



Thai

ESCO

Association

สมาคมบริษัทจัดการพลังงานไทย

# การบริหารโครงการ ESCO ในแต่ละ ระยะ

16 มกราคม 2563

13:00-14:30

วิทยากร

นายพีรศุขม์ อีระโกเมน

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# Agenda

- Recap of the ESCO business model
- Stages of ESCO projects
- ESCO Project Sales
- Project Development
- Project Implementation
- Project Operation
- Q&A

# Recap of the ESCO business model

# ESCO as a suitable solution

ESCO  
ESCO

Energy Service Company

**“ An energy service company (acronym: ESCO or ESCo) is a commercial business providing a broad range of comprehensive energy solutions including designs and implementation of energy savings projects, energy conservation, energy infrastructure outsourcing, power generation and energy supply, arrange financing for projects and risk management for which performance contract and measurement and verification is a core part to ensure that the project technical performance is fully guaranteed during the contract period”**

# Range of ESCO Business Services

ESCO's  
Full Service

**Energy Supply Contracting**

**Third Party Financing**

**Variable Term Contracts**

**One – Year Contracts**

**Supplier Credit**

**Equipment Leasing**

**Consultant  
with Performance Base Payment**

**Consultant  
with Fixed Payment**



**High Risk**

"What's your  
risk tolerance?"



**Low Risk**

# ESCO's characteristics

**W**hat

.....is important  
characteristics of an ESCO



# ESCO's characteristics

Various definition & Wide range of services



When comparing or take figure about ESCO's number into consideration

ESCO offers:

M : Measurement & Verification

I : Integration through O&M

G : Guarantee



Financing is **NOT** considered as a key characteristic.

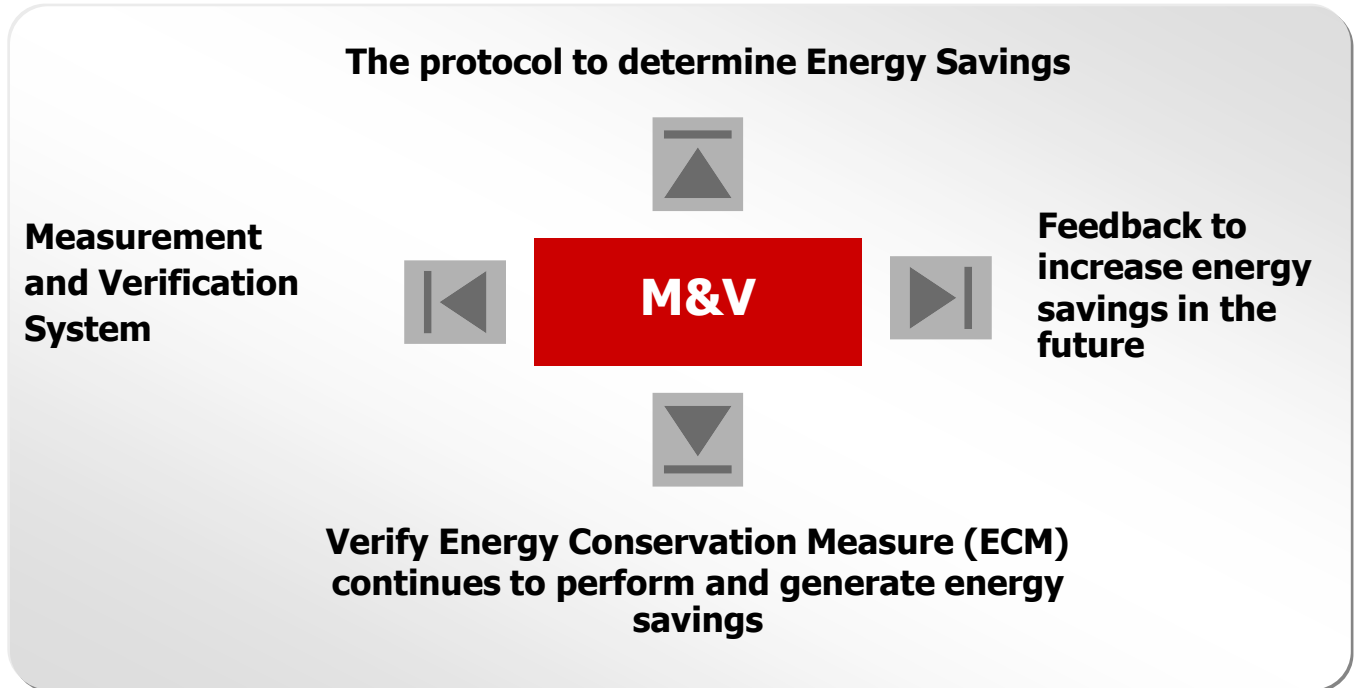


# M : Measurement & Verification (M&V)



## M&V Concepts:

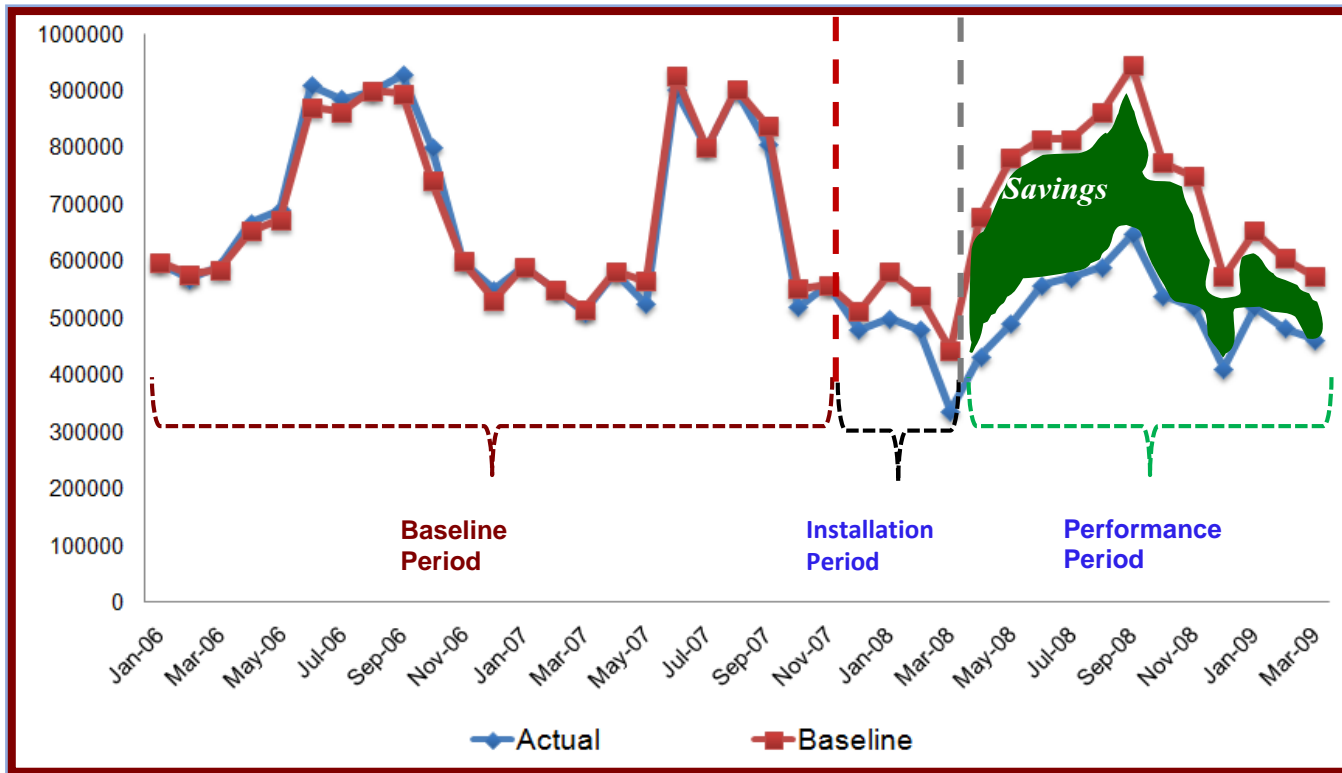
- Base on international standard protocol
- Flexible
- Optimization



## Guideline for M&V

- ✓ **IPMVP** (International Performance Measurement and Verification Protocol)  
(<http://www.ipmvp.org>)
- ✓ **FEMP** (Federal Energy Management Program of the U.S. Department of Energy)  
(<http://www.eren.doe.gov/femp/financing/espc/measguide.html>)

