

**TRAINING MODULE
ENERGY AUDIT IN BUILDING**

PROGRAM OUTLINE DAY 1

Time	Topic	Duration
9.00 a.m.	Introduction & Overview	15 mins
9.15 a.m.	Chapter 1: Overview Of Energy And Energy Efficiency For Buildings 1.0 Introduction 2.0 Energy policies 2.1 The National Petroleum Policy (1975) 2.2 The National Energy Policy (1979) 2.3 The National Depletion Policy (1980) 2.4 The Four Fuel/ Diversification Policy (1981) 2.5 The five fuel policy (2000) 2.6 National Renewable Energy (RE) Policy and Action Plan (2009) 3.0 Energy consumption trends 4.0 Energy efficiency initiatives in building sector 4.1 Energy efficiency targets in annual budget 4.2 The Building sector energy efficiency project (BSEEP) 4.3 Energy efficiency initiative in economic transformation program (ETP) 4.4 Promotion of energy performance contracting (EPC) Mechanism to implement energy efficiency measures at government buildings 4.5 Energy efficient demonstration buildings 5.0 Energy efficiency potentials for building sector 6.0 The way forward for energy efficiency in Malaysia	1 hr
10.15 a.m.	Break	15 mins
10.30 a.m.	Introduction To Energy Audit 1.0 Types Of Energy Audit 1.1 Walk-trough energy audit 1.2 Detailed energy audit 1.3 Investment grade audit 2.0 Energy Audit Process 2.1 Kick-off meeting 2.2 Data collection 2.2.1 Desktop data collection 2.2.2 Field data collection 2.2.3 Cross checking of load demand data 2.3 Energy accounting & analysis 2.3.1 Load factor 2.3.2 Baseload 2.3.3 Building energy index 2.3.4 Air conditioning power and energy indices 2.3.5 Lighting power and energy indices 2.4 Identification of energy conservation measures 2.5 Reporting and presentation	1 hr 15 mins

11.45 a.m.	Chapter 3: Energy Auditing Measurement Tools 1.0 Introduction 2.0 Basic understanding measurement in energy auditing 2.1 Representative measurement 2.2 Spot and recording measurements 3.0 Setting the measurement objective 4.0 Accuracy & reliability of the measurement 4.1 Measurement accuracy 4.2 Equipment accuracy 4.3 Reading error 4.4 Installation of equipment 4.5 Measurement ranges 5.0 Measurement equipment /Practical exercises 5.1 Useful features of digital measuring equipment	1 hr 15mins
1.00 p.m.	Lunch Break	1 hr 30 mins
2.30 p.m.	Chapter 4: Energy Saving Measures From Electricity Supply And Distribution System 1.0 Electricity supply energy saving category 2.0 Electricity Tariff Optimization 2.1 Utilization of peak and off peak tariff 2.2 Compound and street-lighting tariff and neon / building façade lighting tariff 2.3 Eliminating power factor penalty 2.4 Reducing maximum demand (MD) charges 2.4.1 MD reduction case study 2.5 Reducing electric distribution system losses 2.5.1 Reducing distribution system losses	1 hr
3.30 p.m.	Tea break	15 mins
3.45 p.m.	Implementation of EnMS 1.0 System & Performance Checking 2.0 Management Review for improvement	1 hr 15 mins
5.00 p.m.	End of Day 1	

PROGRAM OUTLINE DAY 2

Time	Topic	Duration
9.00 a.m.	<p>Chapter 4: Energy Saving Measures For Air Conditioning Systems</p> <p>1.0 Introduction</p> <p>2.0 Energy efficiency of air conditioning system</p> <p> 2.1 Maintenance</p> <p> 2.2 Control system</p> <p> 2.2.1 Time control of air conditioning systems</p> <p> 2.2.2 Air handling and temperature controls</p> <p>3.0 Coefficient of performance (COP) for air conditioning system</p> <p> 3.1 Case study 1: Estimating the COP of centralized air conditioning system</p> <p> 3.2 Case study 2: COP calculation for an office building</p> <p> 3.3 Case study 3: Estimating the COP of a split unit</p> <p>4.0 Air conditioning energy savings through reduction of excess air</p> <p> 4.1 Excessing outside air supply</p> <p> 4.2 Estimating air conditioning heating load of outside air intake</p> <p> 4.3 Case study: Excess outside air supply</p> <p> 4.4 Case study 4: Replacing cooling tower</p> <p>5.0 Indoor temperature setting</p> <p>6.0 Ice thermal storage (ITS) in air conditioning</p> <p> 6.1 Ice thermal storage concepts</p> <p> 6.2 Case study 5: Ice storage system</p> <p>7.0 District cooling system (DCS)</p>	1 hr 30 mins
10.30 a.m.	Morning Break	15 mins
10.45 a.m.	<p>Chapter 6: Energy Saving Measures For Lighting Systems</p> <p>1.0 Introduction</p> <p>2.0 Types of lamps</p> <p> 2.1 Incandescent lamps</p> <p> 2.2 Fluorescent lamps</p> <p> 2.2.1 CFLs</p> <p> 2.3 LED lamps</p> <p> 2.3.1 Energy saving potentials</p> <p> 2.4 Lighting requirements</p> <p>3.0 Energy saving measures for lighting</p> <p> 3.1 Selection of energy efficient lighting system and technologies</p> <p> 3.2 Day lighting</p> <p> 3.3 Lighting controls</p> <p>4.0 Examples calculation of energy saving measures for lighting systems</p> <p> 4.1 Lighting energy saving through equipment replacement</p> <p> 4.2 Lighting energy saving through lamp replacement</p> <p> 4.3 Lighting energy saving through ballast replacement</p>	2 hrs 15 mins
1.00 p.m.	Lunch	1 hr 30 mins

