildings to the beneficiary (and their user/occupant committees) for their approval considering their needs and the function of the building. The Consultants shall submit a letter countersigned by the principal and/or directorates of the relevant public buildings and the Consultant's representative indicating that the principal and/or directorate is informed about and agreed on the Final

Architectural, Structural, Mechanical and Electrical works subject to tendering following the decision of the Client on the works approved to be integrated to the relevant parts of the tender documents.

Revisions shall be made by the Consultant, in drawings or other documents in case of any discrepancy or mistake recognized during the Construction Phase.

**2c) Visual presentation file of renovation designs and works:**

Visual presentation file including:

- Posters, leaflets with 3D images that is prepared to give information and to raise awareness about the energy efficiency measures implemented in the building, and the benefits of these applications.
- Graphic representation of the design steps that shifts the energy performance of a standard building to an efficient energy use class.

The graphic designs of the presentation visuals will be subject to the Client approval before printing. All visual materials shall include the logo and the names of the Client and the project, the template of which will be provided by the Client. The posters will be presented especially in the areas/sections where innovative and green applications are implemented. The number of the leaflets to be printed and distributed will be up to 500-1000 for each building complex according to the number of the building users and visitors to be distributed.

**2d) Prepare Synthesis Report**

The Consultant shall submit a synthesis report after completion of all final designs and relevant tender documents. The report shall at least cover;

- An executive summary indicating overall information regarding the scope of the services, amendments, final decisions, energy efficiency measurements and methodologies indicating comparison of energy consumption before and after renovation works,
- An overall Report that brings together in one place all the information used to produce the Consultant's recommendations for renovation works of the buildings assessed in the project. The report shall only cover the methodologies, summary of processes, brief of the recommendations and summary of findings.
- Building executive summary reports for each public building under the scope of the Consultant.
- In addition, the Consultant shall provide a full risk assessment, performance indicators and an implementation strategy for the Construction process, to be used by the Client.

**2e) Prepare Measurement and Verification (M&V) Plans**

- M&V Plan that explain how to verify savings for each Energy Efficiency Measure, how to adjust the Reference Energy Consumption (or baseline) by using the data of the building, with methods and calculation details. The plan will include the verification method of savings, important measures to be taken, the timing of these activities, the duties and responsibilities of the parties and how to ensure quality

assurance for this process.

**Deliverables**

2a) Preliminary Design Stage Report

2b) Detailed renovation designs, technical specifications (including BoQs and cost estimates)

2c) Visual presentation file of renovation designs and works

2d) Synthesis Report

2e) M&V Plans

***Task 3: Identify environmental and social risks and prepare Environmental and Social Management Plans (ESMPs)***

**3a) Identify environmental and social risks associated with the building renovations:** Identify environmental and social risks associated with the building renovation, including identifying presence and quantity of any hazardous materials (specifically asbestos and mercury containing light-bulbs) that would have to be removed as part of the renovation works.

**3b) Prepare site specific Environmental and Social Management Plans (ESMPs):** Prepare site-specific Environmental and Social Management Plans (ESMPs) in line with the Environmental and Social Management Framework (ESMF) developed for the Project and submit them to the Client to be finalized and integrated into construction contractor bidding documents. The ESMF of the project entails an ESMP format, which shall be deployed in development of ESMPs for renovation activities. In addition, the consultant shall update ESMPs during implementation/construction in consultation with the construction contractors, during construction, if required. The ESMPs shall include specifications and bill of quantities for removal, packaging, transport and disposal/interim storage of hazardous materials, personal safety equipment, monitoring requirements (the Environmental Mitigation and Monitoring Measures based on the Environmental and Social Management Framework) and estimate of costs for the measures. This will also include the location where the asbestos can be disposed and the interim storage location for the mercury containing lightbulbs as per ESMF and Turkey legislation. The Consultants shall also liaise with MoEU in order to finalize the ESMPs with World Bank's approval and help MoEU organize disclosure and consultation for the ESMPs with the public, stakeholders who might be affected from the renovations.

Each of the ESMPs will be made publicly available on MoEU's website and the physical copies will be accessible by the public at the offices in the construction yard during the construction activities. In this manner, all stakeholders will have full access to the ESMPs which provides information regarding the potential environmental and social impacts and the details of the mitigation measures to be taken. The Consultant will make sure that both site specific ESMPs will be publicly available at the construction sites, and easily accessible places within the local area.

**Deliverables**

3) ESMP for each building site (including environmental and social risks assessment covering each building site)

## IV. Submission Requirements for Deliverable

The deliverables for each task will be submitted to and approved by the Client. The Consultant must obtain approval for each deliverable before moving to subsequent tasks. The table below summarizes the deliverables and includes an indicative timeline and payment schedule.

| **Task** | **Deliverable** | | **Deadline** (calendar days after effectiveness of the contract ) |
|---|---|---|---|
| 1 | Investment Grade Energy Audit Report | | 120 days |
| | 1a | Preliminary reviews | |
| | 1b | Site assessments | |
| | 1c | Data analysis<br>Preliminary Calculation Result Report (Ön Hesap Sonuç Raporu) of the energy performance class (EKB) | |
| | 1d | Report on applications based on green and innovative technologies including impact assessment and cost estimate | |
| | 1e | Final audit report | |
| 2 | Detailed renovation designs, technical specifications (including BoQs and cost estimates) | | 200 days |
| | 2a | Preliminary Design Report | |
| | 2b | Detailed renovation designs, technical specifications (including BoQs and cost estimates) | |
| | 2c | Visual presentation file from designed renovation works | |
| | 2d | Final Synthesis Report | |
| | 2e | M&V Plans | |
| 3 | Environmental and Social Management Plans (ESMPs) | | 180 days |

**<u>Submission Requirements</u>**

All the documents and deliverables for Task 1 and Task 2d need to be prepared both in English and Turkish languages. The deliverables for Task 2 (2a, 2b, 2c) and Task 3 will be in Turkish. For Task 2 three or four of the buildings' detailed designs may be requested also in English. Approved detailed designs and technical specifications shall be delivered as one

hard copy (signed and stamped) and three DVD soft copies (including drawings in PDF and AutoCAD format).

- Format of Reports : A4 or A3 including where appropriate drawings reduced to A3 size
- Format of Drawings : A1 size (unless otherwise required or agreed)
- Scale of Drawings : To be agreed with the Client.
- Format of Posters : A0, A1 and A2 size
- Format of Leaflets : A4 size (500-1000 copies will be printed for each building complex)

The Consultant shall upload all the deliverables into the online platform which the Client addresses and submit also the electronic copy (one external hard disc) of the all the above deliverables in addition to hard copies. The metric system of weights and measures shall be used. The drawings shall be submitted in the format, labeling, grouping and details as required by the Client. The plot size, parcel, map sheet for all buildings shall be listed and integrated into the drawings and other required documents.

In addition to the above numbers, the Consultants shall submit a set of reproducible copy of Final Design Drawings and visual presentation, leaflets, posters file including 3D images from the points where innovative energy renovation applications are made.

As indicated in the General Conditions of Contract all the drawings, reports, plans, specifications, and any other documents produced under this Contract are the property of the Client and therefore the Consultants shall also submit all the originals of the drawings and the other documents in required format.

## V. Facilities provided by the consultant

The Consultant is responsible for the establishment of an audit and design group who are experienced in the preparation of architectural, structural, electrical, mechanical, designs relevant with the renovation works for EE/RE. This group shall be a complete team including project management, structural engineering, architecture, mechanical and electrical engineering and cost estimating, benefit-cost analyzing to support the development of tendering documents. Therefore, the Consultants shall separately indicate the staff to be assigned in the preparation of designs and documents by indicating positions planned to be assigned for each staff.

The Consultant must ensure that its professional staff has adequate support and equipment. All costs for equipment and administrative and logistic support must be covered by the Consultant and included in the bid price, including:

- All costs arising from the activities of its staff during the contract period, including accommodation, allowances, transportation, insurance, etc.
- Automotive, equipment, office supplies and hardware and software to ensure that the monitoring is fully functional;
- All communication costs, including fax, email, telephone, etc.
- All the equipment, instruments, services and logistical support required for the implementation of the contract, and any costs incurred during its preparation of documents and drafts, copying, printing, etc.

- Technical equipment at the monitoring site;
- Other equipment, instruments, services and logistical support necessary for the implementation of the contract.
- Excellent written and spoken English and Turkish is required. If the Consultant will require a translation services, it will be at his own expenses and the Consultant will be responsible for the accuracy of the translation.
- Translation whenever required by the Client regarding the project documents (contract, specifications, reports etc.)
- Preparation of the minutes of all the meetings both in English and Turkish and shall be submitted to the Client within a week after the meeting.
- The Consultant is required to obtain all the necessary permits, approvals, payment of all fees and contributions, as well as all the other elements necessary for the work of his professional staff who is engaged at his own expense for the performance of this Contract.
- All expatriate staff who will work in Turkey should obtain a work permit and all who are resident for more than 90 days should obtain a non-resident visa. The consultant will obtain all required permits, visas for all expatriate staff at his own cost. Furthermore, the Consultant will be responsible to ensure that all proposed personnel are eligible to obtain such permits and visas. The information related to visas can be obtained from the embassies and consulates of Turkey. The Client will assist the consultant for the issue of work permits.

## VI. Timeline

This assignment will be held in the 2nd quarter of 2022 and finalized in 7 months period.

## VII. Support to be provided by the client to the consultants

- The Client provides the existing inputs, project data, reports etc. about the buildings with the RFP. The consultants shall verify the provided inputs during the field studies and in all cases; the assignment shall be undertaken according to the consultant's own inputs.
- The Client will sign letters with the beneficiary buildings that describe the responsibilities of the beneficiary, including appointing a contact/facility coordinator for all project phases, facilitating access to buildings or facilities, providing existing documentation, etc.

## VIII. Team Composition and Qualification Requirements for the Key Staff

The Consultant shall provide an experienced energy efficiency auditing and design team with proven technical and managerial competence and experience.

### i) Consultant Profile:

The Consultant should have similar previous experience in energy efficiency auditing and design services.

The attention of interested Consultants is drawn to Section III, paragraphs, 3.14, 3.16, and 3.17 of the World Bank's "Procurement Regulations for IPF Borrowers" July 2016, as amended, setting forth the World Bank's policy on conflict of interest.

Consultants may associate with other firms to enhance their qualifications, but should indicate clearly whether the association is in the form of a joint venture and/or a sub-consultancy. In the case of a joint venture, all the partners in the joint venture shall be jointly and severally liable for the entire contract, if selected.

### ii) Team Composition

The working language of the project is English. All the team members assigned by the Consultant must possess proficiency in English language. Day-to-day communication language will be Turkish or English at the field level to ensure smooth communication among all participants, direct and indirect, of the Project.

All key staff and support staff shall be mobilized immediately after the contract signature. In addition, support staff for the administrative services shall be proposed additionally as required (surveyors, clerks, drivers, secretary etc.)

**Key staff's qualifications shall include but not limited to the following:**

| Services | Position (Min. *Number of Staff Required*) | Required Experience |
|---|---|---|
| Management of Phase I | Team Leader (1): | Architect, Civil, Electrical or Mechanical Engineer with minimum fifteen (15) years of professional experience, includes at least ten (10) years' energy efficient building design experience in public buildings and five (5) years working experience in manager position. |
| Development of Energy Audit Reports (Phase I) | Mechanical Engineer (1): | Mechanical Engineer having ten (10) years of professional experience including five (5) years' energy audit experience in public buildings. Energy manager or audit-project certification given by Ministry of Energy and Natural Resources is mandatory. |
| | Electrical Engineer (1): | Electrical Engineer having ten (10) years of professional experience including five (5) years' energy audit experience in public buildings. Energy manager or audit-project certification given by Ministry of Energy and Natural Resources is mandatory. |
| | Architect (1): | Architect with minimum five (5) years of professional experience including at least three (3) years' energy efficient building design experience in public buildings. |
| | Structural Engineer (1): | Civil Engineer with minimum ten (10) years of professional experience including at least five (5) years' structural design experience in superstructures. |
| Development of Detailed Designs and Technical | Design Architect (2): | Architects with minimum five (5) years of professional experience including at least three (3) years' energy efficient building design experience in public buildings. |
| | Mechanical Engineer (2): | Mechanical Engineer having ten (10) years of professional experience including five (5) years' energy efficient building design experience in public buildings |

| | | |
|---|---|---|
| | Electrical Engineer (2): | Electrical Engineer having ten (10) years of professional experience including five (5) years' energy efficient building design experience in public buildings |
| | Structural Engineer (1): | Civil Engineer with minimum ten (10) years of professional experience including at least five (5) years' structural design experience in superstructures. |
| | Environmental and Social Specialist (1): | University degree in engineering with minimum five (5) years of professional experience including at least three (3) years' experience in environmental and social impact/risk assessment, preparation of environmental and social assessment tools (Environmental and Social Management Plan (ESMP), Environmental and Social Impact Assessment (ESIA), etc.) and knowledge in environmental and social safeguard policies and Environmental and Social Standards (ESSs) of the World Bank's Environmental and Social Framework (ESF) or other international development institutions.in public buildings |
| | Cost and Planning Engineer (1): | University degree in engineering with minimum five (5) years of professional experience including at least two (2) years' specific experience on development of project specifications, time schedules and budgets in public buildings. |