# M : Measurement & Verification (M&V)



**Higher Efficiency,  
More Reliable, Less  
Pollutions**

**Less Energy  
Consumption, Less  
Energy Expense, Less  
\$\$\$**

**Energy Savings = Baseline Energy Use - Post Installation Use**

# I : Integration through O & M



## Additional ESCO Services



**Providing or Arranging Financing**



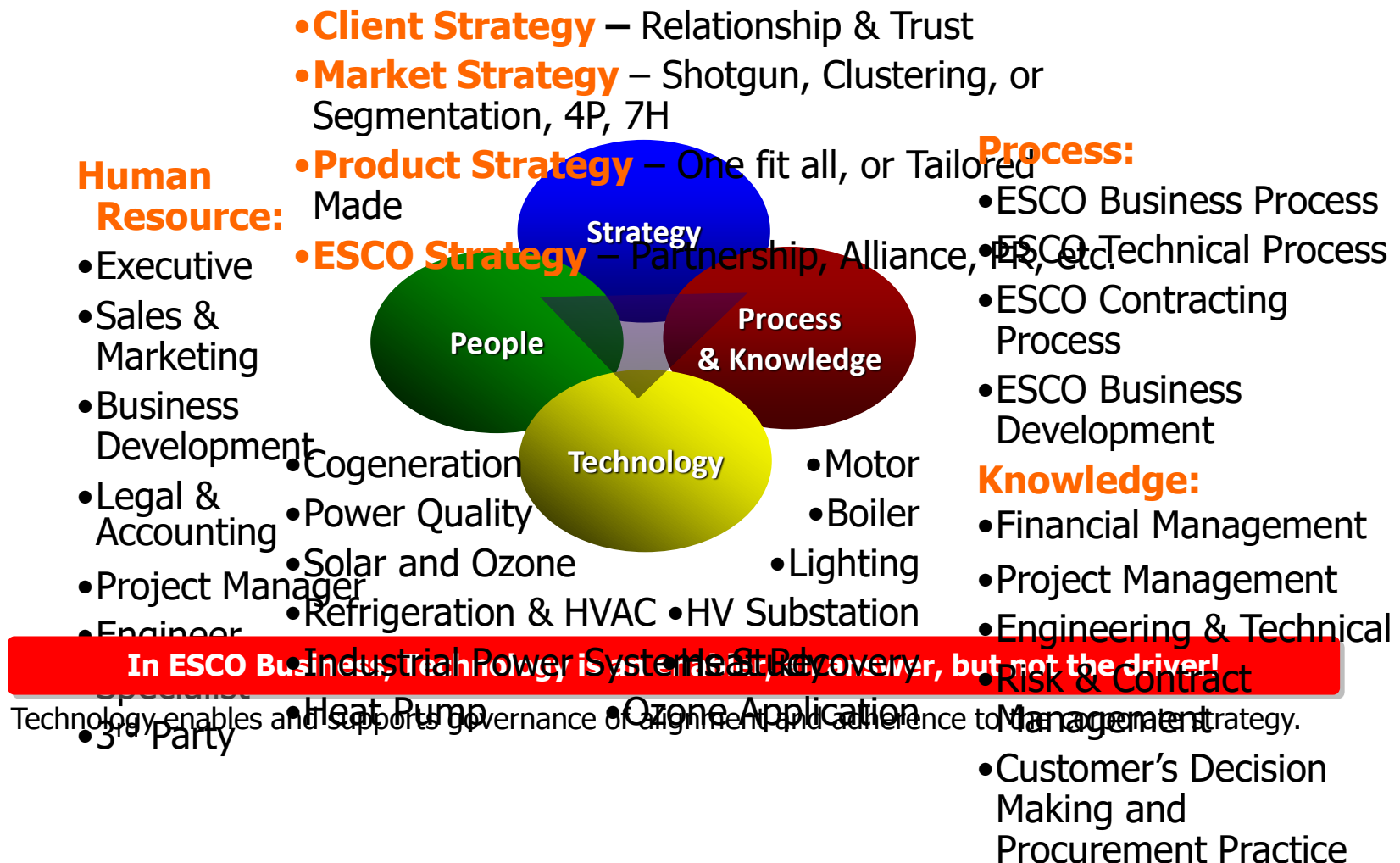
**Operations and Maintenance**



**Training**

# G : Guarantee

To successfully discover the value of ESCO business and ultimately deliver the value to client and country, an ESCO company needs to commit to the **Strategy** and drive it through the development of **People, Process, and Technology**.



# What's the difference?



Analyze energy consumption, design and inspect construction



Advise financial arrangement



Equipment warranty



Guaranteed project's efficiency



Compensate for deficit



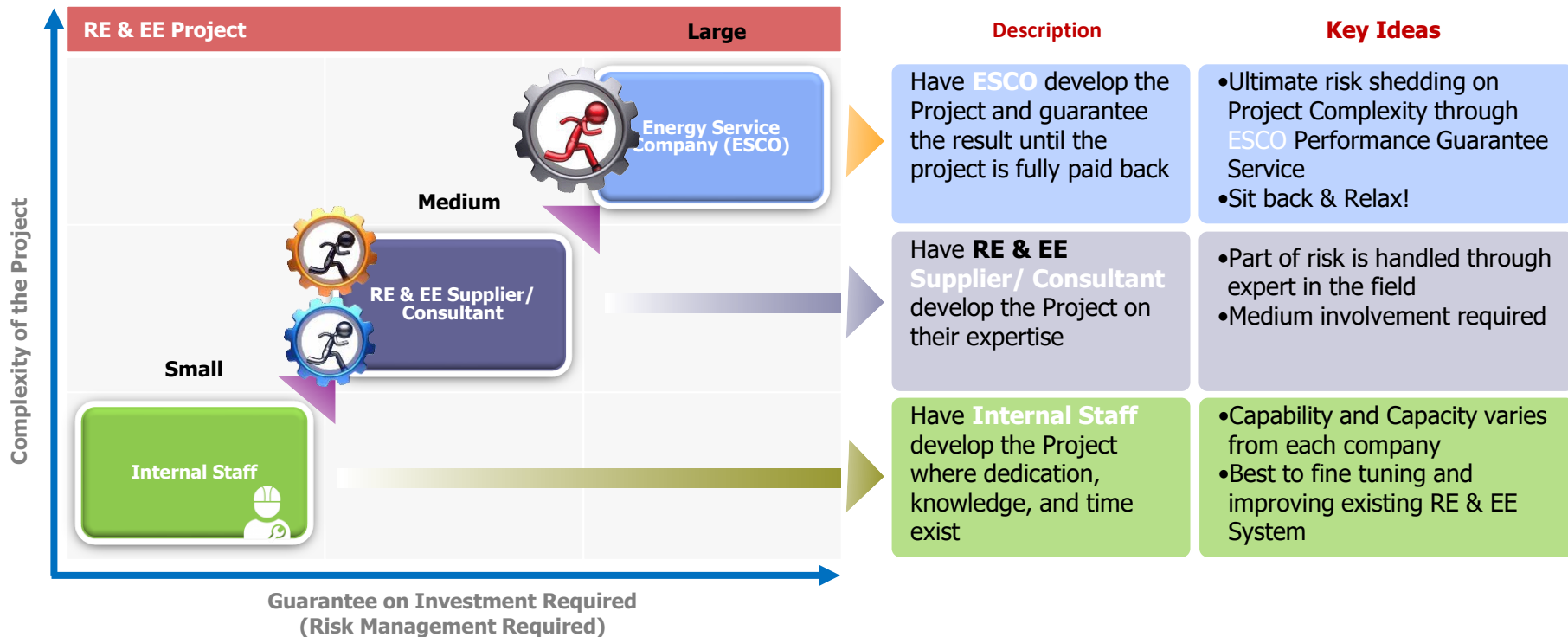
Measurement & Verification



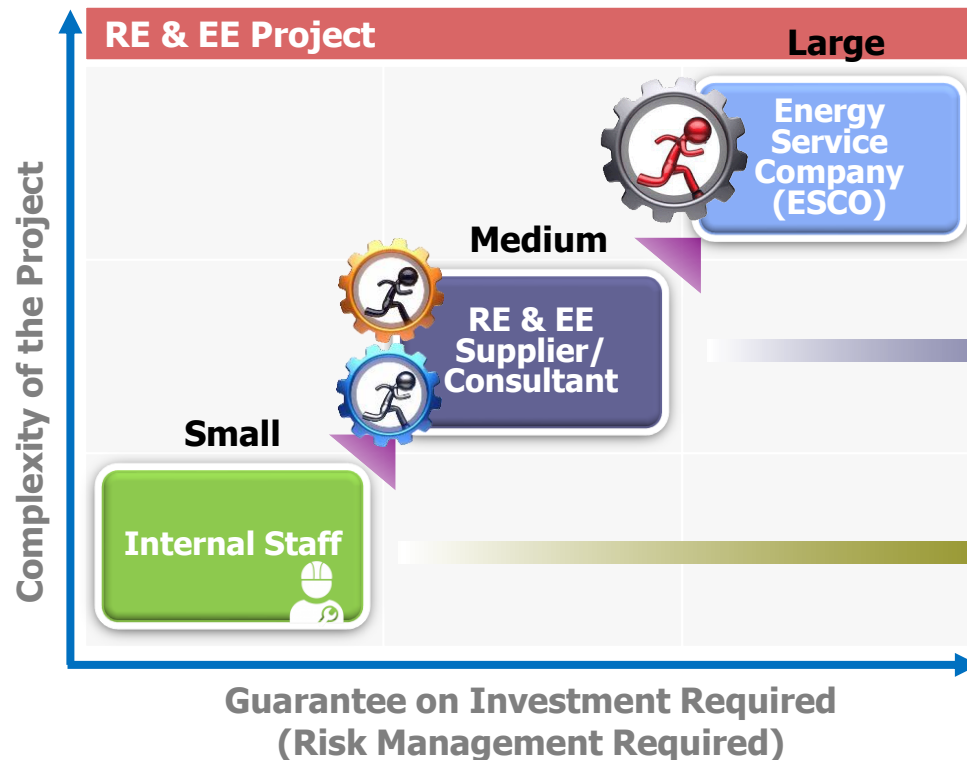
Operating and Maintenance



## Who is the best choice ?



# Who is the best choice ?



**IMPORTANT!**

- Accessibility to Financial Source
- Investment Priority
- Company's Investment Criteria and Condition (e.g. IRR, Payback Period)
- Capacity, Availability, and Capability of current staff and technical resource
- Executive Confidence Level on Project Success



