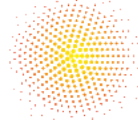




**Altensis**  
Managing Sustainability



**S317**  
CONSULTING



# ..... BUILDING ENERGY AUDIT QUALITY CRITERIA CHECKLIST

Package No	0
Lot No	0
Date of Review	0
Review No	0
Result of Review	APPROVED



**T.C. ÇEVRE VE  
ŞEHİRCİLİK BAKANLIĞI**



**THE WORLD BANK**  
IBRD • IDA | WORLD BANK GROUP

.... 2022

SUMMARY OF ENERGY AUDIT REPORT REVIEW RESULTS			
Date of Review			
Review No			
Information about Energy Audit Report			
1	Package No		LOT No
2	Building Name		
3	Date of Energy Audit Report		
4	Revision Number of Energy Audit Report		
5	Energy Efficiency Consulting Company Name		
6	Energy Efficiency Expert Name		E-mail
Energy Audit Report Review Outputs			
Chapters of Energy Audit Report		Compliance Rate	Notes
1	Cover Page	100%	Etüt raporunun bu bölümü uygundur.
2	Table of Contents, Tables and Figures	100%	This section of energy audit report is appropriate.
3	Executive Summary	100%	This section of energy audit report is appropriate.
4	Energy Audit	100%	This section of energy audit report is appropriate.
5	Energy Efficiency Measures Details	100%	This section of energy audit report is appropriate.
6	Energy Management and No/Low-Cost Opportunities	100%	This section of energy audit report is appropriate.
7	Building Management Systems (BMS) and Metering Systems	100%	This section of energy audit report is appropriate.
8	On-site Generation and Renewable Energy Systems	100%	This section of energy audit report is appropriate.
9	Energy Performance Certificate	100%	This section of energy audit report is appropriate.
10	Energy Performance Contracting (EPC) Methodology	100%	This section of energy audit report is appropriate.
11	Appendix	100%	This section of energy audit report is appropriate.
Percentage of Total Completion		100%	The energy audit report is appropriate.
General Assessment - Technical Consulting (ESCON-ALTENSIS-ENVE-S317) Review Notes			
1			Appropriate
2			Revision needed
3			Sufficient
RESULT			APPROVED
General Assessment - MoEU Review Notes			
1			Appropriate
2			Sufficient
3			Appropriate
RESULT			APPROVED

<b>1</b>	<b>Cover Page</b>
<b>1,1</b>	Is the report name specified?
<b>1,2</b>	Is there a building/establishment name in the report title?
<b>1,3</b>	Is the building/establishment location specified?
<b>1,4</b>	Is the building type (hospital, school etc.) specified?
<b>1,5</b>	Is there a picture of building?
<b>1,6</b>	Is there a date of report?
<b>1,7</b>	Is there a name of the company that prepared energy audit report?
<b>1,8</b>	Are the certificate numbers of experts who prepared the energy audit report specified?

<b>2</b>	<b>Table of Contents</b>
<b>2,1</b>	Is there a table of contents?
<b>2,2</b>	Does the table of content contain all main headings?
<b>2,3</b>	Are there subheadings in the table of contents?
<b>2,4</b>	Are the appendices heading included in table of contents?
<b>2,5</b>	Does the table of contents match the headings in energy audit report?
<b>2,6</b>	Is there a list of tables used in energy audit report?
<b>2,7</b>	Are the tables in energy audit report with their numbers and names available under Tables heading?
<b>2,8</b>	Is there a list of figures used in energy audit report?
<b>2,9</b>	Are the figures in energy audit report with their numbers and names available under Tables heading?
<b>2,10</b>	Is there a list of abbreviations used in energy audit report?
<b>2,11</b>	Are abbreviations used in energy audit report clearly defined under abbreviation list?
<b>2,12</b>	Is the reference values table available at beginning of energy audit report or in appendix section?