## Annex 1: Building List

## Annex 2: Audit Template

# ANNEX-1: BUILDING LIST

Yıldız Teknik Üniversitesi Davutpaşa Kampüsü


| No | YTÜ Davutpaşa Kampüsü Binaları | İnşaat Alanı (m²) |
|---|---|---|
| 1 | Elektrik Elektronik Fakültesi | 35.073,00 |
| 2 | Fen Edebiyat Fakültesi | 27.910,00 |
| 3 | Kimya Metalürji Fakültesi | 30.738,00 |
| 4 | Kütüphane Binası | 5.667,00 |
| 5 | İnşaat Fakültesi | 38.897,00 |
| 6 | Kapalı Spor Salonu | 3.066,00 |
| 7 | Kapalı Yüzme Havuzu | 3.937,00 |
| 8 | İktisadi ve İdari Bilimler Fakültesi | 18.820,00 |
| 9 | Yemekhane | 6.918,00 |
| 10 | Kız Yurdu | 2.564,00 |
| 11 | Eğitim Fakültesi | 15.890,00 |
| | **Toplam Alan (m²)** | **189.480,00** |

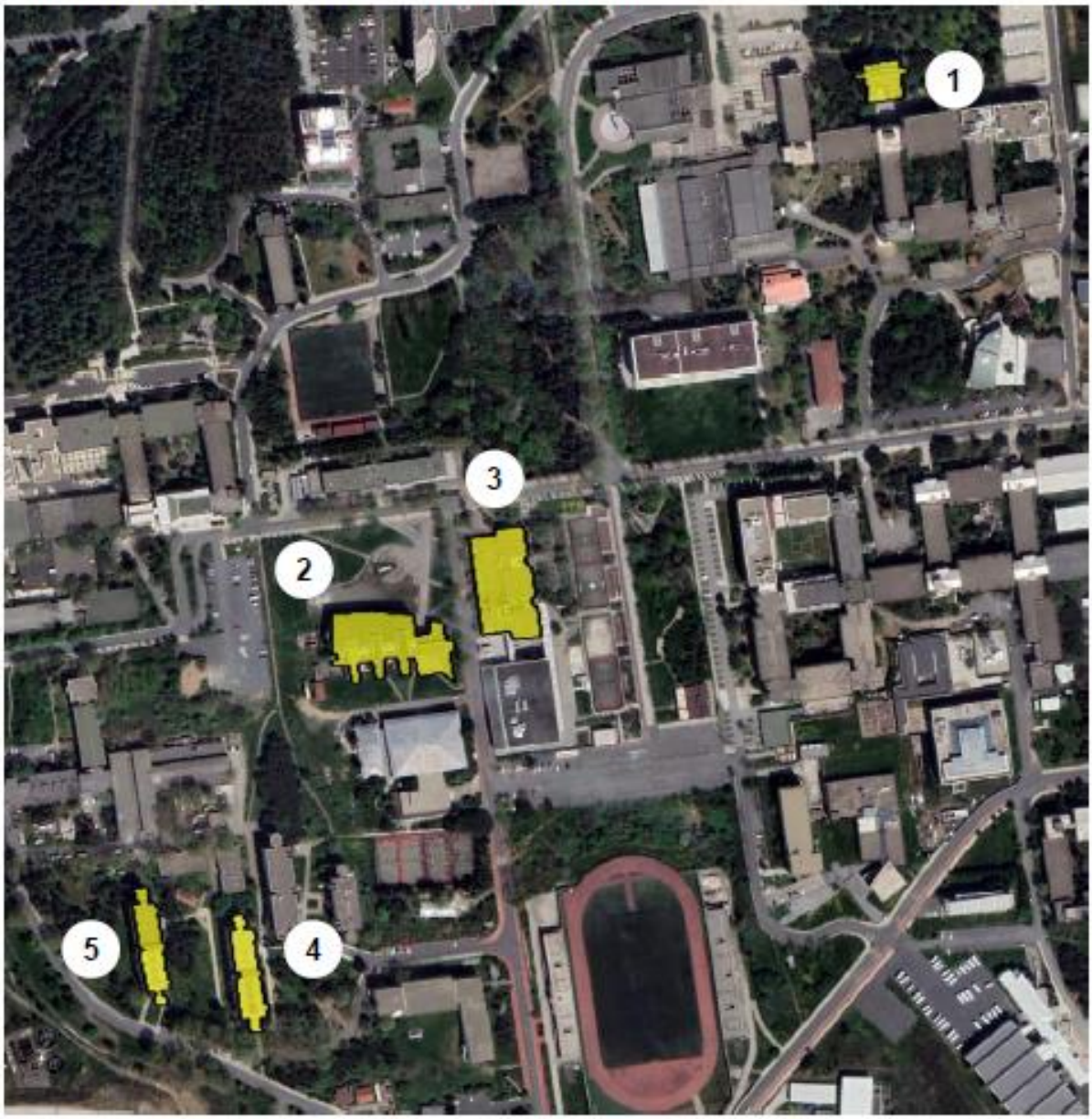
## Boğaziçi Üniversitesi Kuzey Kampüsü


| No | Boğaziçi Üniversitesi Kuzey Kampüsü Binaları | İnşaat Alanı (m²) |
|---|---|---|
| 1 | Kütüphane Ek Binası | 3.920,00 |
| 2 | Bilgisayar Mühendisliği | 3.445,00 |
| 3 | Eğitim Fakültesi | 5.471,00 |
| 4 | Eğitim Teknolojisi B Blok | 4.306,00 |
| 5 | Yeni Derslik Binası | 9.921,00 |
| 6 | 4. Kuzey Yurdu | 7.407,00 |
| 7 | 3. Kuzey Yurdu | 6.684,00 |
| | **Toplam Alan (m²)** | **41.154,00** |

## Boğaziçi Üniversitesi Hisar Kampüsü


| *No* | Boğaziçi Üniversitesi<br>Hisar Kampüsü Binaları | İnşaat Alanı (m²) |
|---|---|---|
| *1* | Hisar Blokları (A-B-C-D-E) | 9.664,00 |
| *2* | Kapalı Spor Salonu ve Yüzme Havuzu | 3.153,00 |
| | **Toplam Alan (m²)** | **12.817,00** |

## İstanbul Teknik Üniversitesi Ayazağa Kampüsü




| No | İTÜ Ayazağa Kampüsü Binaları | İnşaat Alanı (m²) |
|---|---|---|
| 1 | Moleküler Biyoloji ve Genetik Araştırmalar Merkezi (MOBGAM) | 3.340 |
| 2 | Mustafa İnan Kütüphanesi | 8.998 |
| 3 | 75. Yıl Öğrenci Sosyal Merkezi (Eski Yemekhane Binası) | 4.670 |
| 4 | Altan Edige Kız Öğrenci Yurdu | 7.633 |
| 5 | Ali İhsan Aldoğan Kız Öğrenci Yurdu | 7.633 |
| | **Toplam Alan (m²)** | **32.274,00** |

# ANNEX-2: AUDIT TEMPLATE

## Index

**Audit Template**

# 1. Cover Page

a) Main components:

b) Report title (with Building/Facility Name);

c) Entity for which Building/Facility has been audited;

d) Location of Building/Facility;

e) Building type (hospital, school etc.);

f) Building picture;

g) Date of report;

h) The firm responsible for the Audit;

i) Consultants certificate numbers.

# 2. Table of Contents, Tables and Figures

Table of Contents should include all significant headings, sub-section headings and appendix sections. Ensure that the table of contents is updated when the report is finalized. It is also desirable to add tables for relevant figures and tables. The abbreviations and acronyms used should also be indicated and explained in a friendly format, and the conversions and reference values should be presented, either at the beginning of the report or in the first Appendix.

# 3. Executive Summary

All information in the Executive Summary should be drawn from the detailed information of the full report. Must be concise and up to a point. The minimum contents should be as follow:

a) Short building description (owner, size, type of use, systems, insulation, etc.), using a table with this format:

| Ref | Category | Description |
|---|---|---|
| 1 | Name of Building/Building Group | |
| 2 | Owner | |
| 3 | Year of Construction | |
| 4 | Purpose of Use | |
| 5 | Number of Buildings in Building Group | |
| 6 | Enclosed Volume | |
| 7 | Construction Area | |
| 8 | Building Floor Area | |
| 9 | Annual Heating Degree Days | |
| 10 | Annual Cooling Degree Days | |
| 11 | Heating/Cooling System | |
| 12 | Insulation Status | |
| 12 | Number of employees | |

| Ref | Category | Description |
|---|---|---|
| 13 | Number of other building users | |
| 14 | City | |
| 15 | Building Address | |
| 16 | Postal Code | |
| 17 | Phone number | |
| 18 | Fax Number | |
| 19 | email address | |
| 20 | Energy manager | |
| 21 | Certificate number of the energy manager | |
| 22 | Phone number | |
| 23 | Fax Number | |
| 24 | email address | |
| 25 | Energy Performance Certificate number (if any) | |

b) Key yearly energy consumption:

| Year | Total Annual Average Energy Consumption [TOE] |
|---|---|
| Year #1 | |
| Year #2 | |
| Year #3 | |
| Year #(…) | |
| Baseline Energy use | |

c) General Indicators:

| # | Indicator | Units | Year #1 | Year #2 | Year #3 | Year #(...) | Average |
|---|---|---|---|---|---|---|---|
| 1 | Energy Consumption per $m^2$ | kWh/$m^2$ year | | | | | |
| 2 | Emissions per $m^2$ | Ton $CO_2$ eq. /$m^2$ year | | | | | |
| 3 | Emissions per person | Ton $CO_2$ eq. /person year | | | | | |
| 4 | Fuel Consumption per HDD | kWh / HDD $m^2$ year | | | | | |
| 5 | Electricity consumption per CDD | kWh / CDD $m^2$ year | | | | | |

d) Key systems and equipment analysed.

e) Resume of building energy consumption and consumption breakdown, through a table and a graph:

| | Annual Energy Use [TOE] | Annual Energy Cost [TL] | Cost [TL/TOE] |
|---|---|---|---|
| TOTAL Baseline Energy Usage | | | |
| TOTAL Energy Savings | | | |
| TOTAL Proposed Energy Usage | | | |

| | Electrical | | | | Fuel #(…) | | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| year/month | Consumption | Consumption | Share of Total Consum | Total Cost | Consumption | Consumption | Share of Total Consum | Total Cost | Consumption | Consumption [TOE] | Total Cost |
| Year #1 total | | | | | | | | | | | |
| Year #2 total | | | | | | | | | | | |
| Year #3 total | | | | | | | | | | | |
| Total | | | | | | | | | | | |

Insert a slice graph of the last table for easy reading of the total values.

f) Summary of recommended energy conservation measures (including cogeneration and renewables opportunities), annual energy savings and cost savings. There should always be four tables: i) base scenario, ii) deep renovation scenario, iii) recommended package and iv) measures that were studied but not taken into account. Refer to the Energy Efficiency Measures (EEM) chapter for scenario detail. The tables for all scenarios should follow this format:

| No. | EEM | Estimated annual energy savings [TOE] | Estimated annual cost savings [TL] | Estimated implementation cost [TL] | Payback period [years] | IRR | NPV |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| (…) | | | | | | | |
| Total | | | | | | | |

g) The EEMs that were studied but not proposed should be presented. The analysis for all the factors may not be detailed, but the reason for not being proposed has to be carefully explained. The table should follow this format:

| No. | EEM | Estimated annual energy savings [TOE] | Estimated annual cost savings [TL] | Estimated implementation cost [TL] | Payback period [years] | Data based on the base or deep scenario | Comments |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | | | | | | | |
| (…) | | | | | | | |

h) Briefly present No Cost, Operations and Maintenance (O&M) or energy management opportunities, if any.

# 4. Energy Audit

In this chapter, there should be clearly stated all the information regarding the existing systems, from their basic characteristics to their energy consumption and their role in the energy profile of the installation.

## 4.1. Meteorological data

Present the monthly average ambient temperature and humidity, monthly HDDs and/or CDDs for 3 consecutive years for the area where the building is situated. The data should preferably be sourced from the National Meteorological Service.

## 4.2. Standards for indoor comfort and building operation

Present the national standards for indoor comfort and building operation, i.e., internal temperature and humidity, required fresh air requirements in different spaces (e.g., separately for ICUs, patient rooms), lighting, domestic hot water)

## 4.3. Building Info

The building description must contain sufficient baseline details about the building (e.g., year built, number of remodels, type of construction), including measured and/or verified area.

a) General

Building layout (show sections and years if remodeled), general construction, types of spaces/general layout, floor area. Explain, if needed, the different areas used (e.g. net, built, etc.).

b) Envelope

Describe the components/layers of the envelope (construction materials used for the exterior walls, roof and basement), including insulation material and its thickness, R-values/U-values of the envelope, condition, wall/roof/floor areas, and presence of asbestos or other materials. Indicate if the U-Values of the envelope components are relevant for the TS 825 Building Insulation Code for the region of the building. A table for comparison can be given. Use TS 825 Local Building Insulation Code, when possible.

c) Windows

Glazing type, frame type, location and dimension (area) of each unique type, shading, orientation, operability, weather-stripping, and condition. Include U or R-values, approximate Solar Heat Gain Coefficient (SHGC), and window tint description. Note if specific windows are left open for purposes of ventilation or comfort issues. Indicate also areas per different glazing/construction solution. Indicate if the U-Values of the windows are relevant for the TS 825 Building Insulation Code for the region of the building. A table for comparison can be given. Use TS 825 Local Building Insulation Code, when possible.

d) Observable deficiencies

Indicate the existence of wall cracks, observable structural elements, leakages, mould or other observable building pathologies.

e) Other

Insert floor plans that include all buildings.

Pictures of major building elevations and exterior. Include additional photos and descriptive captions of all building elements, systems, or conditions that are related to the proposed EEMs (included in EEM Section or Appendix).