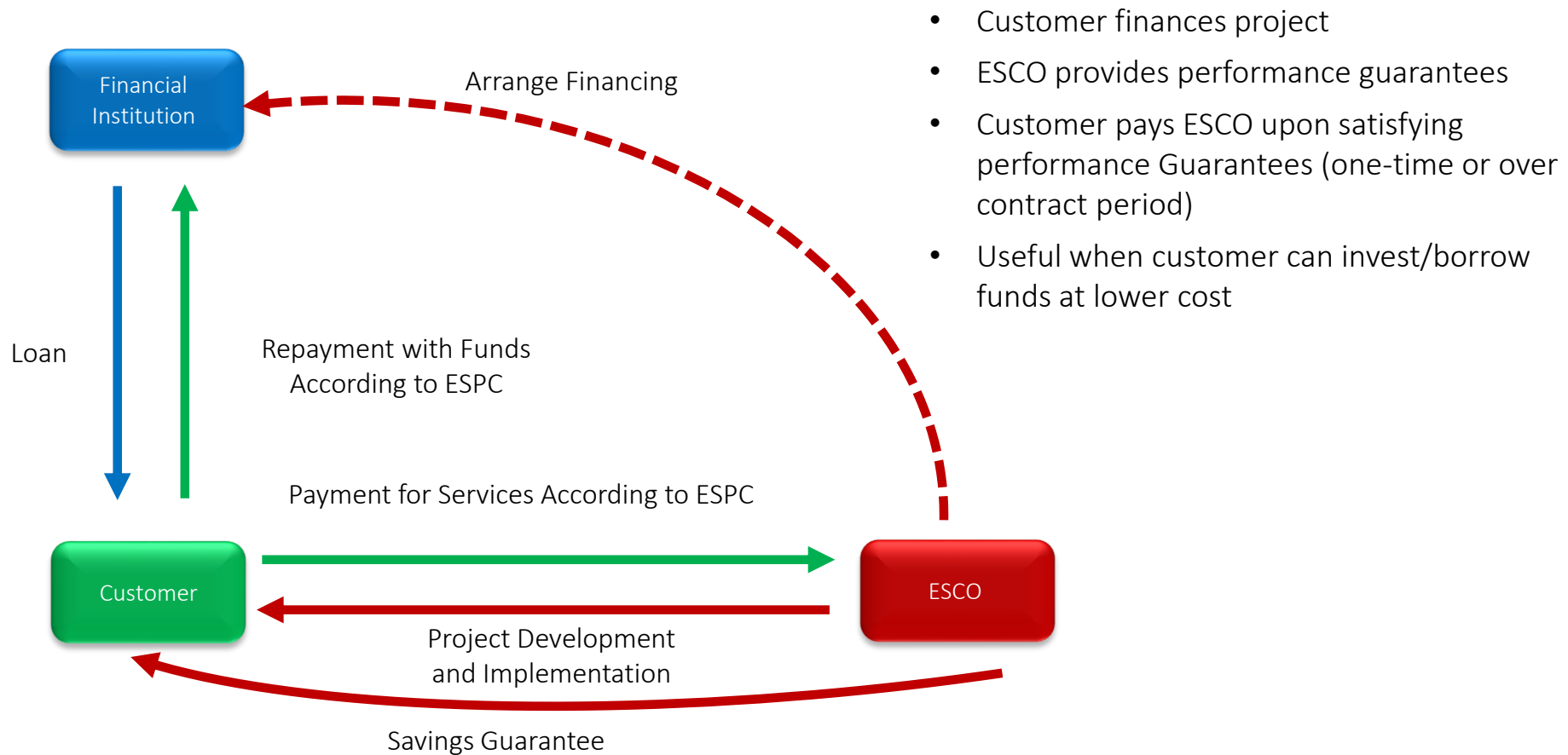
**Guaranteed  
Savings**

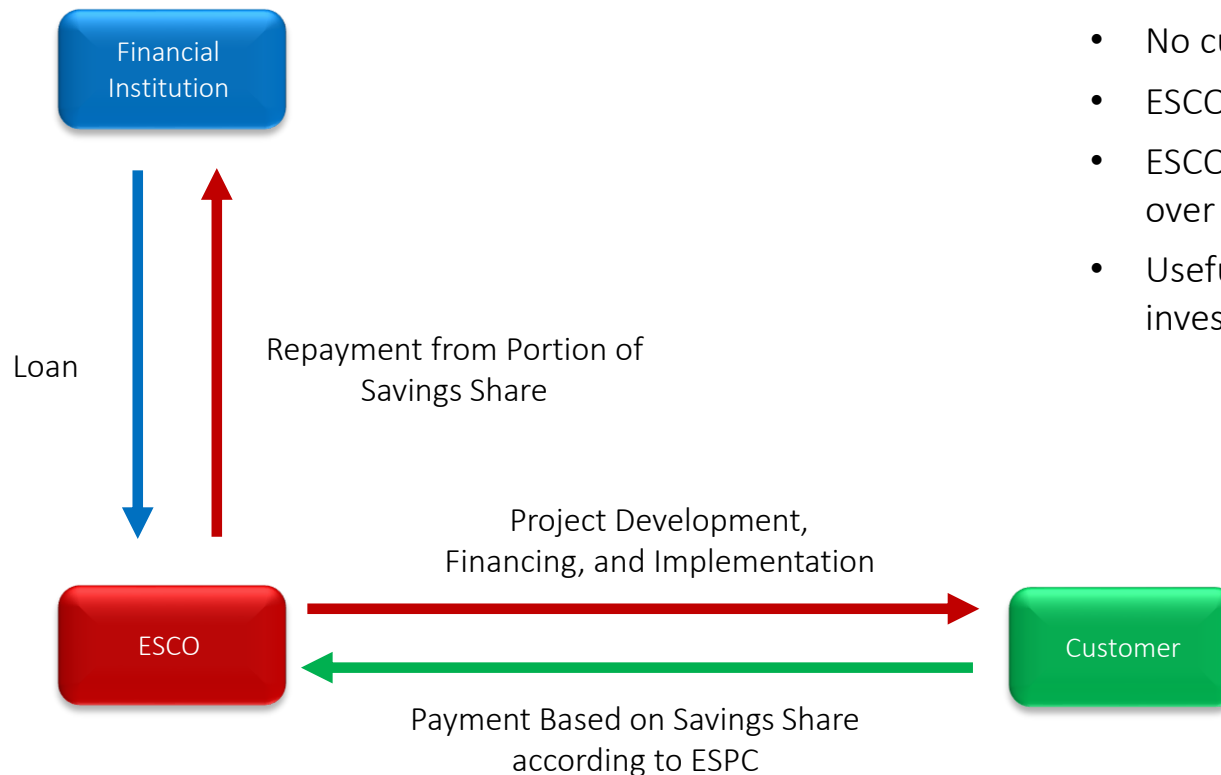
**Shared  
Savings**



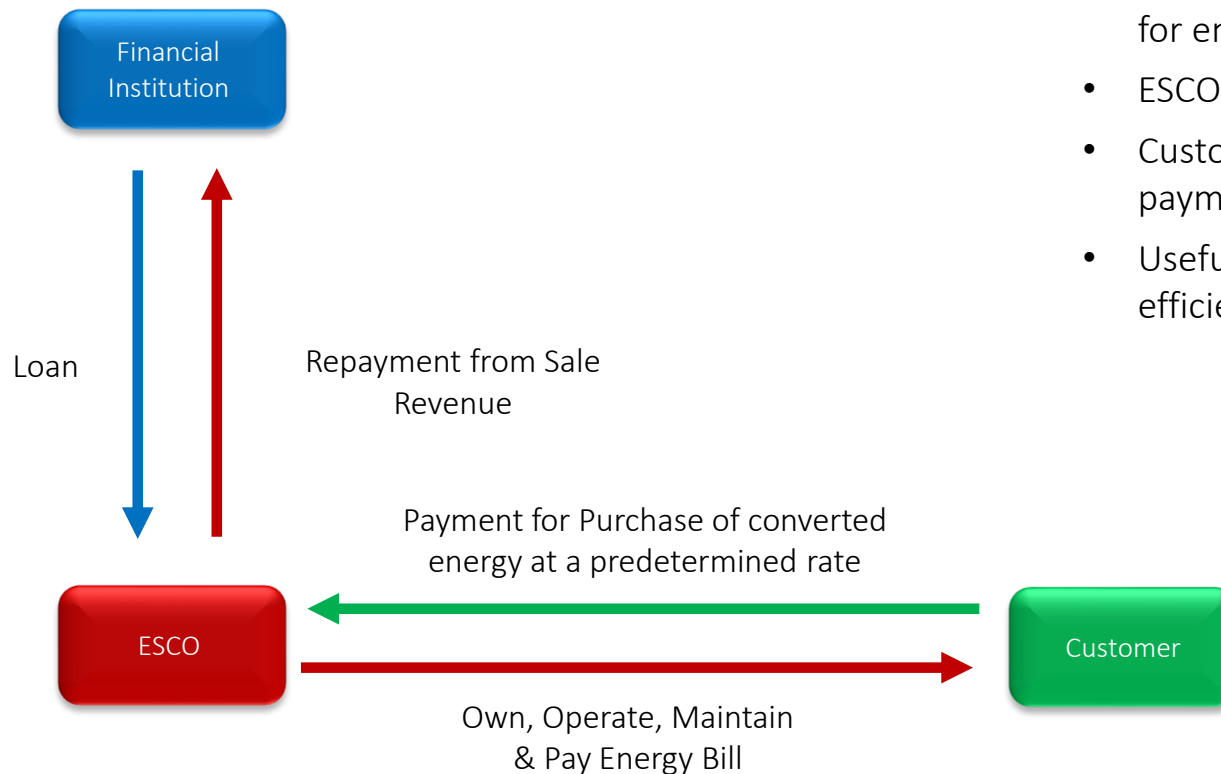
**Guaranteed Rebate  
(CHAUFFAGE)**







- ESCO finances project
- No customer investment needed
- ESCO borrows funds from FI
- ESCO and customer defined share savings over contract period
- Useful when customer does not want to invest own funds