<b>3</b>	<b>Executive Summary</b>
<b>3,1</b>	Is there an Executive Summary?
<b>3,2</b>	Is the building information provided in a summary table? (Year of construction, purpose of use, building usage area, heating-cooling-ventilation system, current energy manager information, etc.)
<b>3,3</b>	Has the building's energy consumption data for the last three years been tabulated in Tons of Oil Equivalent (TOE)?
<b>3,4</b>	Has the building reference (baseline) energy consumption been calculated?
<b>3,5</b>	Is there a figure for specific energy consumption (kWh/ m2.year) among the general performance criteria of the building?
<b>3,6</b>	Is there a figure for the emission amount per square meter (Ton CO2 equivalent / m2.year) among the general performance criteria of the building?
<b>3,7</b>	Is there an emission amount per occupant (Ton CO2 eq./person.year) among the general performance criteria of the building?
<b>3,8</b>	Is there a figure for fuel consumption per heating degree day (kWh/ HDD m2.year) among the general performance criteria of the building?
<b>3,9</b>	Is there a figure for electrical energy consumption per cooling degree day (kWh/ CDD m2.year) among the general performance criteria of the building?
<b>3,10</b>	Is the purpose, scope of the audit, and working period specified?
<b>3,11</b>	Is the reference energy consumption and cost of the building provided with the energy consumption/cost after the energy efficiency measures provided in the table?
<b>3,12</b>	Is the energy consumption, energy costs, and their ratio of total consumption for the last three years provided in tables and graphics?
<b>3,13</b>	Are the annual energy savings and costs for each measure provided in the summary table of proposed energy efficiency measures?
<b>3,14</b>	Is the Base Scenario energy efficiency measures summary table provided with the necessary savings and economic analysis data?
<b>3,15</b>	Is the Deep Renovation Scenario energy efficiency measures summary table provided with the necessary savings and economic analysis data?
<b>3,16</b>	Is the Mixed Scenario energy efficiency measure summary table provided with the necessary savings and economic analysis data?
<b>3,17</b>	Is the evaluated but not recommended energy efficiency measures summary table provided with the necessary savings, economic analysis data, and the reason behind them?
<b>3,18</b>	Have energy efficiency measures been briefly explained in relation to low/no cost measures and the operation and maintenance process?
<b>3,19</b>	Has the building's compliance with the nZEB (Nearly Zero Energy Building) and ESCO (Energy Performance Contract Building) models been evaluated and added to the audit report?

<b>4</b>	<b>Energy Audit</b>
4,1	Is there building information (building year, building type, number of renovations, etc.)?
4,2	Is there a building layout plan?
4,3	Are there any sectional views of the building?
4,4	Are the different types of spaces in building specified?
4,5	Are there floor areas, numbers and story heights?
4,6	Are there building envelope elements (exterior wall, roof and floor), thickness, R and/or U values?
4,7	Is there any information about areas of external wall, roof and floor?
4,8	Is there information at what stage of economic life the building envelope elements are in current situation?
4,9	Is there information on asbestos content in the building components?
4,10	Is there a comparison table for U values of building components due to climate zone of building specified in the TS 825 local heat insulation standard and the existing building component U values?
4,11	Is the glass type and frame type specified?
4,12	Is there an area and location information for windows located on building façade?
4,13	Is there any information about color of the glass used on building façade?
4,14	Is there any information about windows' operability?
4,15	Is there any information at what stage of economic life for windows are in current situation?
4,16	Is there any information about window's U-value (Glass+Frame) and solar factor of glass (SHGC)?
4,17	Is there any information about shading elements?
4,18	Is there a comparison table for U values of windows due to climate zone of building specified in the TS 825 local heat insulation standard and the existing window U values?
4,19	Is there any information about whether there are defects such as cracks, air leaks, moisture, mold on the façade of the building?
4,20	Are there building floor plans?
4,21	Are there any exterior views of the main building?
4,22	Is there information about building occupancy rates on a daily, weekly and annual basis?
4,23	Are the times when there is no building use (holidays, weekends, etc.) that may affect energy use seasonally specified in energy audit report?
4,24	Is there any information (capacity, design and working conditions, equipment lists, control types, number of auxiliary equipment, etc.) of the equipment and systems evaluated in energy audit?
4,25	Are there performance values (COP, SEER, etc.) of the equipment or systems evaluated in energy audit?
4,26	Is there an explanation about the HVAC system and zones that are addressed by these systems?
4,27	Is there information about number, location, nameplate information, power, capacity, year of manufacture, fuel type of central heating/cooling equipment such as boilers, chillers and cooling towers?
4,28	Is there information about supply-return temperatures, operating hours, the areas or systems it addresses, control type, performance values of central heating/cooling equipment such as boilers, chillers and cooling towers?
4,29	Is there a statement indicating at what stage the economic life of central heating/cooling equipment such as boilers, chillers and cooling towers?
4,30	Is there information about number, location, nameplate information, power, capacity, year of manufacture of the ventilation system equipment (air handling units, fresh/exhaust air fans, etc.)?
4,31	Is there information about operation hours, the areas or systems it addresses, control type, performance values (heat recovery efficiency, fan motor efficiency, etc.) of ventilation system equipment (air handling units, fresh/exhaust air fans, etc.)?
4,32	Is there an explanation indicating at what stage the economic life of ventilation system equipment (air handling units, fresh/exhaust air fans, etc.)?
4,33	Is there information about number, location, nameplate information, power, capacity, year of manufacture of the HVAC equipment used in zones (radiator, split AC, VRV etc.)?
4,34	Is there information about operation hours, the areas or systems it addresses, control type, performance values (EER, COP, SEER, etc.) of HVAC equipment (radiator, split air conditioner, VRV, etc.) used in zones?
4,35	Is there an explanation indicating at what stage the economic life of HVAC equipment (radiator, split air conditioner, VRV, etc.) used in zones?
4,36	Is there a summary of how the HVAC systems are controlled in building and how operating charts are made in energy audit report?
4,37	Is there information about number, location, nameplate information, power, capacity, year of manufacture, fuel type of domestic hot water equipment?
4,38	Is there a list of areas (kitchen, laundry, gym, etc.) where domestic hot water needs are intense in building and the number of main consumers (sink, shower, etc.)?
4,39	Is there an explanation indicating at what stage the economic life of domestic hot water equipment (boiler, water heater, etc.)?
4,40	Is there any explanation about the lighting system?
4,41	Are there an information about luminaire types used in the interior lighting system, areas it serves, number information, power values and control types?