### 4.4. Building occupancy

Provide a brief narrative describing typical daily, weekly, and annual occupancy patterns. Be sure to note unusual patterns, weekend or summer occupancy, especially if they affect total or seasonal energy usage. This information is also useful when comparing to Heating, Ventilation, and Air Conditioning (HVAC) schedules and understanding opportunities or limitations for certain EEM savings. Use a table format like this:

| Indicate Building/Area | Hours/day | Days/week | Annual hours | # during normal occupancy | % of the building used |
|---|---|---|---|---|---|
| | | | | | |

### 4.5. Equipment Info

a) Description of systems or equipment audited, their capacities and ratings, design and operating conditions, equipment schedules, etc., including information such as the type of systems, controls, type and number of auxiliary equipment, etc. Performance of systems or equipment audited (e.g. COP or SEER).

b) The system descriptions must contain sufficient detail to understand the building's major energy-using systems, including HVAC, Domestic Hot Water, Lighting, Plug Loads, and other.

The narrative should include explanations on the system type, age, nameplate capacity, condition, controls, the area served by each unit, operating schedules and sequence of operation/controls overview, current capabilities and limitations, and any significant known or suspected issues. This information should provide the necessary background to understand each EEM proposed.

Any equipment information (e.g., power, capacity, nameplate power, etc.) must be provided, as well as a citation of data sources (e.g., data logging, cut sheets, design drawings, engineering assessment, etc.) for each critical value and condition.

Summary findings from the equipment surveys should also be included in the narrative. The full equipment surveys must be included in the Appendix.

Include a description of any operation or conditions that are outside of recommended or standard ranges (e.g., excessive run times, over or under-lit areas, high or low setpoints, etc.).

1. HVAC

   Include a summary description of the HVAC system and HVAC zone(s) floor plan. Include a summary of the sequence of operations and fan schedules (detailed documents/tables to be included in the Appendix). Descriptions can be grouped into the following categories:

   a. Boiler and Chiller Plant

   Include a description of boiler and chiller plant(s), along with the distribution and condensate systems and cooling towers, where applicable. Describe the air handling or terminal units served by each plant and the zones they serve. Include equipment surveys in the Appendix.

b. Airside and Other HVAC System Equipment

Include a description of system equipment (e.g., furnaces, unit ventilators, radiators, heat recovery, etc.) and the zones they serve. Include equipment surveys in the Appendix.

c. Packaged Units

Include a description of packaged unit equipment (e.g., DX, Heat pumps, RTUs, etc.) and the zones they serve. Include equipment surveys in the Appendix.

d. Building-Level HVAC Controls

Individual equipment controls should be included with notations of the related equipment that they control. Building level/global controllers should be explained in the narrative. Include existing control configuration(s) and operating sequence(s).

2. Domestic Hot Water (DHW)

   Include a summary description of equipment, fuel type, capacity, the area served, and settings. This should include a description of tank and distribution, end-uses (e.g., showers for PE class and sports, kitchen, laundry, etc.). Note the major end-use fixture types (e.g., faucets, showers, dishwashers, etc.) and if any end-use equipment has unexpectedly high hot water usage or leaks. Include equipment survey in the Appendix.

3. Lighting (Interior and Exterior)

   Include a summary description of equipment, areas served, and controls. Include lighting survey in the Appendix.

4. Pumps and fans (electrical motors)

   Include a summary description of equipment if not addressed in the HVAC chapter. Include equipment surveys in the Appendix.

5. Plug loads and Other Equipment

   Only include data if it is relevant for the audit work. If so, include a summary description of the location, type, and quantity. In case of hospitals, the data should be separated into medical and non-medical equipment. Include equipment survey in the Appendix.

6. Mechanical systems Insulation

   Refer and describe all insulation used in mechanical systems.

7. Electrical Installation, Power Generation, UPS

   A full description of the electrical installation of the hospital (transformers, network, etc), of the possible power generation (i.e. generators) and of the installed UPS

Equipment info should include an explanation for the assumption of working hours. It should also note any deficiencies with the current operations – under/overheating/cooling, unused equipment, broken/missing lights, and equipment capacity too big/small.

## 4.6. Energy consumption data

### 4.6.1. Rates and providers

In this section should be stated the actual tariffs and utility providers for the facility. The cost should be separated between the fixed tariff (e.g. power) and the net energy (e.g. kWh) tariff.

| | | Year #1 | Year #n |
|---|---|---|---|
| Electric Utility Provider | Type of tariff | | |
| | TL/kWh | | |
| | Yearly average spending | | |
| Natural gas Provider | Type of tariff | | |
| | TL/kWh | | |
| | Yearly average spending | | |
| Other energy Provider | Type of tariff | | |
| | TL/kWh | | |
| | Yearly average spending | | |

a) In the "Other Energy Provider", all different types and amount of fuels have to be clearly specified.

b) If there are large differences between years (e.g. changes not explained by simple economic cycles), the Consultant must explain the possible reasons carefully. Ensure that units are correct.

### 4.6.2. Energy Consumption Profile

This table has to be made with the actual energy and utility provider data and should reflect an overview of the total consumption and cost of energy on a yearly basis.

| | Electricity | | | | Fuel #(…) | | | |
|---|---|---|---|---|---|---|---|---|
| Year/month | Maximum Demand [kW] (if available) | Consumption [kWh] | Consumption [TOE] | Total Cost [TL] | Maximum Demand [kW, m3, ton] (if available) | Consumption [kWh] | Consumptio] [TOE] | Total Cost [TL] |
| (January… December) | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Year #1 total | | | | | | | | |
| (January… December) | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Year #2 total | | | | | | | | |
| (January… December) | | | | | | | | |
| Year #3 total | | | | | | | | |

Add a column for each different type of fuel.

The Time Period should include (if available) at least three years of consecutive monthly data and three-year average. Be sure to include all-electric/gas/fuel meters if there are more than one.

| year/month | Consumption [TOE] | Ton $CO_2$ | Total Cost [TL] | TOE/cost [TL] | $CO_2$/cost [TL] |
|---|---|---|---|---|---|
| Year #1 total | | | | | |
| Year #2 total | | | | | |
| Year #3 total | | | | | |
| Average | | | | | |

The reports should offer some explanation for the presented data on energy use. For example: If gas use increases over 10%, or energy unit prices change significantly from year to year.

Year to year changes (from each of the previous energy consumption data) should be presented and add the narrative to explain fluctuations.

| Primary Energy [ToE] | YY1-2 | YY2-3 | YYn-n+1 |
|---|---|---|---|
| Variation change [%] | | | |

### 4.6.3. Energy Consumption Graphs

Display three years of consumption data graph (time on the x-axis). If available, show monthly values for all three years. All electricity, natural gas, and other fuels used at the facility need to be graphed (each on the separate chart). The graph could be line or bar graphs or any form that visually shows patterns. It has to be properly scaled for relevant information.

Include a brief narrative describing seasonal utility usage patterns and anything that stands out (e.g., note and explain any anomalies, etc.). Explain any trends. As relevant, correlate with features that may drive consumption profiles (e.g., occupancy, use patterns, degree days, etc.), and introduce them in a secondary axis to each graph.

### 4.6.4. Energy baseline and calculation of energy indicators

Based on the available data on electricity and heating fuel consumption, energy baselines should be constructed for (i) electricity and (ii) heating fuel by correlating the electricity or heating fuel consumption with the average monthly outdoor temperatures, preferably over a period of 2 calendar years.

For the baseline construction, a calendar year should be divided into three zones:

- Winter zone, with temperatures $T_{ex} \leq 15.0\ ^oC$,
- Intermediate zone, with temperatures $15.0 < T_{ex} \leq 22.0\ ^oC$ and the
- Summer zone, with temperatures $T_{ex} > 22.0\ ^oC$.

An example of the construction of an electricity baseline is shown below, using the following definitions:

- Electricity consumption $E = b1 * T + b0$

- b1: Regression coefficient
- T: Monthly average ambient temperature
- b0:  Regression coefficient
- a/a: Number of the month
- RMSE: Root mean square error – the standard deviation of the residuals (prediction errors), where residuals measure the distance between the data points and the regression line.
- Min. target EE = RMSE / (average of the expected electricity consumption [baseline] of the zone)^2

| Month - Year | A/A | Temperature (°C) | Electricity cons (kWh) | |
|---|---|---|---|---|
| Jan 19 | 13 | 9,7 | 144.018 | |
| Feb 19 | 14 | 10,1 | 129.874 | |
| Mar 19 | 15 | 13,6 | 173.838 | |
| Apr 19 | 16 | 15,4 | 158.064 | |
| May 19 | 17 | 19,9 | 165.948 | |
| Jun 19 | 18 | 26,8 | 173.279 | |
| Jul 19 | 19 | 28,2 | 205.729 | |
| Aug 19 | 20 | 29,3 | 202.823 | |
| Sep 19 | 21 | 24,8 | 162.341 | |
| Oct 19 | 22 | 21,3 | 154.332 | |
| Nov 19 | 23 | 17,7 | 138.543 | |
| Dec 19 | 24 | 12,2 | 154.641 | |

*Observed data*

| SUMMER ZONE | A/A | Temp .(°C) | Electricity (kWh) | Baseline |
|---|---|---|---|---|
| Jun 19 | 18 | 26,8 | 173.279 | 181.131,7 |
| Jul 19 | 19 | 28,2 | 205.729 | 195.607,1 |
| Aug 19 | 20 | 29,3 | 202.823 | 206.980,6 |
| Sep 19 | 21 | 24,8 | 162.341 | 160.452,6 |
| b1 | b0 | Average | 186.043 | 186.043,0 |
| 10.339,5 | -95.968,1 | RMSE | 9.616,9 | Min. target EE |
| 3,62 | -1,23 | < -t Stud/R2-> | 0,867 | 10,34% |

*Calcuated data*

| WINTER ZONE | A/A | Temp .(°C) | Electricity (kWh) | Baseline |
|---|---|---|---|---|
| Jan 19 | 12 | 9,7 | 144.018 | 145.934,5 |
| Feb 19 | 13 | 10,1 | 129.874 | 146.238,3 |
| Mar 19 | 14 | 13,6 | 173.838 | 148.896,8 |
| Nov 19 | 15 | 17,7 | 138.543 | 152.011,0 |
| Dec 19 | 24 | 12,2 | 154.641 | 147.833,4 |
| b1 | b0 | Average | 148.183 | 148.182,8 |
| 759,6 | 138.566,7 | RMSE | 19.332,7 | Min. target EE |
| 0,25 | 3,57 | < -t Stud/R2-> | 0,021 | 26,09% |

| INTEMEDIATE | A/A | Temp .(°C) | Electricity (kWh) | Baseline |
|---|---|---|---|---|
| Apr 19 | 17 | 15,4 | 158.064 | 159.618,4 |
| May 19 | 22 | 19,9 | 165.948 | 159.397,2 |
| Oct 19 | 23 | 21,3 | 154.332 | 159.328,4 |
| b1 | b0 | Average | 159.448 | 159.507,8 |
| -49,2 | 160.375,5 | RMSE | 8.384,1 | Min. target EE |
| -0,03 | 4,38 | < -t Stud/R2-> | 0,001 | 10,51% |

**BASELINE CONSTRUCTION**

| ALL ZONES | A/A | Temp .(°C) | Electricity (kWh) | Baseline |
|---|---|---|---|---|
| Jan 19 | 13 | 9,7 | 144.018 | 145.934,5 |
| Feb 19 | 14 | 10,1 | 129.874 | 146.238,3 |
| Mar 19 | 15 | 13,6 | 173.838 | 148.896,8 |
| Apr 19 | 16 | 15,4 | 158.064 | 150.264,0 |
| May 19 | 17 | 19,9 | 165.948 | 153.682,0 |
| Jun 19 | 18 | 26,8 | 173.279 | 158.923,0 |
| Jul 19 | 19 | 28,2 | 205.729 | 159.986,4 |
| Aug 19 | 20 | 29,3 | 202.823 | 160.821,9 |
| Sep 19 | 21 | 24,8 | 162.341 | 157.403,9 |
| Oct 19 | 22 | 21,3 | 154.332 | 154.745,4 |
| Nov 19 | 23 | 17,7 | 138.543 | 152.011,0 |
| Dec 19 | 24 | 12,2 | 154.641 | 147.833,4 |
| **TOTAL** | | | **1.963.430** | **1.836.740,7** |

*Calcuated data*

Diagram 1 shows the monthly electric consumption in relation to the average monthly outdoor temperature and the corresponding baselines for the different temperature zones.