- Customer outsources energy management for entire facility
- ESCO invests in equipment/efficiency
- Customer signs long-term contract for payments at fixed price
- Useful when expert help is needed for efficient energy management

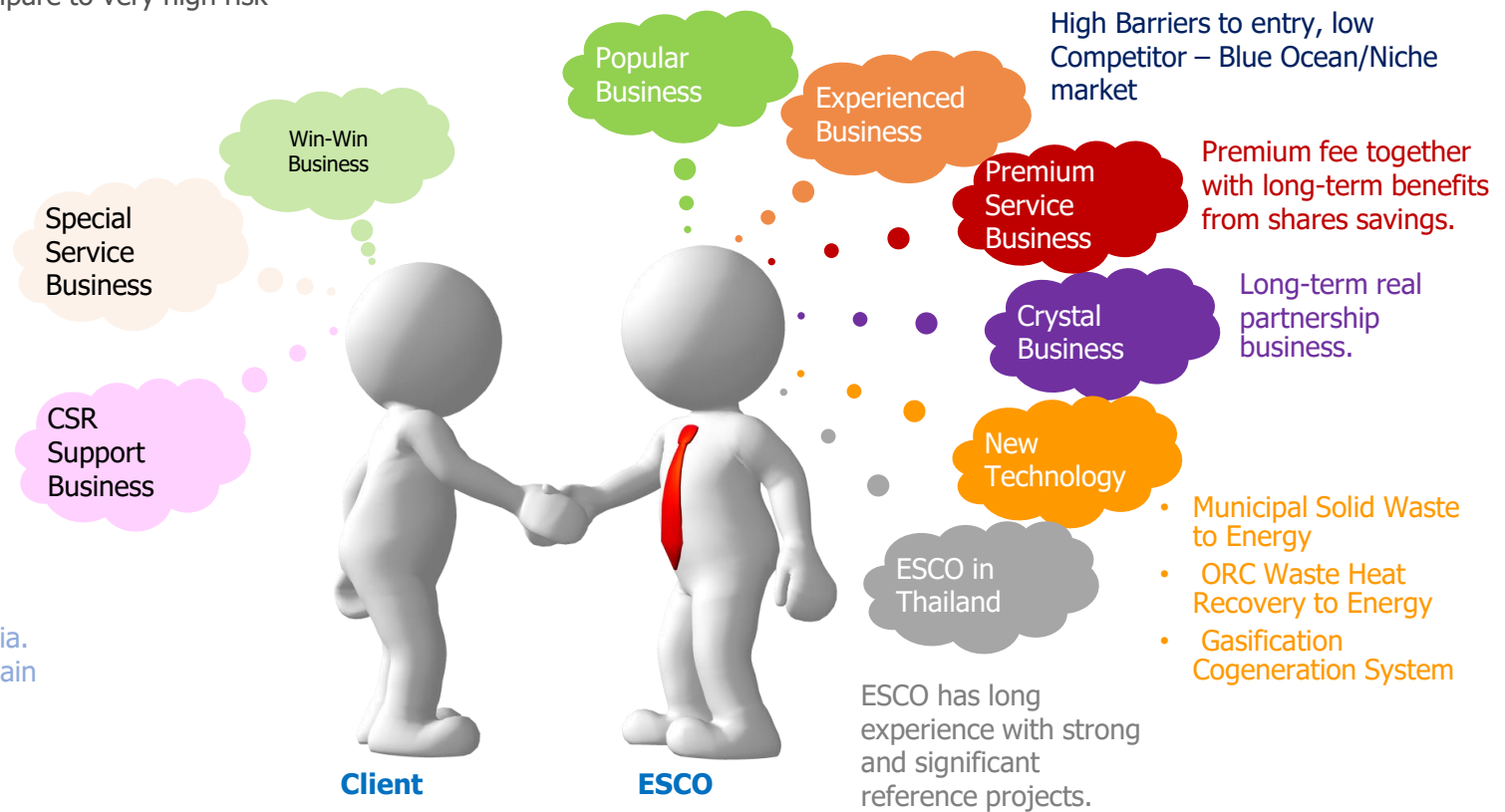
# Good opportunities about ESCO Business

- Share Risk, Share Loss, Share Benefit
- Benefit Ratio is 19:1 (Customer : ESCO)
- Customer share to ESCO only 5% of net overall benefit compare to very high risk reduction.

Energy Business is still one of top rank business form continuous highly increase of energy price.

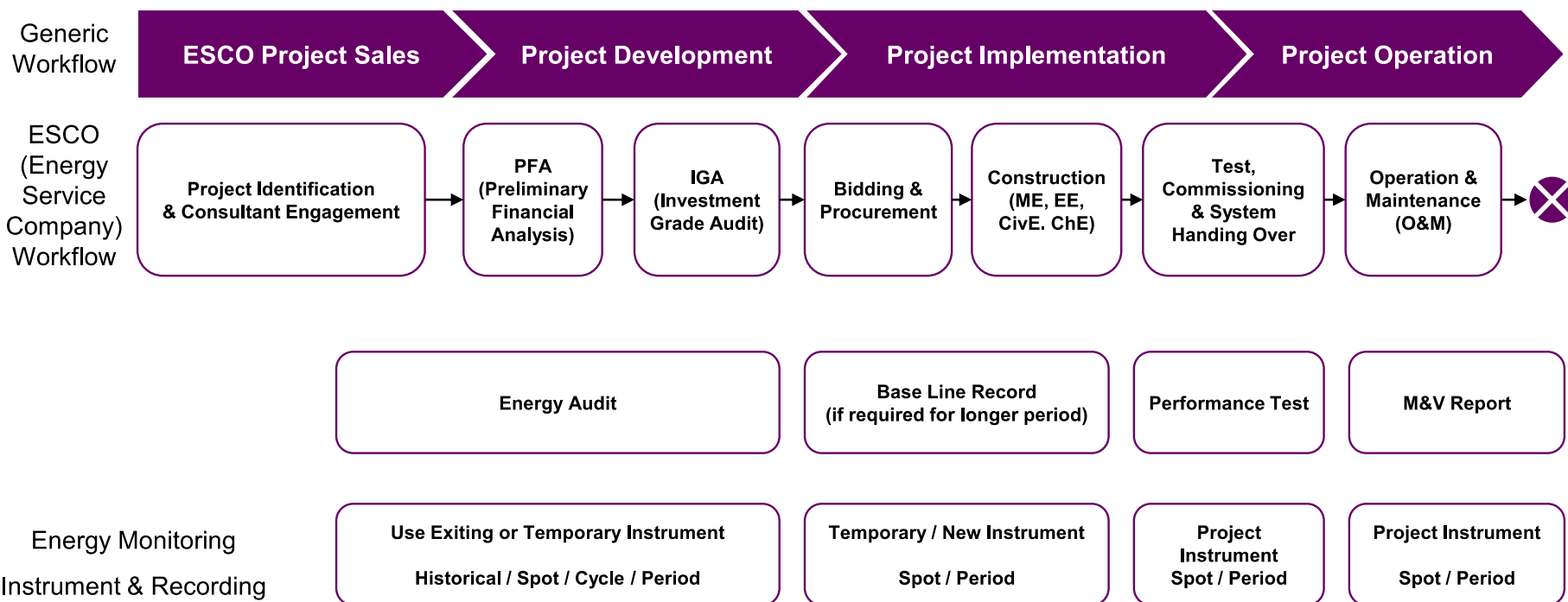
- Customer will have very low chance to gain “the guaranteed savings” if there is no ESCO support.
- ESCO revenue derives from the conversion of customer loss or waste.

- Save energy, save world under the environmental conservation criteria.
- High potential to gain additional revenue from CDM.