<b>4</b>	<b>Energy Audit</b>
<b>4,42</b>	Are there an information about luminaire types used in the exterior lighting system, areas it serves, number information, power values and control types?
<b>4,43</b>	Is there an explanation about the motor loads (pumps, fans, burners, elevators, etc.) in the building?
<b>4,44</b>	Are there any information about number of pumps used in the building, year of manufacture, capacity, power, place of use, performance, control types (constant flow, variable flow, etc.), motor efficiency class and nameplate information?
<b>4,45</b>	Are there any information about number of fan motors used in the building, year of manufacture, capacity, power, place of use, performance, control types (constant flow, variable flow, etc.), motor efficiency class and nameplate information?
<b>4,46</b>	Is there an explanation that gives information about plug loads and other equipment that consumes electrical power in building?
<b>4,47</b>	Is there an explanation that includes thermal camera images showing heat insulation conditions of installation and heat insulation element properties?
<b>4,48</b>	Are there any estimated or calculated operation hours information for the equipment used in building?
<b>4,49</b>	Are there any information about existing idle mechanical equipment?
<b>4,50</b>	Are there any information about existing broken or inoperative lighting fixtures?
<b>4,51</b>	Is there any explanation about unexpectedly operating conditions (at high capacity, different from design temperatures, etc.) of equipment in current situation?
<b>4,52</b>	Are there any views/photographs of main distribution panels and compensation panels?
<b>4,53</b>	Are the main distribution panel measurements showing current, voltage and power values presented in energy audit report?
<b>4,54</b>	Are there any thermal camera images for areas that may be overheating in the panels?
<b>4,55</b>	Is the table containing capacitive reactive and inductive reactive values according to previous period invoices shared in energy audit report?
<b>4,56</b>	Have possible suggestions, such as power factor arrangement, been presented in energy audit report by examining reactive penalty?
<b>4,57</b>	Has a tariff analysis been made?
<b>4,58</b>	Is there a table showing the energy suppliers and the types of energy used?
<b>4,59</b>	Is there any information about tariff type, cost per unit consumption (TL/kWh, TL/Sm <sup>3</sup> , etc.) and the amount of energy use annually for last three years in table showing the energy suppliers and the types of energy used?
<b>4,60</b>	Is there a table showing the energy use profile for last three years?
<b>4,61</b>	Are there consumption amounts (kWh and TEP) and energy cost values for all energy types used in building according to monthly breakdowns in the table showing energy use profile?
<b>4,62</b>	Is there a table showing annual energy use amount, CO <sub>2</sub> amount, total energy cost, costs per unit consumption (TEP/TL, CO <sub>2</sub> /TL) for last three years?
<b>4,63</b>	Is there a table that compares the amount of energy consumed compared to previous year and shows the rate of change?
<b>4,64</b>	In cases where annual energy use changes over 10%, is there any detailed explanation for the reasons of change?
<b>4,65</b>	Is there a chart that compares the electricity use values of last three years with the monthly cooling degree days?
<b>4,66</b>	Is there a chart that compares the fuel (natural gas, coal, fuel-oil, etc.) consumption values for last three years with the monthly heating degree-day values?
<b>4,67</b>	Is there a graph comparing the electricity and fuel consumption values of last three years according to building occupancy rates?
<b>4,68</b>	Is trend analysis performed on the prepared charts?
<b>4,69</b>	Is there an explanation about the values compared (electricity use-CDD, fuel use-HDD, energy use-building occupancy rates) according to graphics?