***Diagram 1. Correlation of monthly electricity consumption to the mean average outdoor air temperature for the period January to December***

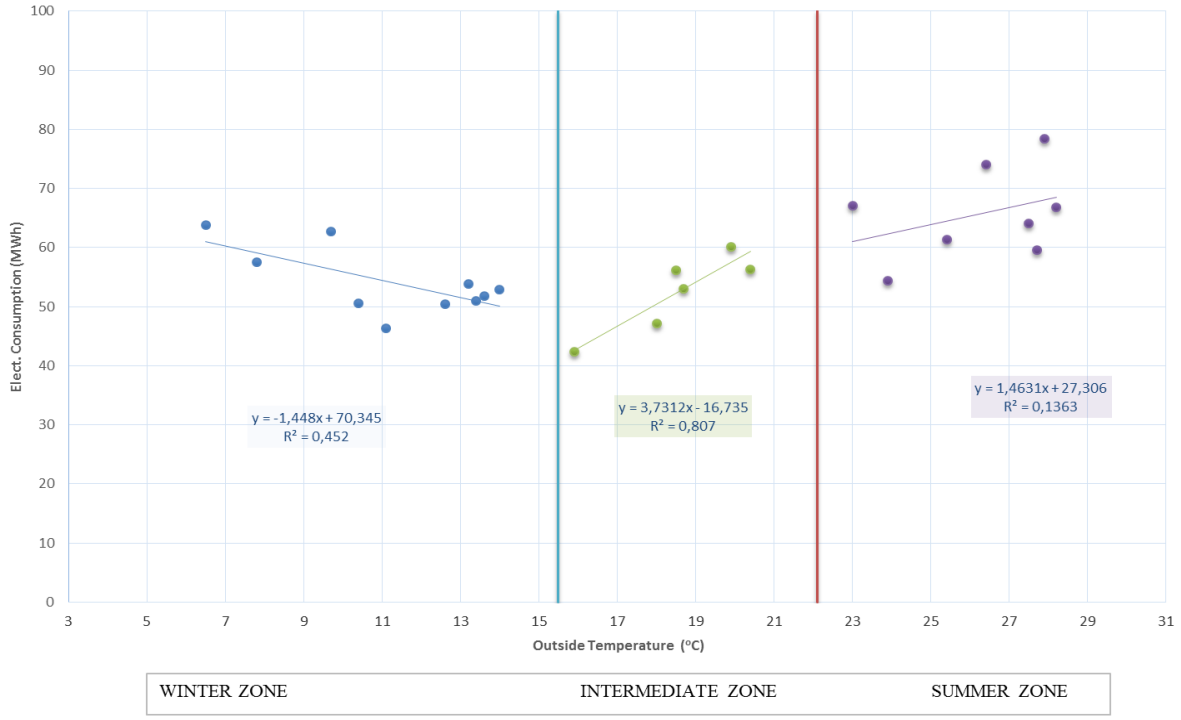



Table 1 provides details on the monthly actual consumption and expected corresponding values calculated from the baseline for the period from January December. Data are split into three zones based on the ambient temperature (as described above). The table also presents the estimated energy performance indicators, evaluation of the current situation, and the possibility of energy saving interventions.

- Divergence of balance = (monthly electric consumption recorded in bills) – (monthly expected electric consumption, baseline)
- CUSUM: Cumulative SUM of deviation between monthly electricity consumption and expected consumption. If m samples are collected, each of size n, compute the mean of each sample. Then the cumulative sum (CUSUM) is formed by one of the following equations.

$$S_m = \sum_{i=1}^{m} (\bar{x}_i - \hat{\mu}_0) \quad \text{or} \quad S'_m = \frac{1}{\sigma_{\bar{x}}} \sum_{i=1}^{m} (\bar{x}_i - \hat{\mu}_0)$$

  - where μ^0 is the estimate of the in-control mean
  - σx¯ is the known (or estimated) standard deviation of the sample means

  The choice of which of these two quantities is plotted is usually determined by the statistical software package (see regression in EXCEL). In either case, as long as the process remains in control centred at μ^0, the CUSUM plot will show variation in a random pattern centred about zero.
- Energy Performance Indicator, EPI = (consumed energy) / (monthly average ambient temperature)

- Energy Target Coefficient, ETC = (consumed energy) / (expected energy consumption)

***Table 1. Estimation of energy indicators for January to December***

| | Month / Year | Divergence of Balance (MWh) | | |
|---|---|---|---|---|
| | | Divergence per zone | | |
| WINTER ZONE | Jan 18 | 0,00 | | |
| | Feb 18 | 0,00 | | |
| | Mar 18 | 0,00 | | |
| | Nov 18 | 0,00 | | |
| | Dec 18 | 0,00 | | |
| | Jan 19 | -1,92 | | |
| | Feb 19 | -16,36 | | |
| | Mar 19 | 24,94 | | |
| | Nov 19 | -13,47 | | |
| | Dec 19 | 6,81 | | |
| INTERMEDIATE ZONE | Apr 18 | | 0,00 | |
| | May 18 | | 0,00 | |
| | Oct 18 | | 0,00 | |
| | Apr 19 | | -1,55 | |
| | May 19 | | 6,55 | |
| | Oct 19 | | -5,00 | |
| SUMMER ZONE | Jun 18 | | | 0,00 |
| | Jul 18 | | | 0,00 |
| | Aug 19 | | | 0,00 |
| | Sep 18 | | | 0,00 |
| | Jun 19 | | | -7,85 |
| | Jul 19 | | | 10,12 |
| | Aug 19 | | | -4,16 |
| | Sep 19 | | | 1,89 |

| | Month / Year | CUSUM (MWh) | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| WINTER ZONE | Jan 18 | 0,00 | | |
| | Feb 18 | 0,00 | | |
| | Mar 18 | 0,00 | | |
| | Nov 18 | 0,00 | | |
| | Dec 18 | 0,00 | | |
| | Jan 19 | -1,92 | | |
| | Feb 19 | -18,28 | | |
| | Mar 19 | 6,66 | | |
| | Nov 19 | -6,81 | | |
| | Dec 19 | 0,00 | | |
| INTERMEDIATE ZONE | Apr 18 | | 0,00 | |
| | May 18 | | 0,00 | |
| | Oct 18 | | 1,55 | |
| | Apr 19 | | -5,00 | |
| | May 19 | | 0,00 | |
| | Oct 19 | | 0,00 | |
| SUMMER ZONE | Jun 18 | | | 0,00 |
| | Jul 18 | | | 18,46 |
| | Aug 19 | | | 15,06 |
| | Sep 18 | | | 21,16 |
| | Jun 19 | | | 18,00 |
| | Jul 19 | | | 16,23 |
| | Aug 19 | | | 7,94 |
| | Sep 19 | | | 0,00 |

| Energy Performance Indicator, EPI (MWh/Month) | Energy Target Coedfficient, ETC |
|---|---|
| 0,000 | 0,000 |
| 0,000 | 0,000 |
| 0,000 | 0,000 |
| 0,000 | 0,000 |
| 0,000 | 0,000 |
| 1,485 | 0,987 |
| 1,286 | 0,888 |
| 1,278 | 1,168 |
| 0,783 | 0,911 |
| 1,268 | 1,046 |
| 0,000 | 0,000 |
| 0,000 | 0,000 |
| 0,000 | 0,000 |
| 1,026 | 0,990 |
| 0,834 | 1,041 |
| 0,725 | 0,969 |
| 0,000 | 0,000 |
| 0,000 | 0,000 |
| 0,000 | 0,000 |
| 0,000 | 0,000 |
| 0,647 | 0,957 |
| 0,730 | 1,052 |
| 0,692 | 0,980 |
| 0,655 | 1,012 |

Diagram 2 shows the correlation of the monthly electric consumption and electric baseline for the period January to December.

***Diagram 2. Correlation of monthly electricity consumption and electricity energy baseline for the period of January to December***

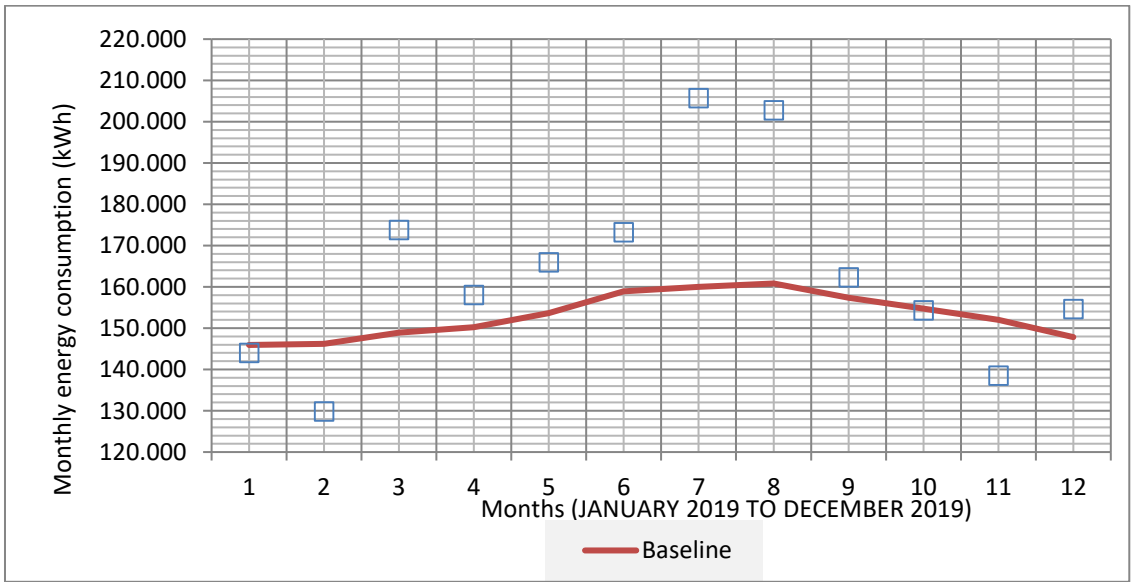



Table 3 presents a summary showing the minimum values of EPI and ETC for each of the three zones.

*Table 3. Energy indicators*

| Winter | | Temp (ºC) | Electr (MWh) | Month | EPI | ETC |
|---|---|---|---|---|---|---|
| **$EPI_{min}$** | 0,783 | 17,7 | 138,5 | Nov 19 | - | 0,91 |
| **$ETC_{min}$** | 0,888 | 10,1 | 129,9 | Feb 19 | 1,29 | - |
| **$RMSE_{max}$=** | 19332,69 | | | | | |

| Intermediate | | Temp (ºC) | Electr (MWh) | Month | EPI | ETC |
|---|---|---|---|---|---|---|
| **$EPI_{min}$** | 0,725 | 21,3 | 154,3 | Oct 19 | - | 0,97 |
| **$ETC_{min}$** | 0,969 | 21,3 | 154,3 | Oct 19 | 0,72 | - |
| **$RMSE_{max}$=** | 8384,09 | | | | | |

| Summer | | Temp (ºC) | Electr (MWh) | Month | EPI | ETC |
|---|---|---|---|---|---|---|
| **$EPI_{min}$** | 0,647 | 26,8 | 173,3 | Jun 19 | - | 0,96 |
| **$ETC_{min}$** | 0,957 | 26,8 | 173,3 | Jun 19 | 0,65 | - |
| **$RMSE_{max}$=** | 9616,91 | | | | | |

# 5. Energy Efficiency Measures Detail

The EEMs list will be presented in scenarios tables. The tables should follow this format:

| No. | EEM | Type of energy [eletrical, gas etc.] | Estimated annual energy savings [kWh] | Estimated annual energy savings [TOE ] | % of total consumption [TOE] savings | Estimated annual cost savings [TL] | Emissions reducing [tCo2] | Estimated implementation cost [TL] | Payback period [years] | IRR | NPV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| (…) | | | | | | | | | | | |
| Total | | | | | | | | | | | |
| Total Energy Savings [%] | | | | | | | | | | | |

As indicated in the executive summary, three scenarios (along with three tables) will be presented:

a) Base scenario with measures that save a minimum of 20%* and the average payback period as a bundle will not exceed 12 years.
b) Deep renovation scenario with measures that will have a minimum of 30%* and the average payback period as a bundle will not exceed 20 years.

c) Recommended bundle of measures (this could be a selection of measures from the base scenario, a selection of measures from the deep renovation scenario, or a mix of measures from the base and deep renovation scenario).

* Primary energy efficiency improvement percentage may be used for calculating overall energy efficiency calculation of the deep renovation scenario in case on-site electricity production measures are proposed such as cogeneration/trigeneration, etc.
Provide an extra line for each type of energy vector that is saved in each measure.

After the table section, provide a complete description of each EEM proposed. Describe how the system/operation would be made more efficient or how the new equipment would reduce energy use. The description must be sufficient to ensure facility staff understand how proposed EEM can be implemented or how this information will be used by an engineer/contractor for design and specification work.

If there are differences from the base scenario and the deep scenario for the same EEM, please describe the rationale (e.g. different savings values for the same piping insulation measure).

The EEM presentation and analysis are detailed in the Appendix sections (under "General notes regarding EEMs").

# 6. Energy Management and no/low-cost opportunities

a) Energy Management or O&M Measures

Include any relevant operational or maintenance measures. Follow the same instructions and template used for EEMs. This section would also include any negative energy savings measure that may be necessary for the implementation of an EEM or needed to help meet a specific operation or maintenance requirement (e.g., increased ventilation or lighting levels).

b) Low and No-Cost EEMs

Include a list of any important Low or No-cost EEMs applicable to the facility.

Please include a brief note for any measures analysed, but not included in EEM section of the report. Also, explain if any measure was not analysed, but sections of the audit report may suggest a measure might be needed (e.g., uninsulated shell but payback would have been over 50 years).

# 7. Building Management Systems (BMS) and metering systems

Add BMS if needed in the EEM list. As a general rule present a monitoring system with central control in the deep renovation scenario if the facility can manage it and only recommend it if payback for this measure is less than 20 years.

Please note that basic building-level metering should be a mandatory measure in all scenarios if does not exists and if exists has to be described even if briefly in the systems description. The basic version should be aimed at primary level energy and to Install new or use existing base building-level energy meters, or submeters that can be aggregated to provide base building-level data representing total building energy consumption (electricity, natural gas, fuel oil, propane, etc.). Utility-owned meters capable of aggregating base building-level resource use are acceptable. The basic system can be standalone (e.g. without automated report capabilities or software aggregation).

# 8. On-site Generation and Renewable Energy Systems

Include data, on-site generation and RE systems. Some issues have to be addressed in the narrative, in text or table format: Total power, total production, installation summary description, connection point, if there is an off-site sale of energy (etc.).

Include some schematics (e.g. drawings for Photovoltaic (PV) panel installation site). Present in the Appendix calculation sheet for forecasted production.