# Stages of ESCO Projects

# Overview of ESCO project stages



# ESCO Project Sales

- Project Identification

- Desktop Audit

- Operation Log Sheet

- Energy Bills

- Energy Audit

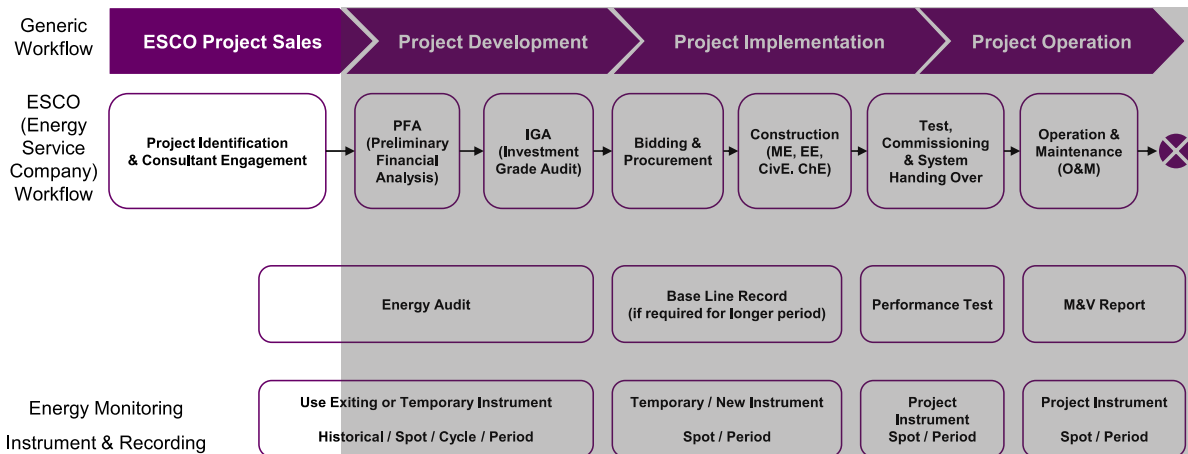
- Tools & Instruments

MOU of Project Engagement

Non-Disclosure Agreements

Project “Boundary”

Sale and Marketing Cost



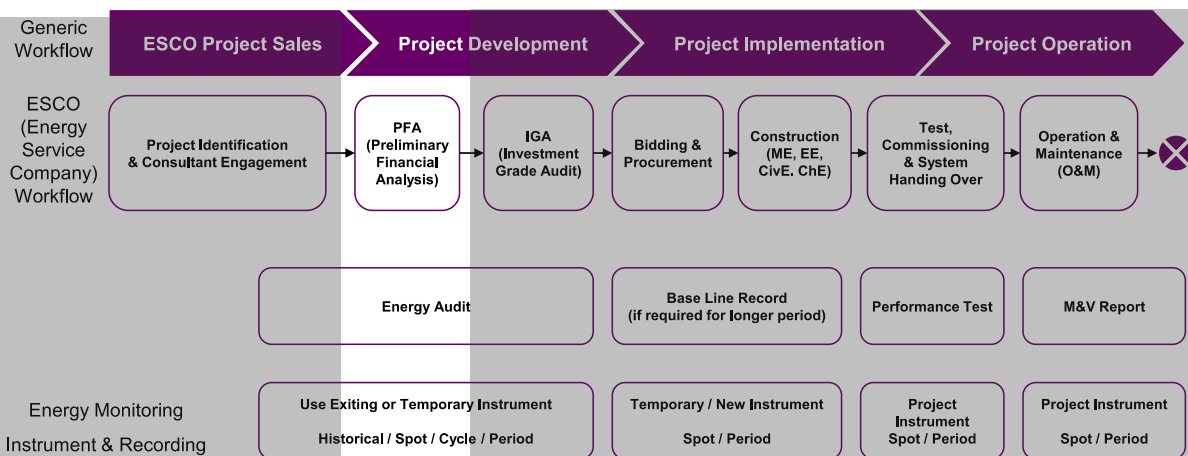
# Project Development

- Preliminary Financial Analysis
  - Preliminary Project IRR
  - Preliminary Project EIRR, ROE, RONCE
  - Preliminary financial index.....

Redefined Project “Boundary”

Continue!!! Or STOP!!!

Sale and Marketing Cost





# Project Development (2)

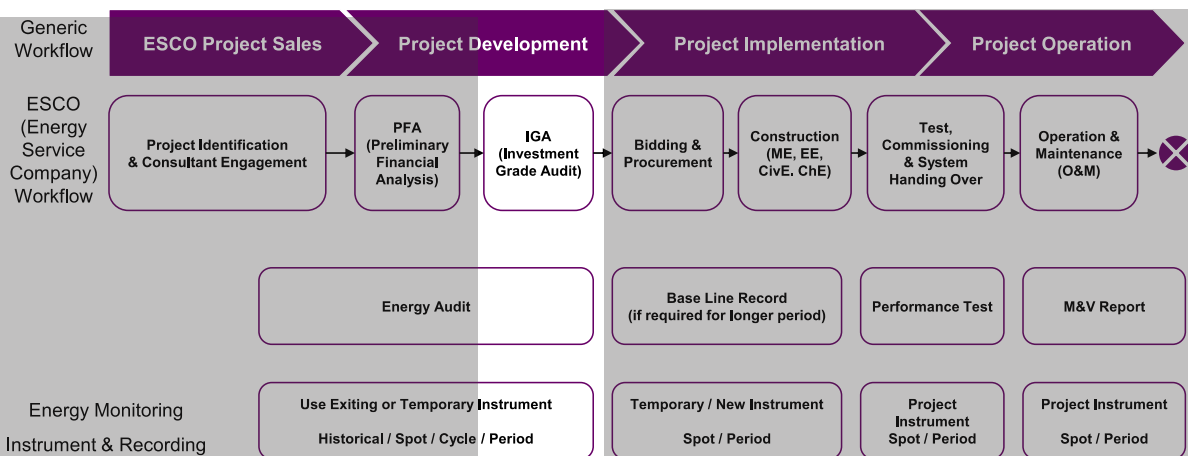
- IGA = Investment Grade Audit
  - Target Project IRR
  - Target Project EIRR, ROE, RONCE
  - Preliminary Energy Baseline
  - Target Savings

Confirm Project “Boundary”

Continue!!! Or STOP!!!

Sale and Marketing Cost (ESCO)  
or  
Project Cost (Client)

Draft M&V Plan



# Business Proposal, Legal and Negotiation

- Commercial Proposal
- Technical Proposal
  - Technical Detail

# Technical Design and Scope of ESCO Project

## Objective :

To understand the objective of project, scope of work and technical design of measure for ESCO project

**What things make ESCO Project different from Construction Project?**



# Technical Design and Scope of ESCO Project

ESCO Project need to survey and understand behavior of existing system



ESCO Project need to do energy audit, analyze and then summaries for energy consumption profile (cycle, seasonal)

ESCO Project need to select proper technology and guarantee selected technology



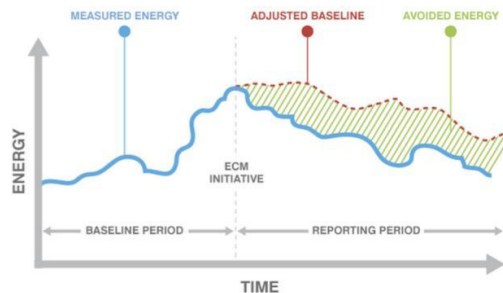
ESCO Project need to guarantee in Technical Part, Need Technical Risk Mitigation

# Technical Design and Scope of ESCO Project



ESCO Project need to verify for the performance of selected technology

ESCO Project need to install measuring device and recording device and monitoring device for important data



ESCO Project need to do the verification report to confirm for performance of system (1 time or every month depend on M&V Plan)