5	Energy Efficiency Measures Detail
5,1	Are proposed energy efficiency measures provided in tabular form with necessary energy saving and economic analysis data?
5,2	Is the content and table of Base Scenario energy efficiency measures provided with a minimum 20% energy saving and a payback period no longer than 12 years?
5,3	Is the content and table of Deep Renovation Scenario energy efficiency measures provided with a minimum 30% energy saving and a payback period no longer than 20 years?
5,4	Is the content and table of Mixed Scenario energy efficiency measures provided with necessary savings and economic analysis data?
5,5	Are energy efficiency measures and savings calculations for different energy types provided as separate items in the summary tables?
5,6	Is there a description of the existing conditions for each energy efficiency measure, a detailed description of the proposed measure, and information about implementation methodology?
5,7	Has justification been made in the case of differences in the base scenario and deep renovation scenario for the identical energy efficiency measure?
5,8	Are detailed explanations and analysis of energy efficiency measures provided in the appendices of the audit report?
5,9	In the detailed calculations of the energy efficiency measures, is the operation time of the relevant system in accordance with the type of building and its climate zone?
5,10	Does building area and volume data used in energy efficiency measure detailed calculations consistent with the existing building area and volume data?
5,11	Has the cross-effect of proposed EEMs in different systems been taken into account in energy efficiency measure detailed calculations?
5,12	Are the energy unit, energy unit price, and CO <sub>2</sub> emission coefficients used in EEM detailed calculations compatible with the values determined by the authorized national and international institutions?
5,13	Have assumptions been made in EEM detailed calculations (operation time, system capacity, system efficiency, etc.) taking into account the existing and proposed system characteristics?
5,14	In EEM detailed calculations, is system-specific energy use taken into account by performing a breakdown of the subsystems?
5,15	Is the simple payback period for energy efficiency measures economic calculations consistent with economic life of the system equipment?
5,16	Are investment costs and net annual income values used in calculating net present value (NPV), internal rate of return (IRR) for economic calculations consistent with calculations and proforma invoices?
5,17	Is the discount rate used in the calculation of net present value (NPV) and internal rate of return (IRR) consistent with the value in the reference values table?
5,18	Are lower heating values used in the TEP, kWh, Sm <sup>3</sup> , kg cycles of fuel and electrical energy compatible with the values defined in the legislation and the values specified in the reference values table?



<b>6</b>	<b>Energy Management and No/Low-Cost Opportunities</b>
<b>6.1</b>	Has it been questioned whether an earlier energy audit was performed in the building? Is there any information shared about the previous audit report?
<b>6.2</b>	Are there ISO 50001 Energy Management System studies being conducted in the building? Is there any information shared in the audit report related to this?
<b>6.3</b>	Is there an energy manager currently assigned to the building? Is there any information shared in the audit report related to this?
<b>6.4</b>	Are there any awareness-raising activities related to energy management? Is there any information shared in the audit report related to this?
<b>6.5</b>	Are there any measures presented that involve the building operation and maintenance process?
<b>6.6</b>	Are the measures in this section provided in a similar template to previous energy efficiency measures?
<b>6.7</b>	Are measures involving negative energy savings explained (increased fresh air rates or amount of lighting power density) that may be required during the operation and maintenance process or implementation of the proposed energy efficiency measures?
<b>6.8</b>	Are there any no-cost/low-cost energy efficiency measures proposed for the building?
<b>6.9</b>	Is a brief explanation provided about these measures?
<b>6.10</b>	Has an explanation been provided for the measures that have not been analyzed as energy efficiency measures but can be recommended in the later parts of the energy audit report (insulation application to the uninsulated building envelope, which may have a very long payback period)?