# 9. Energy Performance Class (EKB)

The building energy class should be stated in a short table:

| Current Energy Performance Class | Energy Performance class under Proposed Scenario |
|---|---|
| | |

# 10. Energy Performance Contracting (EPC) methodology

For future reference, this chapter shows the approach to be used for EPC contracting. There should be a clear path and hard data for reference energy consumption data (baseline), reference conditions for measurement and verification (M&V) accordingly with International Performance Measurement and Verification Protocol (IPMVP) and a general description of what events will be accepted for baseline change.

The general information should be given in a table format:

| Proposed EEM | M&V Option based on IPMVP | Correction Factor (%) | Sensitivity (%) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

| Proposed EEM | Total Usage Area that | Electricity Consumption | Natural Gas Consumption | Other Fuel (Please Specify) Consumption | Total Energy Consumption | Total Energy Consumption Cost | Reference O&M Cost | Total Emissions |
|---|---|---|---|---|---|---|---|---|
| | [$m^2$] | [TOE/Year] | [TOE/Year] | [TOE/Year] | [TOE/Year] | [TL/Year] | [TL/Year] | [Ton CO2 Eq.] |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

# 11. Audit Appendixes

The report appendixes must contain useful information to understand the narrative of the EEMs choice, but also to keep all this information form the main body of the report, for simplicity of analysis. The appendixes can be the following:

a) General Information Appendixes

- Audit Team;
- References, Reference Values and Abbreviations;
- Equipment and their certifications used in Audit.

b) General Audit Appendixes
- Energy End-Use Calculations;
- Energy Modelling Documentation (if energy modelling approach is preffered for EEM calculations by the Consultant);
- Equipment Surveys;
- The sequence of Operation.

c) EEM Related Appendixes

- Cogen details;
- EEM Specific Requirements;
- EEM Energy Calculation;
- EEM Cost Estimation;
- EEM Cut Sheets.

d) Site Measurement Appendixes

- Onsite Visits and Monitoring;
- Data logging and Monitoring Results.

e) Administrative Appendixes

- Audit Team;
- References, Reference Values and Abbreviations;
- Measurement Equipment and certifications used in Audit.

# 12. General Information Appendixes

### 12.1. General Notes

General requirements are items that the energy Consultant must use based on the information gained during the audit. Energy Audit Reports must follow this template report:
Energy Efficiency Measures (EEMs) and Simple Payback (SP) Requirements.

a) All potential EEMs with a *likely* SP less than 20 years (or insulation measures with any SP) must be analyzed.
b) All analyzed EEMs must be included in the Energy Audit Report.
c) Alternate formats may be used only after requesting and receiving prior written approval. If used alternate formats must still include all Sections Headings and required information, be presented in a concise manner, and include all supporting data and documentation.

Energy Audit Reports must be complete and well written. The report should demonstrate sufficient clarity to persons possessing moderate facility knowledge and an average understanding of energy engineering principles. They must be consistent and accurate. Values and measurements for a specific item or usage should be consistent across the entire Energy Audit Report and all supporting documents, including spreadsheets, modelling files, and other related documents.

Information on data collection for the principal energy systems and end uses, should be presented if needed with on-field interviews:

a) What is, if any, the current metering setup;
b) Data source: Statement about which data was used and which was measured, and which was estimated;
c) Provide a complete description of existing conditions. Provide a summary of all related measured site data, including monitoring results, measurements, light levels, and other relevant information. Include sketches, photographs and expanded narrative for clarity where applicable or required.

## 12.2. Calculations and Energy Modelling Requirements

Calculations used in analyses must be supported with sufficient detail and include justification of all assumptions. Calculations completed in spreadsheets must not hide any cells or contain any data, formulas, or referenced cells that are not relevant to the particular audit.

Consultants must use industry-accepted calculation methods to predict achievable energy savings (e.g. ASHRAE Guideline 14, TS 825, etc.). Calculation methods and assumptions must be clearly stated and supported. Accepted sources and citations may include metered data, peer-reviewed and industry-recognized white papers, energy clearinghouses, textbooks, and other similar sources. Use of such sources must be cited and clearly presented.

In case energy modelling approach is followed by the Consultant, use building annual energy or use hourly simulations of energy use by energy source suitable for determining both load analysis and the proposed energy use for each proposed EEM.

The Energy Audit Report must clearly and separately list the baseline and proposed (post-EEM) parameters and inputs. All modelling inputs should reflect actual building characteristics and conditions as described in the Energy Audit Report.

## 12.3. Energy Modelling Documentation (If Energy Modelling Approach is preferred or used for EEM calculations by the Consultant)

If completing energy modelling using whole-building energy simulation computer programs, the Consultant must use annual energy use hourly simulations. Guidance and requirements for modelling done with annual energy use hourly simulations can be found in the ASHRAE 90.1-2016 Appendix G.

The firm must include all of the following documentation in this Appendix:

a) Which modelling software and version was used (e.g. TRNYS, EnergyPlan, etc.);
b) How the model was calibrated to utility data to be within ± 10 per cent;
c) Key model inputs and outputs for each modelling run.

All inputs and outputs should match narrative and data presented in the Energy Audit Report (e.g., equipment survey, data logging results, building characteristics narrative, etc.).

It is still necessary to provide a summary of how the EEMs save energy along with the details as to how estimated energy savings were calculated. Energy auditing firms should fully understand the methodology behind any energy-savings calculations provided by the model, detail this methodology in the Energy Audit Report, and be able to explain the accuracy and reasonableness of any savings estimates.

### 12.4. Equipment Surveys

A simple template for an equipment survey has to be used for the survey. One example is below (chillers). Complete the tables and provide any additional information to document all equipment at the facility fully. Any necessary information or system characteristics that cannot be fully incorporated into the tables should be included in alternative tables and narrative within the report.

| General Information | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ref. | Area Served | Year | Manufacturer | Model | Capacity [kW] | Refrigerant | Type | Air or water-cooled |
| | | | | | | | | |
| | | | | | | | | |

| Ref. | Efficiency | | | Controls | | |
|---|---|---|---|---|---|---|
| | COP 100% load | COP 50% load | Eurovent | supply setpoint | Return Setpoint | Recovery setpoint |
| | | | | | | |
| | | | | | | |

| Ref. | Measurements | | | | |
|---|---|---|---|---|---|
| | Water supply temp | Water return temp | Intake power [kW] | Water flow [l/h] | Outside temperature |
| | | | | | |
| | | | | | |

### 12.5. HVAC Controls

If applicable, provide a detailed narrative for building-level/global controllers. The narrative for controls should include:

a) Age and condition;
b) Type (electronic, pneumatic, combination);
c) Manufacturer and model number;
d) Areas and equipment controlled;
e) Control configuration and operating sequence;
f) Control capabilities and limitations (e.g. optimized start, web interface);
g) Maintenance or operational issues.

### 12.6. Equipment Survey: Domestic Hot Water

Provide a detailed narrative for Hot Water production and distribution systems and controls. Include a brief explanation of the end uses locations and needs in terms of power and

temperature. The actual system behaviors should also be analyzed from user feedback in terms of flow availability and temperature.

### 12.7. Equipment Survey: Lighting

Include all interior and exterior lighting showing specific locations by area, space, room number, or other individual space identification with the actual number and type of existing fixtures. Survey the building to determine connected interior and exterior lighting power and energy usage. Document existing lighting levels, lamp and ballast types, wattages, and controls. Use sampling if more efficient. Document the existence of any hazard's materials, including PCBs and mercury.
It is important to refer if the actual lighting levels are not satisfactory or if there are an important percentage of the lighting fixtures not working or disconnected from the occupants or facility manager feedback.

# 13. EEM Related Appendices

### 13.1. General notes regarding EEMs

**a) EMMs scenarios**
As already stated in the main template body, the EEMs list will be presented in scenarios tables.
The objective is to show the bundling effect of EEMs. The bundling scenario will be treated as one stand-alone EEM, with the totals being the cross-effect value from the whole bundling analyzed together.
As guidance, the recommended package should not include i) measures with payback periods longer than 20 years except for building envelope measure and ii) measures with paybacks longer than the lifetime of the equipment.
If no EEMs can match the conditions, the table will be empty.
If there are obvious problems for improved insulation application, the Consultant can skip the analysis stating the technical rationale in the narrative.
There should be different formatting (e.g., font color) to highlight what insulation is added in the basic and deep renovation scenario compared to the existing situation.

**b) EEM Description**
Provide a complete description of each EEM proposed. Describe how the system/operation would be made more efficient or how the new equipment would reduce energy use. The description must be sufficient to ensure facility staff understand how proposed EEM can be implemented or how this information will be used by an engineer/contractor for design and specification work.
Recommendations must meet current code requirements and standard design recommendations:

1. Describe any repairs or operational changes required for the EEM to be effective. Outline how the implementation of EEM may impact operations and maintenance (O&M) procedures and cost, any new operating skills required, recommended training & hiring, and any impact on existing equipment life;
2. Briefly describe any other impacts on occupant health, comfort or safety, as well as non-energy benefits, especially improvements to health, safety and environment, decreases

in equipment run time, and maintenance labor hours. This should also include: Hazardous material disposal issues (e.g. PCB ballasts, asbestos) and ventilation and indoor air quality (IAQ) issues (e.g. new equipment may increase ventilation);

3. Commissioning Requirements. Include documents related to commissioning and scope of services in the Appendix;
4. The Systems/Equipment responsible for any meaningful consumption has to be addressed the EEM list to avoid having large consumption vectors without any intervention. If they are not addressed, the Consultant should briefly explain why.
5. A detailed explanation should also be given in the case that one particular equipment is not changed by not only more efficient but also for smaller capacity systems due to heat/cooling supply from tri-generation and reduced loads from insulation/window upgrade, for example

**c) EEMs cross effect.**

When considering multiple EEMs with interactive effects between measures, the order of analysis must start with load reduction measures and proceed with distribution systems and associated equipment efficiencies, and then plant and heat rejection systems.

For EEMs that involve system interactions within a single EEM (e.g. lighting retrofits that affect HVAC loads), those system interactions should be considered within that particular EEM analysis.

When analysing measures with interactive effects, including in the analysis:

1. Explanation of how EEMs interact with one another;
2. If and why savings from this EEM may be more or less effective depending on other EEMs;
3. Note if EEM is independent of all other EEMs in terms of savings or its practical application.
4. Interactions within lighting EEMs should be shown on the same row in the table (i.e., electrical savings entered as a positive value (net of cooling savings if any) and any non-electric heating should be entered as a negative value in appropriate heating fuel column. Assumptions on heating/lighting interactions (e.g. percentage of heat loss to conditioned space) should be explained in the EEM Section of the report.
5. If including mutually exclusive EEMs, list each as an individual row on the tables. Only one of the mutually exclusive EEMs should be included in the TOTAL EEM Energy Savings calculation (e.g. include only the recommended EEMs as to not “double count” measures in the total).

For each EEM, note if any significant variance in savings (+/- 20%) would occur if that measure is performed stand-alone, without the other proposed EEMs (for example, boiler replacement without other load reduction EEMs).

**d) Cost-Benefit Analysis**

Include a Cost-Benefit Analysis (e.g. payback, NPV and IRR) for each individual EEM and for the bundle total.

1. Energy Savings: Calculate estimated energy savings and energy cost savings associated with each proposed EEM. When estimating energy cost savings, use and display current energy prices and rates, or refer to the report.

2. Cost Estimates: Provide summary cost estimates in the table, with detailed cost estimates located in the Appendix.
3. O&M savings are included in the EEM cost and should be described in the EEM section.
4. There must exist a clear indication (on the table, on footnote etc.) of the reference prices used for energy.

### 13.2. Cogeneration/Tri-generation details

If cogeneration (or tri-generation) is evaluated as energy efficiency improvement, then natural gas increase and electricity reduction should be given in details in a table format.

| Fuel Consumption at Full Load [kw] | Max.Electricity Generation [kWe] | Max. Heat Generation [kWt] | Annual Expected Electricity Generation [kWh] | Annual Expected Heat Generation [kWh] | Annual Operation and Maintenance Cost [TL] | Annual Fuel Cost [TL] | Total Electricity and Heat Savings [TL] | Investment Cost [TL] | Pay Back [Year] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

### 13.3. Financial analysis and legal requirements

The discount rate for NPV calculations (USD based) is 11%.

The USD/TL and ERU/TL exchange rates for the investment/maintenance cost conversion of imported goods/services will be determined by the Client at the beginning of the energy audit process.

Energy unit prices in TL will be assumed to be inflated by 9% per year regarding NPV calculations.

The NPV analysis is made over 20 years.

For NPV calculations investment expenses should occur in Year 0 and the first annual energy cost savings should then be accounted for in Year 1. The re-investments should be accrued in the year they are expected to occur. The O&M and other recurring yearly costs should be stated when they occur at today's prices.

The average life span of the EEMs, is the following:

| EEMs | Working life [years] |
|---|---|
| Building insulation | 35 |
| Building windows | 35 |
| LED Lighting fixtures | 12 |
| Controls (BMS. Lights etc.) | 10 |
| Distribution systems (air&water) | 20 |
| Solar PV | 25 |
| Chillers and boilers | 20 |
| Other heat generation devices | 20 |

LED working life is based on 50 000 hours. The 12 years of working life assume roughly 4150 hours per year. If the usage is significantly different, please adjust the working life, based on the actual working life of the proposed LED.

If other values are used, or if there are systems not referred to in the table, please describe the rationale, as a footnote of the EEM table.

If the NPV period analysis is larger than the EEMs useful life, some reinvesting funds have to be considered for the savings to be considered over the full NPV time analysis.