ESCO Project need to do M&V report to get back share saving

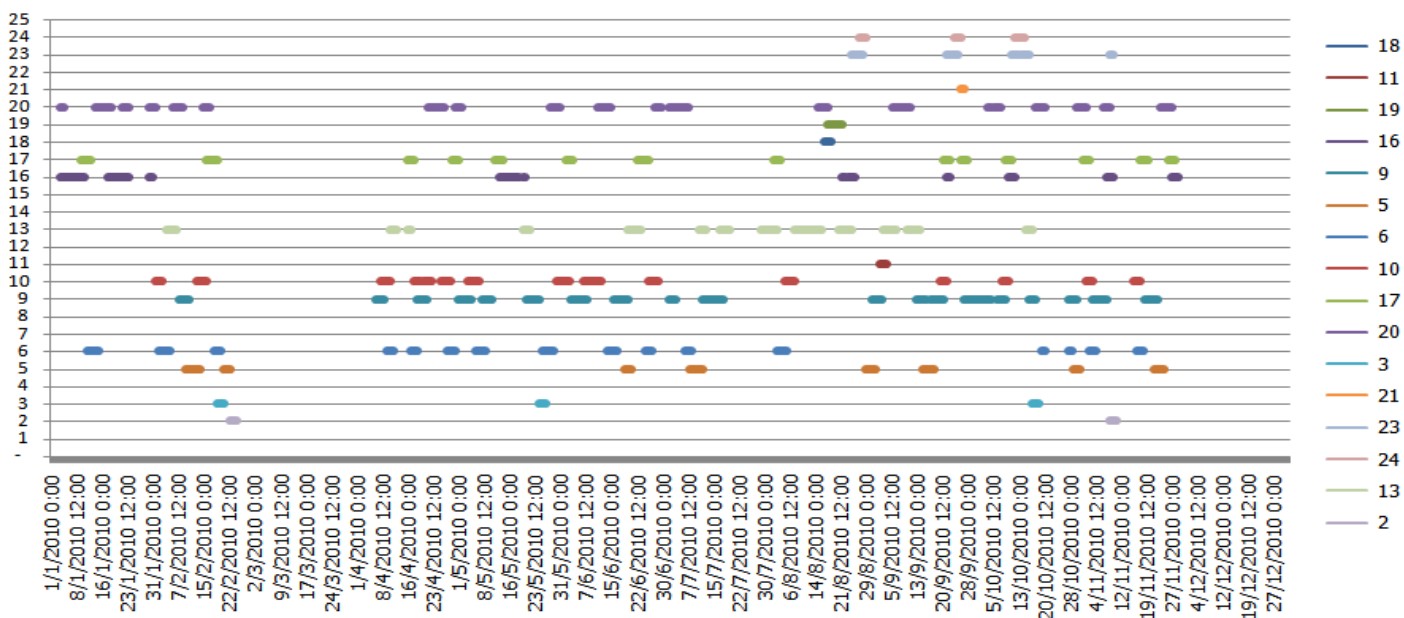


## Because of special requirement and guarantee purpose Generate...The special scope of work

### 1. Technology Selection and Design

Need to understand Energy Data and Measures

Actual Production Time of each  
product in same production line



## 2. The design must support to M&V plan

*Need to understand the methodology of M&V Plan*

### Measurement & Verification must conform to

- 1) International Performance Measurement and Verification Protocol (IPMVP)
  - Option A: Retrofit Isolation: Key Parameters Measurement
  - Option B: Retrofit Isolation: All Parameters Measurement
  - Option C: Whole Facility
  - Option D: Calibrated Simulation
- 2) ASHRAE Guideline 14
- 3) FEMP M&V Guideline
- 4) Industrial Energy Institute : Standard energy saving M&V plan





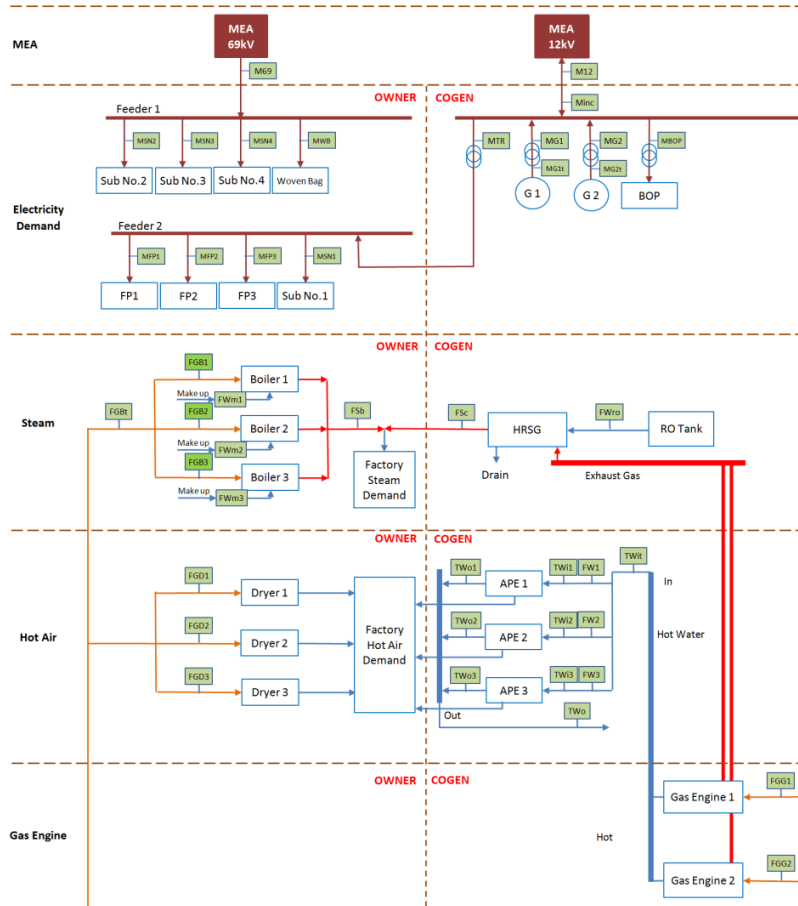
### 3. System Efficiency Monitoring

To maintain system efficiency at higher than guarantee level continuously





## 4. Provide Data that Conform to Measures and Back Up



*Need back up plan for  
Performance or Saving  
Calculation*



# Business Proposal, Legal and Negotiation (2)

- Contents in Commercial & Technical proposal
  - Typical Outline
  - Project Boundary and Objective
  - Scope of work

# Typical Outline of Proposal

## TABLE OF CONTENTS

### SECTION 1 INSTRUCTIONS FOR BIDDERS

#### 1.1 GENERAL

##### 1.1.1 Nature of the Project and Proposals Request

##### 1.1.2 Contract Requirements

##### 1.1.3 The Site

#### 1.2 TENDER DOCUMENTS

##### 1.2.1 Contents of the Tender Documents

##### 1.2.2 Bidder to Check and Examine

##### 1.2.3 Confidentiality of the Tender Documents

##### 1.2.4 Clarification of Tender Documents

#### 1.3 PREPARATION OF TENDERS

##### 1.3.1 General

##### 1.3.2 Information Required from the Bidder

##### 1.3.3 Pricing, Payments and Currencies of Proposal

##### 1.3.4 Tender Validity

##### 1.3.5 Time of Completion

#### 1.4 SUBMISSION OF TENDERS

##### 1.4.2 Deadline for Submission of Tenders

##### 1.4.3 Modification, Alteration, and Withdrawal of Tenders

### SECTION 2 SCOPE OF SUPPLY AND TECHNICAL REQUIREMENTS

#### 2.1 SCOPE OF SUPPLY

#### 2.2 TECHNICAL REQUIREMENTS

##### 2.2.1 General

##### 2.2.2 Plant Control and Monitoring System (PCMS)

##### 2.2.3 Equipment and Accessories

##### 2.2.4 Electrical System

##### 2.2.5 Mechanical Systems

##### 2.2.6 Measurement and Verification (M&V) Instruments

##### 2.2.7 Standards and Codes

### SECTION 3 GENERAL CONDITIONS

#### 3.1 General

#### 3.2 Responsibility of Contractor

#### 3.3 Acceptance Tests

#### 3.4 Failure to Meet Performance Guarantee

#### 3.5 Liquidated Damages

#### 3.6 Equipment Guarantee

#### 3.7 Drawing and Document

#### 3.8 Performance Bond



# 1. Understanding of objective and requirement of the project

The Owner plans to install two (2) units of natural gas engine. Each unit can approximately produce electricity 2 MWe and generate hot water at temperature 90 °C which will be supplied to fin and tube heat exchangers for existing air pre-heater. However, there are 2 options for utilizing heat from exhaust gas of engine;

- Option 1: Supply exhaust gas to heat recovery steam generators (HRSG) to produce saturated steam at pressure 8 barg and flow rate ≥ 1.5 tph per engine
- Option 2: Supply exhaust gas to dryer directly. However the connection point between gas engine's exhaust stack and dryer shall be designed for safety (both of gas engine and dryer) in case of emergency trip of main blower (induce draft fan). (Please see the diagram for more information)

Note: Bidder shall provide information of such system and guarantee the quality and quantity of saturated steam and hot water.

The engines shall be designed for 24 hours per day operation and the electricity output will be sold to the grid. Anyway some part of electricity output may need to supply to the factory.

Two (2) units of gas engines shall be capable of running in Islanding mode with load sharing function in case of the plant losing its synchronism with the grid, in order to serve factory's partial load requirement. The engine and its speed governor control system shall be fast responsibility. (The generating power may need to reduce from 4MW to 2-3MW immediately)

The gas engines shall be equipped with the Black Start feature which enables the plant operators to start the engine even when the electricity from the grid is entirely out of service. Then, the engines can be synchronized back to the grid after MEA/PEA electrical system returns to normal.

Bidder is free to propose alternative units of natural gas engine according to their natural gas engine standard size. However, the Owner expects to have the total power generation of 4 MWe, approximately. Proposing of separated unit is preferable due to half requirements is on holiday.

Natural gas supplied by Petroleum Authority of Thailand (PTT) has pressure of 50 psig approximately, and temperature of 25 °C. The quality of natural gas is described in APPENDIX 6: FUEL DATA.

Because the cogeneration plant will be located in the area of chemical fertilizer factory, all equipment shall be designed and protected for operation in corrosive gas and dust atmosphere.

*Help to make decision and select the right thing*



## 2. Scope of supply and Service

The contract is to be an EPC (Engineering, Procurement and Construction) arrangement as described in these documents. The Contractor has to be responsible for the design, supply, supervision, installation, testing, commissioning, and training of the works under acceptance by the Owner.

Bidder shall guarantee the performance of their equipment;

- NG specific consumption (kJ/kWhe)
- Electrical gross (terminal) and net (after extract for BOP) power output at 100% load (kWe)
- Heat from jacket (cooling system), hot water output at 90 °C (m3/hr)
- Heat from exhaust gas
  - o Option 1: Saturated steam output (after extract for deaerator) at 8 barg (Ts/hr)
  - o Option 2: Exhaust thermal mass flow rate (kg/hr) and temperature (°C) at full load

Bidders shall propose maintenance program and guarantee maintenance cost (per gas engine generator set) for each maintenance interval similar or equivalent to schedule in APPENDIX 8: MAINTENANCE PROGRAM. The maintenance program will be part of Bid evaluation. Owner intends to sign long term maintenance program with Bidder.