<b>7</b>	<b>Building Management System (BMS) and Metering System</b>
<b>7,1</b>	Is a energy monitoring system with central control proposed within the deep renovation scenario and with a payback period of no longer than 20 years?
<b>7,2</b>	If there is a main meter in the building, is this situation briefly described in the system definition section? If there is no main meter, has this been proposed as a measure in all scenarios?
<b>7,3</b>	In the proposed system, does separate metering and/or sub metering exist for different energy types (electricity, natural gas, diesel oil, etc.) of the building?

<b>8</b>	<b>On-site Generation and Renewable Energy Systems</b>
<b>8,1</b>	Are inputs and outputs related to renewable energy systems and on-site generation (installed power, total energy production, brief installation description, connection point, energy sales to the grid if any, etc.) described and presented?
<b>8,2</b>	Are system schematic drawings provided (Drawings of the location where the PV panel will be installed)?
<b>8,3</b>	Tahmini enerji üretimini içeren hesaplama raporun ekler kısmında sunulmuş mudur?

<b>9</b>	<b>Energy Performance Certificate</b>
<b>9,1</b>	Are there energy performance certificates for the building/project blocks?
<b>9,2</b>	Is the building's existing energy performance certificate level provided in the table?
<b>9,3</b>	Is the building energy performance certificate level after the energy efficiency project provided in the table?

<b>10</b>	<b>Energy Performance Contracting (EPC) Methodology</b>
<b>10,1</b>	Has reference (baseline) energy consumption data been defined?
<b>10,2</b>	Are measurement boundaries specified for energy efficiency measures?
<b>10,3</b>	Is it specified which measurement and verification option is used according to the IPMVP protocol for each energy efficiency measure?
<b>10,4</b>	Is there an explanation of the selected measurement and verification options for energy efficiency measures?
<b>10,5</b>	Have independent variables been defined for measurement and verification (M&V) calculations in accordance with the IPMVP protocol?
<b>10,6</b>	Are static factors defined for measurement and verification (M&V) calculations in accordance with the IPMVP protocol?
<b>10,7</b>	Is a measurement and verification reporting period specified?
<b>10,8</b>	Are analysis methods specified for Baseline Adjustment?
<b>10,9</b>	Are regression coefficients and calculation formulas specified in the analysis methods for reference period adjustment (Baseline Adjustment)?
<b>10,10</b>	Is there an explanation of the measurement/monitoring/analysis equipment used in measurement and verification process?

<b>11</b>	<b>Appendix</b>
<b>11,1</b>	Is there information (name, surname, certificate numbers, etc.) of team that carried out energy audit in building?
<b>11,2</b>	Are there references, reference values and abbreviations used in energy audit report?
<b>11,3</b>	Are there calibration certificates of equipment used during the energy audit?
<b>11,4</b>	Is there a copy of the authorization certificate for authorized Energy Efficiency Consulting firm?
<b>11,5</b>	Are there final energy use calculations?
<b>11,6</b>	Are there calculation software outputs that use TS 825 local heat insulation code?
<b>11,7</b>	Are there calculation outputs of BEP-TR2 software that is generated by MoEU to define buildings' Energy Performance Certificate?
<b>11,8</b>	Is there energy model documentation?
<b>11,9</b>	If energy modeling has been generated for building, is there any information about which simulation software and version is used?
<b>11,10</b>	If building energy modeling has been generated, have simulation inputs and outputs been shared?
<b>11,11</b>	Is there an information about equipment evaluated within the scope of energy efficiency measures in building?
<b>11,12</b>	Is there an information about the operating sequence of equipment evaluated within the scope of energy efficiency measures in building?
<b>11,13</b>	If there is a cogeneration system in building, have details of system been shared?
<b>11,14</b>	Is there information on specific requirements (maintenance practices, control requirements, etc.) for energy efficiency measures?
<b>11,15</b>	Are there energy calculations for each proposed energy efficiency measure?
<b>11,16</b>	Are there equipment pro forma invoices showing the investment costs for each proposed energy efficiency measure?
<b>11,17</b>	Are there technical cutsheets of equipment planned to be used for each proposed energy efficiency measure?
<b>11,18</b>	Are there documents (photographs, outputs, etc.) showing the measurements and observations made during the energy audit carried out in building?
<b>11,19</b>	Are there any outputs and screenshots of the measurement/monitoring/analysis equipment used during the energy audit in building?
<b>11,20</b>	Have evaluations been made about the data of measurement/monitoring/analysis equipment used during the energy audit carried out in building?