### 13.4. Lighting Measures (Interior and Exterior)

a) Provide a detailed lighting schedule showing specific locations (by area, space, room number, or other individual space identification) with the proposed number and type of new lamps, luminaires, ballasts and fixtures. Should be in table format.
b) When adding or upgrading lighting controls, detail the proposed operation scheme. Include the number, type, and location of new controls. Include explanation, assumptions, or data-logging to support any reductions in light levels or operating hours.
c) Recommend using sketches of new fixture layouts or controls to explain proposed measures.
d) Calculate the reductions in lighting energy and include any increases or decreases in other forms of energy use, such as increased heating, associated with installing the EEM.
e) For calculations, include all results, explain methodology and assumptions, and document all key input variables.
f) Use lighting simulation software (Dialux or equivalent) to verify the new fixture layout or fixture distribution. Verification must be used when minimum light levels and uniformity are a safety concern (e.g. parking lots, pedestrian areas, stairways, etc.).

### 13.5. EEM Investment Calculations

Include all supporting documentation for EEM Energy Calculations. Include key documents:

a) Materials & Equipment: Identify vendor and contact person who provided material and equipment estimates. Include dates and sources of information.
b) Labor: Must use prevailing wage rates. Include separate "Hours" and "$/Hour" rate. If vendor quotes are used, including dates and sources of information.
c) Itemize specific costs related to design and engineering, contractor overhead and profit, and contingency, if any. Document the source of estimates, amount, and a brief description that includes assumptions and data sources.
d) Disposal & Salvage: Indicate any required or expected disposal costs, including hazardous materials or abatement. Include any salvage value or possible reuse of materials. Document the source of estimates, amount, and a brief description that includes assumptions and data sources.
e) Commissioning: Include estimated commissioning cost for EEMs that require commissioning.
f) Add any additional explanation in the narrative below the table.

### 13.6. EEM Cut Sheets

Include all manufacturer or vendor cut sheets and performance data for recommended equipment and systems. Indicate or highlight key specifications (e.g., efficiency rating, wattage, size, etc.) used in developing the EEM and EEM savings.

# 14. Site Measurements Appendixes

## 14.1. Onsite Visits and Monitoring

a) For each visit, list:
   - Date,
   - Purpose;
   - Critical notes or findings.

b) For each dataset/parameter, list the following:
   - Dates (Installed and removed);
   - Logging period (if different):
   - For instantaneous/point measurements: List date, time, location;
   - Purpose and Measured Parameter(s);
   - Placement (equipment, location, etc.);
   - Quantity and type;
   - Logging Interval(s).

c) Any issues or abnormalities that may have affected monitoring data.

## 14.2. Data Logging and Monitoring Results

Include a summary description of data logging and monitoring methodology. Include monitoring type (e.g., instantaneous, load profile, periodic total) and general approach. Trend data should indicate duration and intervals, with key monitoring graphs and charts included.

Must include all key results that support the assumptions and recommendations made in the Energy Audit Report.

All charts and graphs should include a brief explanation of results and significance to the Energy Audit Report findings. Include annotations to graphs and charts as needed to illustrate key points or explain anomalies.

# REPUBLIC OF TURKEY

## MINISTRY OF ENVIRONMENT AND URBANIZATION (MOEU)

## GENERAL DIRECTORATE OF CONSTRUCTION AFFAIRS (GDCA)

**"Energy Efficiency in Public Buildings Project"**

**Loan No: 9015-TR | Project ID: 162762**

**CONSULTANCY SERVICES FOR**

**ENERGY AUDITS, TECHNICAL DESIGNS AND CONSTRUCTION SUPERVISION SERVICES FOR ENERGY EFFICIENCY RENOVATIONS IN PUBLIC BUILDINGS**

**Reference No:**

**EEPB/WB/MoEU/QCBS-DES&SUP-09**

# TERMS OF REFERENCE

***"For the Construction Supervision and Commissioning"***

***Issued on:*** *November 5, 2021*

## I. Introduction

The Ministry of Environment and Urbanization (MoEU) has received financing from the World Bank toward the cost of the Energy Efficiency in Public Buildings Project (EEPBP) and intends to apply part of the proceeds for consulting services.

The project investments will focus primarily on the renovation of central public buildings with high energy consumption and shorter pay-back periods. The proposed project would be implemented through two components: (i) energy efficiency (EE) investments in central government buildings; and (ii) technical assistance (TA) and project implementation support. The General Directorate of Construction Affairs (GDCA) under the MoEU has been delegated to assume overall responsibility for the project. This will include completion of the necessary activities to support project preparation as well as implementation for the six-year project period. In parallel, grant funding has been mobilized from the Clean Technology Fund (CTF) to help analyze the investment needs and potential of the central government buildings.

The GDCA has established a project implementation unit (hereinafter called the "Client") to administer all aspects of the project, including selection of the buildings, procurement of the various contractors (e.g. energy audits, technical designs, renovation works, construction supervision, savings verifications, technical assistance or consultancies, etc.), and monitoring.

Through the EEPBP, approximately 500-700 public buildings will be renovated for EE. Investments would include building envelope measures (roofs/wall insulation, windows, doors), heating/cooling systems, water heating, pumps/fans and lighting and some renewable energy (RE) applications (e.g., rooftop solar PV, biomass heating, solar water heating, geothermal heat pumps) to offset the building's electricity/fuel use. A limited amount of funds may be allocated for non-EE/RE measures (e.g., rewiring, minor structural repairs, painting, seismic safety, etc.).

Within the framework of the EEPBP, a consulting firm will be employed to carry out construction supervision and building commissioning.

## II. Scope of Services

The Consultant will be required to carry out construction supervision and building commissioning services issuance of an energy performance certificate after the renovation, supervise remedial works to rectify defects that arise during the Defects Notification Period (DNP), and prepare Measurement and Verification (M&V) reports for the renovated buildings.

This Terms of Reference covers construction supervision for energy efficiency renovations of selected public buildings in three (3) campuses having 243.451,00 m² total area as listed below in Table. The building list given in the annex-1.

**Table 1:** List of the Campuses to be renovated in the scope

| | Name of Campus | Beneficiary Institution | City | Construction Area (m²) |
|---|---|---|---|---|
| 1 | Yıldız Technical University Davutpaşa Campus | Council of Higher Education | Istanbul | 189.480,00 |

| | | | | |
|---|---|---|---|---|
| 2 | Boğaziçi University<br>North Campus | Council of<br>Higher Education | Istanbul | 41.154,00 |
| 3 | Boğaziçi University<br>South Campus | Council of<br>Higher Education | Istanbul | 12.817,00 |
| 4 | İstanbul Technical University<br>Ayazağa Campus | Council of<br>Higher Education | Istanbul | 32.274,00 |
| | | | **TOTAL** | **275.725,00** |

## III. Description of the Consultant's Tasks

**Principles of consultant assignment**

- The Consultant as "the Engineer/Project Manager" shall also be responsible to carry out all the duties envisaged in the Contractor's contract document. The Consultants shall perform all duties, which may be required to do pursuant to any Contract entered into between the Client (designated as "the Employer") and the Contractor where Consultants are designated as "the Engineer/Project Manager" in such Contract.
- The Consultant shall provide consulting services for execution of works with qualified personnel approved by Client.
- The Consultant shall execute the services in accordance with recent laws and regulations,
- The Consultant shall supervise and oversee all aspects of the construction and installation of the various components of the works and engineering services to ensure strict compliance with the drawings and contract documents, subject to any expressed or implied terms contained in the Contract entered into between the Client and the Contractor,
- The Consultant shall stipulate the criteria, the planning and the procedure for all tests and inspections necessary for the materials, equipment, plant and workmanship and the commissioning of the Works and shall provide supervision and inspection for these tests. The Consultant shall compile a record of all such tests and compare the results with the specifications, standards or with the performance criteria that has been guaranteed by the suppliers or contractors,
- Consultant shall follow up evacuation of buildings (if needed) with respect to the planned schedule of the works, communicate with the related authorities and inform the Client timely on the issues identified,
- The Consultant shall collect and/or prepare the necessary documents required for obtaining the renovation construction permit (if needed) from the Municipality shall also sign the documents to be submitted for the official permits and assist the Contractors for obtaining the renovation construction permit (if needed),
- The Consultant shall arrange weekly and monthly meetings with contractors, inform the Client about progress of the work and activities, attend any meetings reasonably

convened by the Client and provide any information or evidence reasonably required by the Client at any public meetings or inquiries which might be held in connection with the Project,

- It is the duty of the Consultants to interpret the drawings and specifications and to consult with the Contractors as required to ensure compliance with the Contract and the work programme.
- The Consultant shall check the Contractor's valuations for payment on account and issue certificates according to the Conditions of Contract used and shall also be responsible for agreeing with the Client on each payment certificates in payable amount. The actual procedure and presentation of the certificates, supporting documents, etc. shall be discussed and agreed with the Client,
- The Consultant shall review and report on any financial claims submitted by the Contractors within 2 weeks of receipt of such claim submission. Report on any claim shall include (not limited to) determinations, the justification letter, cost-benefit analysis, all probable effects on approved work plan and the final decision on any variation.
- If payment certificate is not prepared by contractor, consultant will prepare payment certificate for contractor,
- The Consultant shall have a quality review of the designs, plans, technical specifications, BOQs, etc. that were originally prepared during the first phase design services contract and prepare any additional documents and detailed designs (if needed) that would minimize variation orders during the construction/installation stage. However, in case it is considered necessary by the Consultant or the Client that any alterations in any of the Contract Documents, Plans or Specifications are advisable (due to reasons not attributable to the works contractor), the Consultant shall prepare and submit such alterations to the Client for approval, in a timely manner, supported by the necessary calculations, details and, time and cost implications. The Consultant shall state whether the alterations will cause any delay in the work program, and therefore the contractor(s) to be entitled any time extension or not, supported by necessary documentation. On receiving written approval from the Client, the Consultant shall promptly amend the existing designs or supply any additional designs, plans, drawings and specifications where required or found necessary for the satisfactory completion of the works. Furthermore, the Consultant shall review and approve Contractor's and manufacturer's drawings and where appropriate incorporate these drawings into the overall design and review alterations which might be requested by the Contractors during the course of Works. The Consultant shall fully inform the Client about the cost and time impact and any other consequences of his any sort of proposals (such as revisions, recommendations, etc). The Client shall not be responsible from the consequences of the fact of which the Client is not informed in advance,
- The Consultant shall not delay any action required to be taken by the Consultant during the construction. In any case, all the correspondences received from the contractor shall be reviewed, evaluated and responded the latest within one week. Any claim from the contractor(s) under the construction contracts shall be evaluated by the Consultant and

necessary recommendation shall be made the latest within two weeks, as well,

- Some of the works may be executed by the Contractor in night hours rather than daily hours because of the sustainability of services in buildings or any other reasons. In that case, Consultant will arrange his staff employment according to this condition without any extra cost to the Client and the Contractor.
- The Consultant shall take necessary measures for environmental, social and safety aspects. In this context, alongside with the Environmental and Social Management Plans (ESMPs) prepared based on the ESMF, the most recent Turkish environmental and safety regulations are required to be taken into consideration particularly during the supervision of the construction works. The Consultant shall monitor/assess Contractors' activities in compliance with the site-specific ESMPs (including environmental, social, occupational health and safety, community safety, received grievances if any, etc.), include ESMP issues and grievances (if any), in the monthly progress reports, and provide feedback and give notice to the MoEU. The details of the Environmental and Social Management and the responsibilities of the "Engineer/Project Manager" shall also be detailed in the Contractor's contract. Consultant shall have the responsibility for relevant supervision and instruction of the applications to the Contractor.
- The consultant will assist the Client in the Public Participation Meetings for EEPB Project that will be led by the Client. Both virtual and physical PP meetings will be held with participation of the Client representative/s. Presentation material including relevant content of per sub-project for public participation meetings shall be prepared by Construction Contractor Supervisor and relevant personnel of the CCS shall be delivered the presentation to the relevant stakeholders. Content of each presentation for per sub-project is subject to review and approval of the Client.
- The Consultant shall assist in the setting of all disputes or differences, which may arise between the Client and the Contractors, in a timely manner. In the case of litigation and arbitration the Consultant shall assist the Client in the preparation of the documents needed by the Client,
- Since the similar construction works will also be supervised by other Consultant in other sites, the Consultant shall co-operate with the other Consultant and join the meetings whenever required by the Client,
- Awarded consultants and their nominated sub-consultants (if applicable) shall have a local branch office in Ankara for the administrative communication aspects (corresponding letters, printing or plotting of project document, etc.).

Not limited to the above, the specific tasks are described as follows:

***Task 1: Carry out construction supervision and building commissioning services***

This task is estimated to last about 8 months, from the time of signing the contract and work commencement notice letter with the construction contractor until completion of the renovations works by taking over certificate.

**1a) Supervise construction projects:**

- Oversee all phases of the project and contract and sign payment parts as specified on contract.
- Conduct regular (semi-monthly or more often if required) site visits of each construction site.
- Prepare semi-monthly progress reports and send a copy of material acceptance to the construction company and the Client.
- Administer contracts; evaluate schedules; monitor progress of the contractors on projects; ensure that project deadlines are met; proactively identify renovation challenges and propose solutions; ensure installation and renovation works follow design specifications and good practices for EE renovations.
- The Consultant, shall ensure the construction progress is in compliance with the workplan, building access plan, and restrictions (for access to users during the construction phase).
- The Consultant shall check the Contractor's valuations (including measurements) for payment on account and issue certificates according to the Conditions of Contract used and shall also be responsible for agreeing with the Client on each payment certificates in payable amount. The actual procedure and presentation of the certificates, supporting documents, etc. shall be discussed and agreed with the Client.
- Oversee implementation of the Environmental and Social Management Plans (ESMPs), including supervision regarding proper removal, packaging, and transport and disposal/interim storage of the hazardous materials, use of personal safety equipment, and monitoring in line with requirements of design and Environmental Mitigation and Monitoring Measures based on the Environmental and Social Management Framework.
- Ensure that all health & safety measures are respected by the construction company in compliance with the monitoring and reporting requirements of relevant official authorities and the World Bank.