*Help to summarize for responsibility*

*Help to disclaim for the unclear tasks*

*Help to define price as of scope*



### 3. Performance Guarantee

*Specify Guarantee Condition*



***For Input***

*Quality  
Quantity  
Reliability  
Availability*

***For Output***

*Quality  
Quantity  
Reliability  
Availability*



***Environmental Condition***

*Weather, Altitude  
System Operating Condition  
Environment Impact*



Reliability	Maintainability	Availability
Constant	Decreases	Decreases
Constant	Increases	Increases
Increases	Constant	Increases
Decreases	Constant	Decreases



## 4. Specify the Standard use for the project

*Help to confirm for conforming of each sub-system or existing system*

*Specify for Mechanical, Electrical, Control and instrument,  
Chemical, Safety, Environment*

All works, equipment, materials and systems shall be designed, manufactured and/or constructed in accordance with the latest issue of the International Codes and Standard (collectively, the “Standards”) at the date of the signing of the Contract.

Mechanical Engineering:	ASME, ASTM, NFPA, ANSI, AMCA, NBFU, HI, ABMA, IGCI, DIN, PFI, JIS
Electrical Engineering:	IEC, ANSI, NEC, NEMA, ASTM, DIN, VDE, JIS, IPCEA, IEEE, NFPA, UL
Control and Instrumentation:	IEC, ISA, IEEE, SAMA, DIN, VDE
Chemical Engineering Application:	IUPAC, VDI, JIS
ANSI/NFPA 70	National Electrical Code (Note: ANSI: American National Standards Institute; NFPA: National Fire Protection Association)
ANSI/IEEE 472	Guide for Surge Withstand Capability (SWC) Tests
ANSI/IEEE 488	Digital Interface For Programmable (Note: IEEE: Institute of Electrical and Electronics Engineers)
EIA RS-232-C	Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange
ISA IPTS 68	Conversion Tables for Thermocouples (Note: ISA: Instrument Society of America)
UL 1418	Implosion-Protected Cathode Ray Tube for Television-Type Applications (Note: UL: Underwriters Laboratories, Inc.)

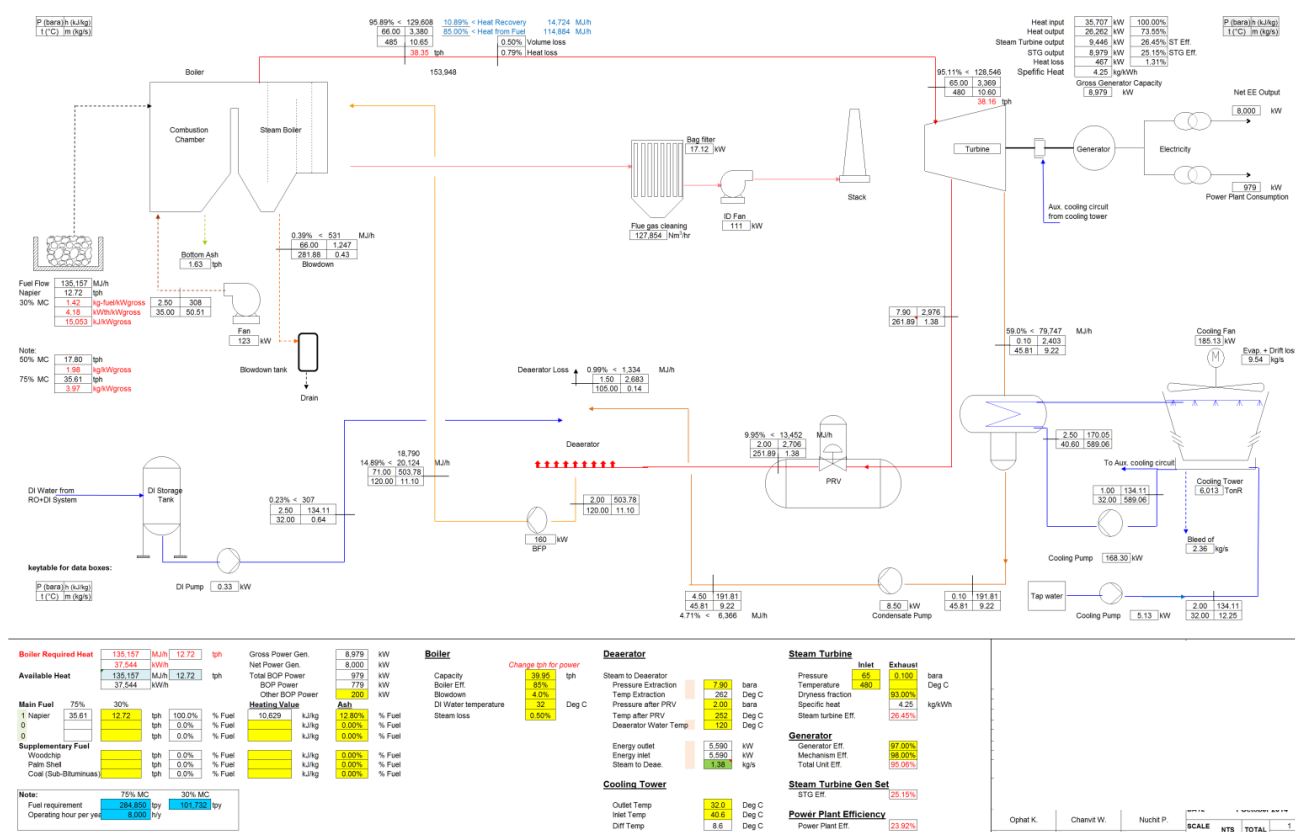


## 5. Drawing and Diagram use in project

### Mass and Heat Balance Diagram

Help to confirm for the conforming of heat transfer between part

Help to guide for the capacity of each system





*Help to estimate for power require and consumption*



## 6. Technical Requirement

*Help to specify exact technical data that project required*  
*Help to specify for safety, life time, controlling, accuracy, feature etc.*

### 2.2.5.7.2 Hot Water Piping System

The distance from plate heat exchanger to air pre-heater is approximately 150 meters  
(Please see appendix 3 Balance of Plant)

- Hot Water Pipe  
Pipe size: [Calculated by Bidder](#)  
Material: [STPG 370 Sch 40 ERW \(ASTM A53 Gr.B Sch 40 ERW\)](#)
- Flexible Joint  
Stainless steel flexible hose (SUS 304), RF flange Class 10K, Static Lateral Offset 50mm (Brand: Preference for TOZEN or Equivalent) (if any)
- Check Valve  
Cast steel, SO-RF flanged Class 10 K (Brand: Preference for KITZ or Equivalent)
- Globe Valve  
Cast steel SO-RF flanged Class 10 K (Brand: Preference for KITZ Brand or Equivalent)
- Gasket  
EPDM Class 10 K
- Flange  
SS 400, SO-RF flanged 10 K
- Insulation  
Rock wool, 120 kg/m<sup>3</sup>, thickness 50 mm.
- Jacketing  
Stainless steel sheet (SUS 304), thickness 0.3 mm.

- Temperature Gauge with thermo well), consist of:

- Gauge Size 4 inch
- Body Material Stainless steel 304
- Temperature Range Max 100 °C
- Connection Pipe ½" NPT
- Measuring Element: Bimetal

(Brand: Preference for [Wika](#), [Tertrice](#), [Weksler](#) or Equivalent)



- Control Valve, consist of:
  - Body Material SUS 304
  - Flanged Type
  - Process Temp Max 100 °C
  - Process Pressure Max 5 barg
  - Electric actuator unit, consist of:
    - Input 4-20 mA
    - Output 4-20 mA for [feedback position](#).
    - 2 [travel limit switches for open and close](#).
    - 2 torque limit switches for each direction of rotation (If need).
    - [Overheat protection for motor](#) as standard.
    - Enclosure IP67.
    - [Explosion prove](#) available (If need).

(Brand: Preference for [Asco](#), [Fisher](#), [Maxseal](#), [Yoshitake](#) or Equivalent)

- Pressure gauge with needle valve and siphon, consist of:

- Gauge Size 4 inch
- Body Material Stainless steel 316
- Process Pressure Max 5 barg
- Process Temp Max 100 °C
- Connection pipe ½" NPT
- Measuring Element Bourdon Tube
- Liquid Filled Gauge Silicone

(Brand: Preference for [Yamatagi](#) Brand or Equivalent)



## 7. Performance Test Procedure

*Help to confirm for the methodology to prove performance and reduce conflict to accept task*

The two load points on which the tests shall be carried out are:

Load Point A : 100% of Boiler MCR  
Load Point B : 30% of Boiler MCR

In the event of a delay in these tests due to reason not related to Bidder or the Supplier, an aging allowance on a monthly basis will apply to the guaranteed efficiency in accordance to [ASME PTC 4](#) or equivalent international standards. There is no aging allowance for Boiler Output Guarantee. The tests for the plant shall be carried out according to the most recent versions of [ASME PTC 4](#) codes and other relevant ASME standards.

- A minimum of thirteen (13) measurements during the test period shall be taken at regular intervals not exceeding fifteen (15) minutes.
- The relation between the bottom ash and fly ash shall be determined according to the fuel ash content, flue gas analysis, and particulate concentration of the flue gas.
- Fuel samples shall be collected from a point of the fuel feeding system, which is as close as possible to the furnace inlet.
- Bottom ash samples shall be collected from the nearest point to the bottom ash discharging valve.
- Fly ash samples shall be collected from a spot locating multi-cyclone, the place being preferably the same in which the flue gas temperature and O<sub>2</sub> measurements take place.
- Fly and bottom ashes shall be collected in intervals no longer than fifteen (15) minutes. The separate samples shall be combined and mixed, so that in the end there is one (1) sample of each matter, representing the average composition of the matter during the test period.
- Each sample shall be analyzed in a laboratory to determine if it meets the guaranteed values.
- The heating value, which is analyzed in the laboratory tests, is usually the gross heating value of dry matter. The conversion to net heating value of wet matter shall be done.