<p>2.30 p.m.</p>	<p>Chapter 7: Energy Saving Measures For Motors</p> <ul style="list-style-type: none"> 1.0 Introduction 2.1 Understanding Motor Efficiency <ul style="list-style-type: none"> 2.2 Motor efficiency definition 2.3 Motor efficiency and standards 2.4 Motor loading and motor efficiency 2.5 Electric motor losses <ul style="list-style-type: none"> 2.5.1 Fixed losses 2.5.2 Variable losses 2.6 Over-sizing and motor efficiency 2.7 Quality of voltage supply and motor performance <ul style="list-style-type: none"> 2.7.1 Voltage imbalance 2.7.2 Over-voltage 2.7.3 Under voltage 2.8 Rewinding electric motors 3.0 High efficiency motors (HEMs) <ul style="list-style-type: none"> 3.1 Classification of HEMs 3.2 Policy for using High and premium efficiency motors 4.0 Incremental cost analysis and high efficiency motors 5.0 Use of variable speed drives for pumps and fans <ul style="list-style-type: none"> 5.1 Pump and fan loading characteristics 6.0 Basic guidelines on motor system optimization <ul style="list-style-type: none"> 6.1 Size the selected motor properly 6.2 Match the motor to the needs to the driven equipment 6.3 Correct adverse operating conditions 6.4 Establish a motor management 	<p>1 hr</p>
<p>3.30 p.m.</p>	<p>Tea Break</p>	<p>15 mins</p>
<p>3.45 p.m.</p>	<p>Chapter 8: Energy Saving Measures From Building Envelope</p> <ul style="list-style-type: none"> 1.0 Introduction 2.0 Building performance fundamental 3.0 Solar heat gain through windows <ul style="list-style-type: none"> 3.1 Shading of windows 3.2 External shading devices 3.3 Reflective window surfaces 3.4 Advanced technology glazing systems 3.5 Internal window treatments 4.0 Heat gain through structure <ul style="list-style-type: none"> 4.1 Solar transmission gains 4.2 Thermal storage effect 4.3 Building colour 4.4 Shading 4.5 Insulation 4.6 Water sprays 4.7 Landscape features 5.0 Outside air heat gain <ul style="list-style-type: none"> 5.1 Mechanical ventilation 5.2 Ductwork losses 	<p>1 hr 15 mins</p>

	<ul style="list-style-type: none"> 5.3 Infiltration 6.0 Internal loads <ul style="list-style-type: none"> 6.1 People 6.2 Lighting 6.3 Office equipment 7.0 Minimizing thermal heat gains <ul style="list-style-type: none"> 7.1 OTTV – A method of heat transfer assessment 7.2 Energy savings through reduction of building structure heat gains 	
5.00 p.m.	End of Day 2	

PROGRAM OUTLINE DAY 3

Time	Topic	Duration
9.00 a.m.	<p>Chapter 9: Financial Analysis And Business Proposal</p> <p>1.0 Introduction</p> <p>2.0 Investment analysis concepts</p> <p> 2.1 Financial evaluation of energy efficiency projects</p> <p> 2.1.1 Key stages in economic evaluation</p> <p>3.0 Financial analysis tools</p> <p> 3.1 Simple investment methods</p> <p> 3.2 Discount method</p> <p> 3.3 Payback period</p> <p> 3.3.1 Understanding time value of money</p> <p> 3.4 Nett present value</p> <p> 3.4.1 Interpreting and applying net present value</p> <p> 3.4.2 Selecting the discount rate</p> <p> 3.5 Internal rate of return</p> <p> 3.6 The choice of method</p> <p>4.0 Investment analysis process</p> <p> 4.1 Risk analysis</p> <p> 4.2 Sensitivity analysis</p> <p> 4.3 Options for financing effect efficiency project</p> <p> 4.3.1 Corporate loans</p> <p> 4.3.2 Leasing</p> <p> 4.3.3 Energy performance contracting</p> <p> 4.4 Tips on project assessment by financial institutions</p> <p> 4.5 Monitoring (or Measurement) and verification methods</p> <p> 4.5.1 Why M & V?</p> <p>5.0 Preparing a business proposal</p> <p> 5.1 Structure of an energy efficiency project proposal</p> <p> 5.2 Tips in preparing the investment proposal</p> <p> 5.3 Success factors in implementing energy efficiency projects</p> <p> 5.4 Risk analysis</p> <p> 5.4.1 Technical risks</p> <p> 5.4.2 Commercial risks</p>	1 hr 15 mins
10.15 a.m.	Break	15 mins
10.45 a.m.	Group Project and Activities	2 hr 15 mins
1.00 p.m.	Lunch	1 hr 30 mins
2.30 p.m.	Group Presentation	1 hr
3.30 p.m.	Break	15 mins
3.45 p.m.	Group Presentation	1 hr
4.45 p.m.	Wrap-up session	15 Mins
5.00 p.m.	End of Program	