The Consultant is required to follow-up all the necessary permits, approvals, payment of all fees and contributions during the course of the construction contract.

**1b) Evaluate the completion and implement commissioning of the construction projects until Taking-over Stage**

- Confirm the projects' compliance with the investment plan. In case of deviation from those plans, justification of the differences and evaluation of consequences in terms of compliance of the project with the eligibility criteria of the facility.
- Before issuing the Taking-Over Certificate, the Consultant will enforce any obligation placed on the construction contractor to remove all obstructions, surplus materials, plant, wreckage, rubbish and temporary works.
- Upon completion of the works, the Consultant will require the construction contractor to remove all plant, equipment and materials except those required to complete any outstanding or remedial works and facilities required by the Consultant during the

Defects Notification Period.

- The Taking-over certificate shall be prepared and issued by the Consultant in consultation with the Client, following the successful completion of the works provided that the Consultant is satisfied that any defects or deficiencies have been successfully rectified.
- The Consultant shall oversee training of O&M staff on new equipment. The issuance of the Taking-over Certificate shall be subjected to:
  - The Contractor having provided the operating and maintenance manuals, training of O&M staff on new equipment, as well as all the drawings and documents handed over to the Client requested in the contract.
  - No major deficiencies are found and minor deficiencies are listed in the defects list by the Consultant.
- The Consultant shall witness the works performance tests carried out after completion and will analyze, evaluate and approve the final performance tests with the concurrence of the Client. The analyses, results and conclusions with recommendations shall be compiled in the project completion report to be submitted to the the Client.
- Prepare Energy Performance Certificate (EKB): The consultant shall prepare the energy performance certificate of the building before and after the completion of the works with the BEP-TR program.

**1c) Interim semi-monthly progress reports for works contract**. These will describe the physical and financial progress of the works and will address contractual and technical matters. They shall provide information on (tentative list below that can be amended):

(i) a description of physical progress, with reference to the program (including progress charts and dated photographs in color giving all information regarding the progress of the Works);

(ii) explanations for differences between actual and forecast progress;

(iii) a summary financial report containing cash-flow forecasts and budget expenditure:

(iv) status of payments and requests for payment:

(v) explanations for differences between actual and forecast cash-flow o summary of claims and disputes;

(vi) major milestones, obstacles, achievements, constraints on progress and problems encountered and appropriate identified solutions;

(vii) remarks on procedural issues;

(viii) variations and proposals for future variations to the timing and budgets of individual activities;

(ix) a projection of activities for the forthcoming month;

(x) recommendation for further actions and improvements, both short- and long-term;

(xi) records of human resources, mechanical equipment and materials, testing and quality control, with copies of the test results and, statistical evaluation of the test results in table or graphical form. Action taken with regard to poor results shall be stated;

(xii) local issues/stakeholder issues (including any grievances received by nearby communities and/or workers);

(xiii) a summary of site-specific environmental and social issues (update on the status of implementation of the respective ESMP, OHS compliance, and also outline any environmental, social and OHS problems being encountered);

(xiv) The report shall include the percentages of the Work items completed and planned, and also the actual and planned cash-flows for each work item as of the reporting period prepared in the project planning tools (such as Primevera, Asta, etc) accepted by the client.

The report shall be submitted to the Client by the fifth day of following month. Any comment by the Client on the report shall be reviewed and re-submitted to the Client within a week.

In addition, the Consultant have to record views from at least 5 points for each building, on weekly base, showing the progress on the site with dates and record them with acceptable format on USB storage and submit to the Client.

Consultants shall also prepare a report in table form showing summary of cumulative progress in main work activities on weekly basis. The report shall be submitted to the Client in an acceptable format by the Monday of each week via electronic mail.

**1d) Draft project completion report**, to be delivered 4 weeks prior to completion of the contract period. These will provide an overview and measure of success of the project. They shall contain: (i) a summary of information contained in the previous monthly reports; (ii) an overall review of the project; (iii) a description of physical progress, with reference to the program; (vi) explanations for differences between actual and forecast progress; (v) a summary financial report containing cash-flow forecasts and budget expenditure; (vi) the status of payments and requests for payment; (vii) explanations for differences between actual and forecast cash-flow on summary of claims and disputes; (viii) an assessment of impact of project on the number of people employed; (ix) a report on problems encountered and how they were overcome; (x) recommendations for maintenance works; (xi) report on the compliance with ESMPs. The Consultant shall review and approve in consultation with the Client the relevant completion reports with enclosed test results for the particular work sections submitted by the Contractor. These reports shall address all Tests on Completion and Tests after Completion including their results. The approval of the completion reports shall be a pre-condition for issue of any Taking-over Certificate and Tests after Completion.

**Final inspection report.** The final inspection report of the Consultant shall address the status of the work items at the time of Taking-over by the Client. The minor outstanding works, defects, failures, shortcomings are to be listed and compiled. Possible remedial actions by the Contractor as needed, are to be listed and noted, including the given period of time the Contractor is to rectify. The material handed over by the Contractor to the Client will be checked and listed for status and completeness

**Final completion report**, to be delivered 2 weeks after completion of the contract period or after comments on the draft project completion report provided by the Client. The contents will be as for the draft completion report, with the incorporation of comments/suggestions from the reviewing parties.
The report shall contain at least:

(i) Copies of requests for issuance of a takeover certificate;
(ii) A list of approved As-Built Design submitted by the Contractor showing all the modifications in relation to the Main design elements or surveyor of performed works;

(i) Quality assessment of materials and workmanship;

(ii) Data on the technical difficulties encountered and how they were solved;

(iii) Comment on the As-Built Design, (vi) List of Instructions for Use and Maintenance,

(iv) Final Report on Contractor's ESHS performance (Code of Conduct, compliance with ESMP, consent/permits and other relevant project requirements.

The report shall be delivered to the Client upon completion of the works all job records, reproducible "as-built" drawings including (but not limited to) calculations, drawings, specifications, test reports and final cost analysis and the instruction necessary for the satisfactory operation and maintenance of the works.

**Energy Performance Certificate (EKB)** should be prepared for each building after completion of the renovation works.

**Other reports upon request.** The Client may request the Consultant to submit specific reports on the issues related to the execution of the works. The Consultant will make the requested report in such manner within a reasonable time. The Consultant is obliged to provide all assistance to the Client, upon request, in drawing up reports to the bodies that comprise the institutional framework for project implementation described in the introduction to this project task, relating to project implementation reports, financial reports and etc.

***Task 2: Supervise remedial works to rectify defects that arise during the Defects Notification Period (DNP)***

The Defects Notification Period (DNP) is 12 months, starting on the date of building commissioning.

- The Consultant shall continue to be responsible for the supervision and inspection of the construction and completion of the Works during the DNP as defined in the works contracts. The level of supervision shall be appropriate to the scale of the works being carried out. The Consultant will provide adequate number of technical staff acceptable to the Client on each construction site during the DNP. These inspections and supervision are to ensure that works, agreed to be carried out during the DNP, are properly carried out and have been completed and that any failure of any part of the Works has been rectified. If any defect is discovered, during this period, the Consultant shall promptly investigate the reason for it, report to the Client and take required actions to rectify the defect. A report of these inspections shall be submitted to the Client, which shall include all details of any defects, faults, accidents or breakdowns, which have occurred together with the estimated costs of repair and the time scales within which they will be completed.
- The Consultant will provide minimum number of technical staff acceptable to the Client on each construction site during the Defects Notification Period. Defects are expected to be minimum for a competent Consultant Firm during defects notification period. Therefore, consultant should consider minimum number of staff assigned in DNP consisting of technicians.
- Preparation and submission of as-built drawings, shop drawings, operating and maintenance manuals for all items of equipment and plants incorporated in or associated with the works, shall be controlled and followed by the Consultant in timely manner. As-built drawings, operating and maintenance manuals should be obtained from the Contractor during the issuing of taking-over certificate. Otherwise, the Client might ask the Consultant for the conversion of the approved shop drawings into as-built drawings if Client considers that the Consultant is not strictly following up the work. The Consultant shall also prepare and submit to the Client's approval a report giving all information about the "as-built-conditions" including (but not limited to) calculations, drawings, specifications, test reports and final cost analysis.

**Reporting Requirements for this Task:**

The Reports should cover, but not necessarily be limited to, the information as follows:

- **DNP quarterly reports.** A report of the DNP inspections shall be submitted to the Client, which shall include all details of any defects, faults, accidents or breakdowns, which have occurred together with the estimated costs of repair and the time scales within which they will be completed. The reports shall be prepared on a quarterly basis.
- **DNP final report** shall be submitted by the time of the expiration of the DNP giving full details of all works carried out during the period. This report shall be submitted by the Consultant to the Client at least 30 days prior to issuing the Defects Notification Certificate for the completed Works.

**Task 3: Preparation of Measurement and Verification (M&V) report**

The M&V period covers 12 months, starting on the date of building commissioning.

- Conduct required measurements to prepare the M&V Report. Measurement and verification of savings will be made in accordance with TS ISO 50.006 and IPMVP Option C (full facility renovation) the consultant should compare the baseline and final energy bills and adjust for degree days (HDD and CDD), changes in operating use, changes in energy prices, occupancy rates, etc.
- Prepare M&V reports for all buildings renovated in one year after the renovation works are completed. The M&V reports need to be consistent with the format to be published by MENR. The Client will review and approve the M&V report or request from the contractor to revise the report. The M&V report shall demonstrate the amount of savings realized by comparing the actual energy consumption with the reference energy consumption in which the necessary adjustments are made according to the TS ISO 50.006 standard and IPMVP will be calculated.

**Reporting Requirements for this Task:**

The Reports should cover, but not necessarily be limited to, the information as follows:

- M&V reports for all renovated buildings

## IV. Reporting Requirements and Time Schedule for Deliverables

**Reporting Requirements**

All Documents need to be in Turkish language. M&V reports also need to be delivered in English language. All reports must be submitted as hard copy (in one copy signed and stamped) and soft copy.

The reports for each task will be submitted to and approved by the Client. The consulting firm must obtain approval for each deliverable before moving to subsequent tasks. The table below summarizes the reports and includes an indicative timeline.

| **Task** | **Reports** | | **Submission** (months after contract signing) |
|---|---|---|---|
| 1 | 1a | Interim semi-monthly progress reports for works contract | Together with the submission of the interim payment certificate for each month |
| | 1b | Final inspection report; final completion report;<br>Energy Performance Certificates (EKB);<br>As-Built drawings (including calculations, drawings, specifications, test reports and final cost analysis);<br>Other reports as requested related to the completion of the works (Taking-Over stage) | At the time of drafting the taking-over report, 2 weeks after taking over, as agreed with the client |
| 2 | | DNP Quarterly Reports and DNP Final Report | Quarterly, at the time of drafting DNP Certificate |

| | | |
|---|---|---|
| 3 | M&V Report | At the time of submitting the DNP Report |

**Time Schedule for Deliverables**

| **Task** | **Deliverables** | **Time Schedule** (months after contract signing) |
|---|---|---|
| 1 | Carry out construction supervision and building commissioning services | This task is estimated to last about 8 months, from the time of signing the contract and work commencement notice letter with the construction contractor until completion of the renovations works by taking over certificate. |
| 2 | Supervise remedial works to rectify defects that arise during the Defects Notification Period (DNP) | The Defects Notification Period (DNP) is 12 months, starting on the date of building commissioning. |

## V. Facilities provided by the consultant

The Consultant shall provide sufficient, qualified and experienced staff to ensure proper site supervision of the works and engineering services both during the construction and defects notification period including M&V works and ensure that the works are executed in accordance with recent regulations and rules. All costs for equipment and administrative and logistic support must be covered by the Consultant and included in the bid price, including:

- All costs arising from the activities of its staff during the contract period, including accommodation, allowances, transportation, insurance, etc.
- Automotive, equipment, office supplies and hardware and software to ensure that the monitoring is fully functional;
- All communication costs, including fax, email, telephone, etc.
- All the equipment, instruments, services and logistical support required for the implementation of the contract, and any costs incurred during its preparation of documents and drafts, copying, printing, etc.
- Technical equipment at the monitoring site;
- Other equipment, instruments, services and logistical support necessary for the implementation of the contract.
- Excellent written and spoken English and Turkish is required. If the Consultant will require a translation services, it will be at his own expenses and the Consultant will be responsible for the accuracy of the translation.
- The Consultant is required to obtain all the other elements necessary for the work of his professional staff who is engaged at his own expense for the performance of this Contract.

- All expatriate staff who will work in Turkey should obtain a work permit and all who are resident for more than 90 days should obtain a non-resident visa. The consultant will obtain all required permits, visas for all expatriate staff at his own cost. Furthermore, the Consultant will be responsible to ensure that all proposed personnel are eligible to obtain such permits and visas. The information related to visas can be obtained from the embassies and consulates of Turkey. The Client will assist the consultant for the issue of work permits.

## VI. Timeline

The estimated time period for this assignment will be held in 2023 and finalized in twenty (20) months period (8 months for construction and 12 months for Defects Notification Period), subject to completion of the construction contract.

During the supervision periods, it should be noted by the Consultant that any schedule, report specification and other document submitted to the Client for approval will be reviewed by the Client and approved or returned for revision and/or resubmission in 15 calendar days.

The Consultant shall submit all the documents in a timely manner to complete the services on time without any delay. Time schedule for the completion of the consultants' services for the various parts of the work as mentioned below shall be submitted to the Client.

During the execution of the Services, the Client and the Consultant shall review the Work Plan and Staffing Schedule of the Consultant for every month. If required, Consultant shall update them requesting the official approval of Client.

## VII. Variations in Scope

- The commencement dates of renovation works in each building may vary due to the unexpected reasons. The Consultants shall wait for the finalization of the tender evaluation or other issues to be concluded in order to start up the construction works and shall not request any payment or compensation.
- In relation to the ongoing stages of the Consultants Services, the submission requirements for deliverables above should be allowed by the Consultants as a guideline for the extent and type of documentation that will be required by the Client during the performance of the Services. However, the Consultants shall allow in its fee for the submission of all reports, drawings, documents, etc. either specifically requested in these Terms of Reference or those which may be implied therefrom and the Contractors' contracts. The Client may however vary such requirements during the course of the Services to be performed.
- Should additional reports or copies be required extra over to those stated above or to be implied from these Terms of Reference, these shall be supplied by the Consultant(s) at the cost of preparation and reproduction of such documents, reports or drawing.
- Upon the completion of Works, the Consultants shall submit all the original copies of correspondences, documents, test results, drawings etc., relating to the Services and Works, to the Client together with indices in acceptable files and forms by the Client.

## VIII. Support to be provided by the client to the consultants

- The client will sign letters with the beneficiary buildings that describe the responsibilities of the beneficiary, including appointing a contact/facility coordinator for all project phases, facilitating access to buildings or facilities, providing existing documentation, etc. Client shall, where possible, assist the Consultants in obtaining approvals, permissions from the Municipalities and other State Authorities in respect of the Services to be performed.
- The inputs (contract drawings, Bill of Quantities, tender documents, etc.) shall be provided free of charge by the Client to the Consultants. Consultant shall return all such drawings and documents received to the Client upon the completion of services.
- The Works Contractors' bidding documents are already arranged to incorporate clauses to provide temporary office facilities to the Consultants depending on the size and location of the construction sites, the size and number of rooms (generally the site office has approximately 80 m2 area and includes 1 meeting room, 3 room, 1 WC and 1 Kitchen) shall be jointly determined by the Client and the Consultant considering the needs of the Client as well. However, these will be constructed by the Contractors and will take some time. The Consultants will be fully responsible for providing their central site office until the contractors are in place to make site offices available. The central office shall be furnished and equipped by the Consultants, whereas the site offices shall be furnished by the Contractor. All sort of running expenses for the site offices except water and electricity (to be provided by the Contractor) shall be under the Consultant's responsibility. The Consultant shall not be required to deliver any equipment and materials provided by the reimbursable expenses and which have been used for the Services to the Client.

## IX. Team Composition and Qualification Requirements for the Key Staff

The Consultant shall provide an experienced construction supervision and contract administration team with proven technical and managerial competence and experience in the supervision of construction works under FIDIC Conditions of Contract or other internationally recognized contract conditions used by IFI's.

### i) Consultant Profile:

The Consultant should have similar previous experience in supervision of construction works in superstructures or Energy Efficiency renovations.

The attention of interested Consultants is drawn to Section III, paragraphs, 3.14, 3.16, and 3.17 of the World Bank's "Procurement Regulations for IPF Borrowers" July 2016, as amended, setting forth the World Bank's policy on conflict of interest.

Consultants may associate with other firms to enhance their qualifications, but should indicate clearly whether the association is in the form of a joint venture and/or a sub- consultancy. In the case of a joint venture, all the partners in the joint venture shall be jointly and severally liable for the entire contract, if selected.

**ii) Team Composition**

The working language of the project is English. All the team members assigned by the Consultant must possess proficiency in English language. Day-to-day communication language will be Turkish or English at the field level to ensure smooth communication among all participants, direct and indirect, of the Project.

All key staff and support staff shall be mobilized immediately after the first Construction Contract signature in way to evaluate the design and make the necessary adjustment before the works commence. At least one Technician/Junior Engineer (responsible from Mechanical and Electrical works) shall be assigned for every campus. Technicians/Junior Engineers should have at least three (3) years' experience. In addition, support staff for the administrative services shall be proposed additionally as required (surveyors, clerks, drivers, secretary etc.)

The Team Leader together with the respective Cost & Planning, Electrical and Mechanical Engineers will be required for Inspections during the twelve (12) month Defects Notification Period. The Supervision Team and the Team Leader will be entitled to follow, supervise and certify the implementation of the health and safety measures as per the law 6331.

**Key staff's qualifications shall include but not limited to the following:**

| Services | Position (Min. *Number of Staff Required*) | Required Experience |
|---|---|---|
| Management of Phase II | Team Leader (1): | Architect, Civil, Electrical or Mechanical Engineer with minimum fifteen (15) years of professional experience including at least ten (10) years' energy efficient building supervision experience in public buildings and five (5) years working experience in manager position. |
| For Supervision and Commissioning for Energy Efficiency Building Renovations (Phase II) | Civil Engineer (1): | Civil Engineer with minimum ten (10) years of professional experience including at least five (5) years' energy efficient building supervision experience in public buildings |
| | Architect (1): | Architect with minimum ten (10) years of professional experience including at least five (5) years' energy efficient building supervision experience in public buildings. |
| | Mechanical Engineer (1): | Mechanical Engineer having ten (10) years of professional experience including five (5) years' energy efficient building supervision experience in public buildings and measurement - verification of energy efficiency measures after commissioning of works. |
| | Electrical Engineer (1): | Electrical Engineer having ten (10) years of professional experience including five (5) years' energy efficient building supervision experience in public buildings and measurement - verification of energy efficiency measures after commissioning of works. |
| | Environmental and Social Specialist (2): | University degree in engineering with minimum five (5) years of professional experience, includes at least three (3) years' experience in environmental and social impact/risk assessment, preparation of environmental and social assessment tools (Environmental and Social Management Plan (ESMP), Environmental and Social Impact Assessment |

| Services | Position (Min. *Number of Staff Required*) | Required Experience |
|---|---|---|
| | | (ESIA), etc.) and knowledge in environmental and social safeguard policies and Environmental and Social Standards (ESSs) of the World Bank's Environmental and Social Framework (ESF) or other international development institutions. |
| | Occupational Health and Safety Specialist (2): | University degree in engineering with health and safety monitoring experience in public buildings and having at least B Class Certification (defined in the law 6331 of the Turkish legislation) or similar internationally recognized certification is mandatory. |
| | Cost and Planning Engineer (1): | University degree in engineering with minimum five (5) years of professional experience including at least two (2) years' specific experience on development of project specifications, time schedules and budgets in public buildings |
| | QA/QC Engineer (1): | University degree in engineering with minimum five (5) years of professional experience including at least five (2) years' quality assurance and control experience in public buildings. |

## Annex 1: Building List

# ANNEX-1: BUILDING LIST

Yıldız Teknik Üniversitesi Davutpaşa Kampüsü


| No | YTÜ Davutpaşa Kampüsü Binaları | İnşaat Alanı (m²) |
|---|---|---|
| 1 | Elektrik Elektronik Fakültesi | 35.073,00 |
| 2 | Fen Edebiyat Fakültesi | 27.910,00 |
| 3 | Kimya Metalürji Fakültesi | 30.738,00 |
| 4 | Kütüphane Binası | 5.667,00 |
| 5 | İnşaat Fakültesi | 38.897,00 |
| 6 | Kapalı Spor Salonu | 3.066,00 |
| 7 | Kapalı Yüzme Havuzu | 3.937,00 |
| 8 | İktisadi ve İdari Bilimler Fakültesi | 18.820,00 |
| 9 | Yemekhane | 6.918,00 |
| 10 | Kız Yurdu | 2.564,00 |
| 11 | Eğitim Fakültesi | 15.890,00 |
| | **Toplam Alan (m²)** | **189.480,00** |

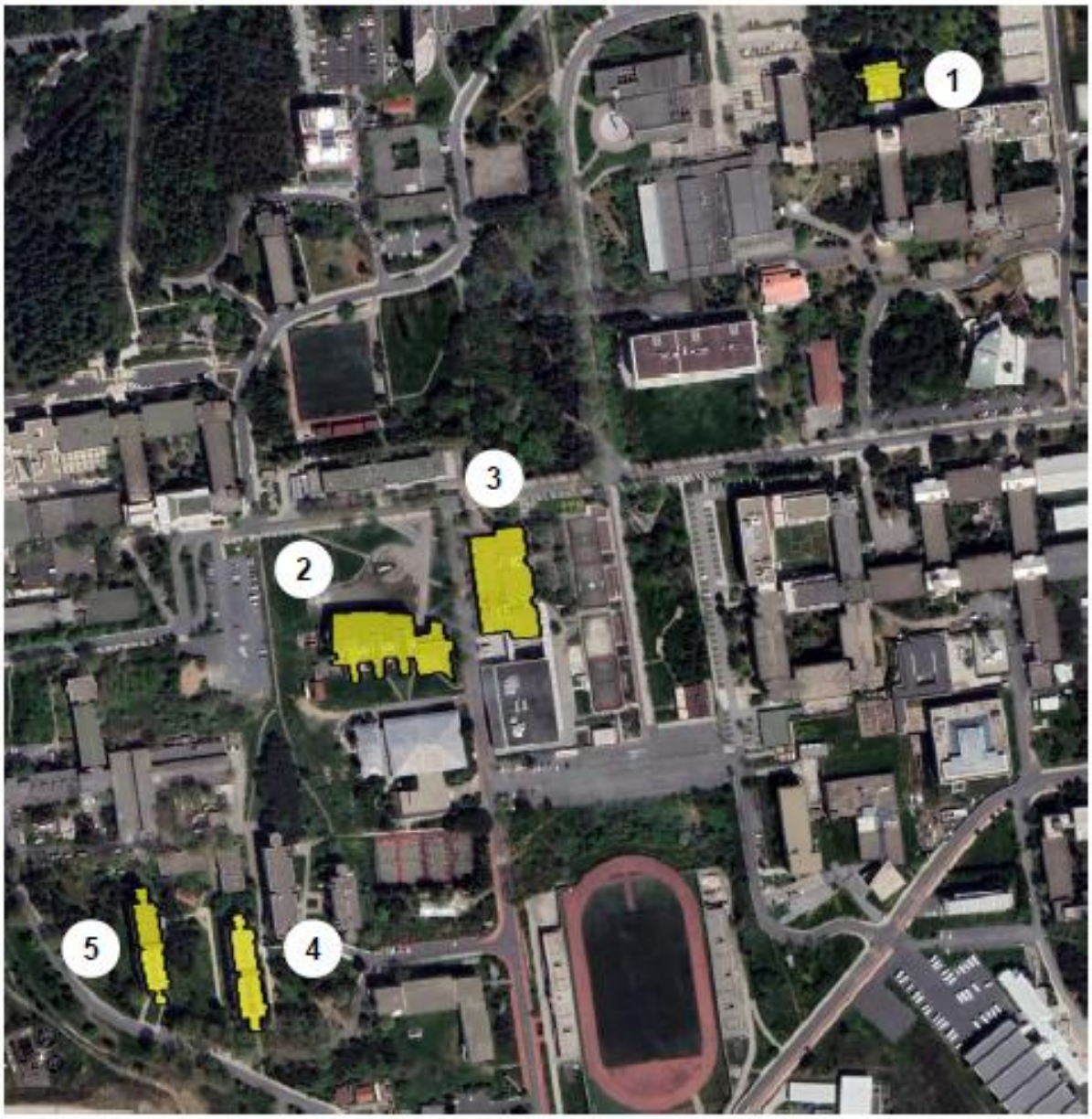
## Boğaziçi Üniversitesi Kuzey Kampüsü


| *No* | Boğaziçi Üniversitesi<br>Kuzey Kampüsü Binaları | İnşaat Alanı (m²) |
|---|---|---|
| *1* | Kütüphane Ek Binası | 3.920,00 |
| *2* | Bilgisayar Mühendisliği | 3.445,00 |
| *3* | Eğitim Fakültesi | 5.471,00 |
| *4* | Eğitim Teknolojisi B Blok | 4.306,00 |
| *5* | Yeni Derslik Binası | 9.921,00 |
| *6* | 4. Kuzey Yurdu | 7.407,00 |
| *7* | 3. Kuzey Yurdu | 6.684,00 |
| | **Toplam Alan (m²)** | **41.154,00** |

## Boğaziçi Üniversitesi Hisar Kampüsü


| *No* | Boğaziçi Üniversitesi<br>Hisar Kampüsü Binaları | İnşaat Alanı (m²) |
|---|---|---|
| *1* | Hisar Blokları (A-B-C-D-E) | 9.664,00 |
| *2* | Kapalı Spor Salonu ve Yüzme Havuzu | 3.153,00 |
| | **Toplam Alan (m²)** | **12.817,00** |

## İstanbul Teknik Üniversitesi Ayazağa Kampüsü




| *No* | İTÜ Ayazağa Kampüsü Binaları | İnşaat Alanı (m²) |
|---|---|---|
| *1* | Moleküler Biyoloji ve Genetik Araştırmalar Merkezi (MOBGAM) | 3.340 |
| *2* | Mustafa İnan Kütüphanesi | 8.998 |
| *3* | 75. Yıl Öğrenci Sosyal Merkezi (Eski Yemekhane Binası) | 4.670 |
| *4* | Altan Edige Kız Öğrenci Yurdu | 7.633 |
| *5* | Ali İhsan Aldoğan Kız Öğrenci Yurdu | 7.633 |
| | **Toplam Alan (m²)** | **32.274,00** |