Test Wide Range of Operation



Refer to International Standard



Additional Procedure for  
Confident Result



## 8. Liquidate Damage

### Late delivery of equipment



If the Contractor fails to deliver the Equipment within the period time of Guaranteed Date of Delivery of Equipment or after the extension of time which may be granted under the Extension of Time, the Owner shall claim deduction from the Contract Price, as liquidated damages at **the amount of one-tenth (0.1) per cent of the total contract price for each calendar day, but not more than the aggregate of 10 % of the total Contract price.**



*Limitation of Liability*

### Failure to meet performance guarantee



**Electricity Output:** If the measured electrical output is less than the Guarantee electrical output, the liquidated damage shall be the amount of X0,000 Baht/kWe of deficit.

**Fuel Consumption:** If the measured fuel consumption is more than the Guarantee average consumption, the liquidated damage shall be the amount of X0,000 Baht/MJ/kWe of excess fuel consumption correspond to Natural gas HHV stated in APPENDIX 6: FUEL DATA.

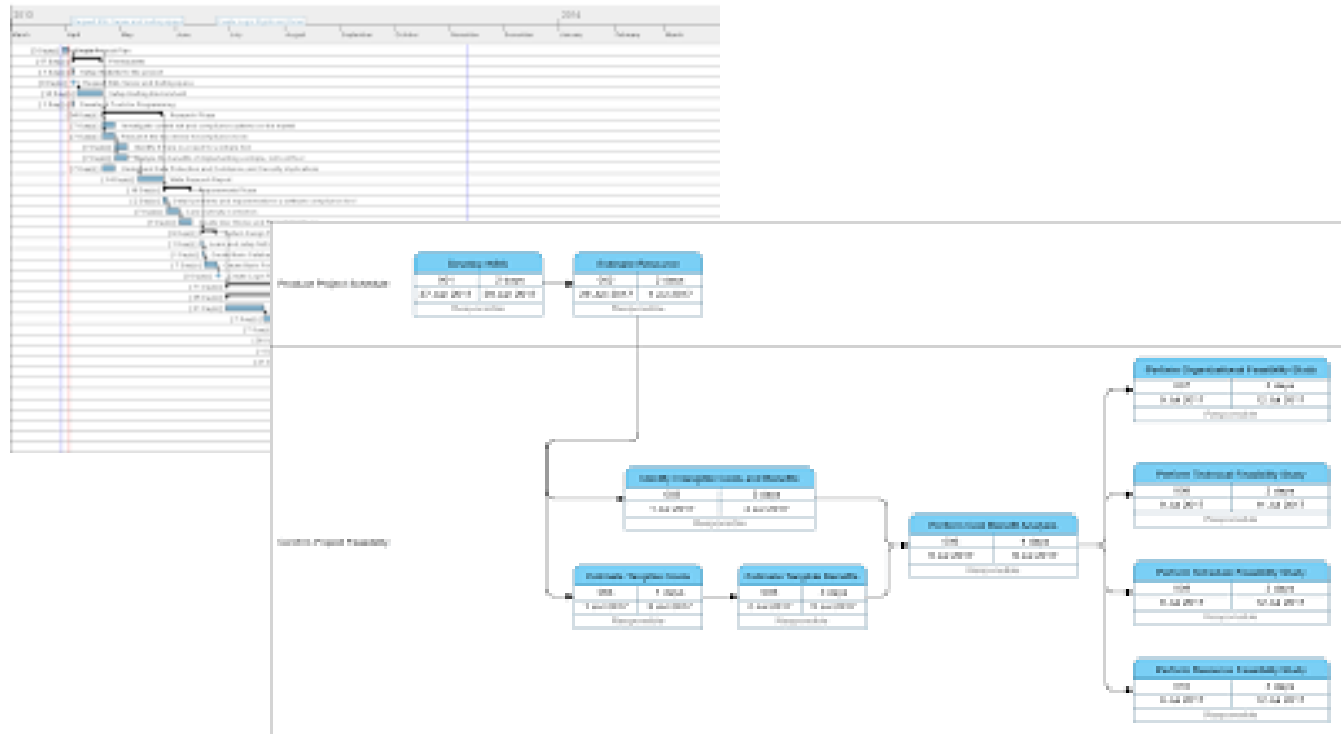
**Steam Output:** If the measured steam output is less than the Guarantee steam heat output, the liquidated damage shall be the amount of X0,000 Baht/kWth of deficit.

**Hot Water Output:** If the measured hot water heat output is less than the Guarantee hot water heat output, the liquidated damage shall be the amount of X0,000 Baht/kWth of deficit.

**Condition (it may be changed depend on it's price on performance test)**

- Electricity price X.XX Baht/kWe, the average electricity price paid during the warranty period; whichever is more.
- NG price XXX Baht/MMBtu HHV; or the average NG price paid during the warranty period; whichever is more.
- Engine run at 100% of rated capacity

# 9 Project Planning and Timeline



# LEGAL and NEGOTIATION

Congratulation you win the  
project

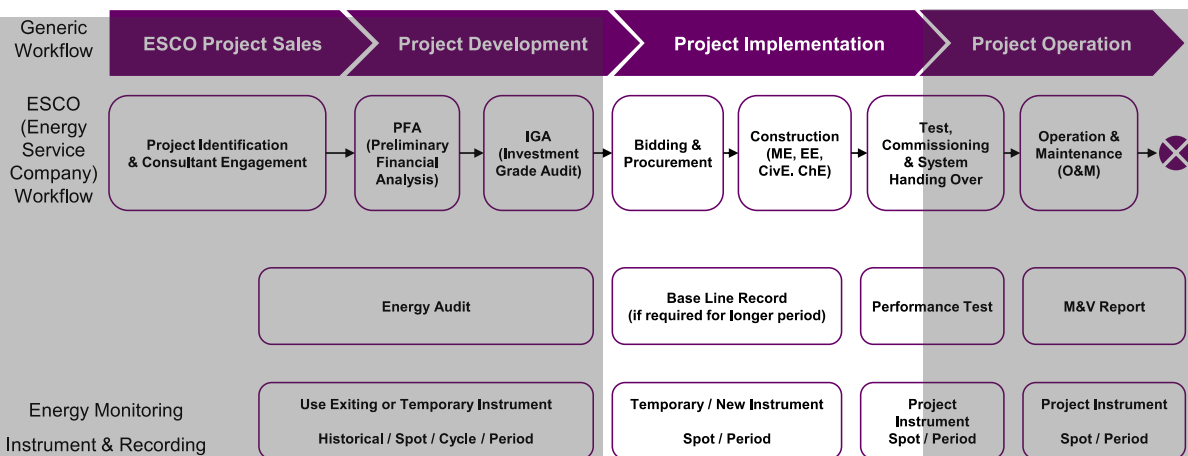
# Project Implementation

- Bidding and Procurement
- Construction
  - Continuing baseline monitoring!!!
- FAT
- SAT

Data Data Data

Actual Base Line

Final M&V Plan





# Project Operate

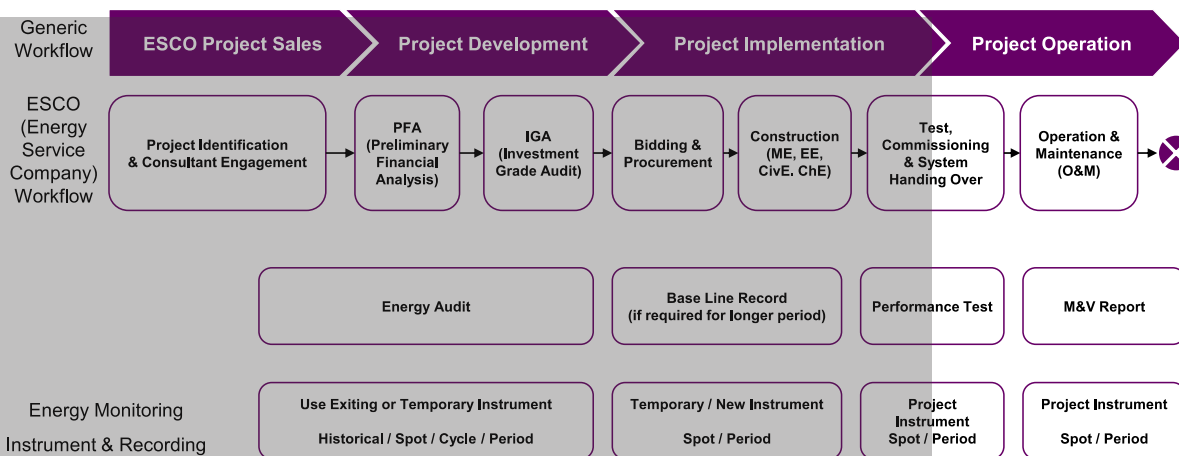
- Commissioning and Hand Over
- Verification
- Training
- O&M
- Continue M&V Reports

As-Built Drawing

Operation Manual

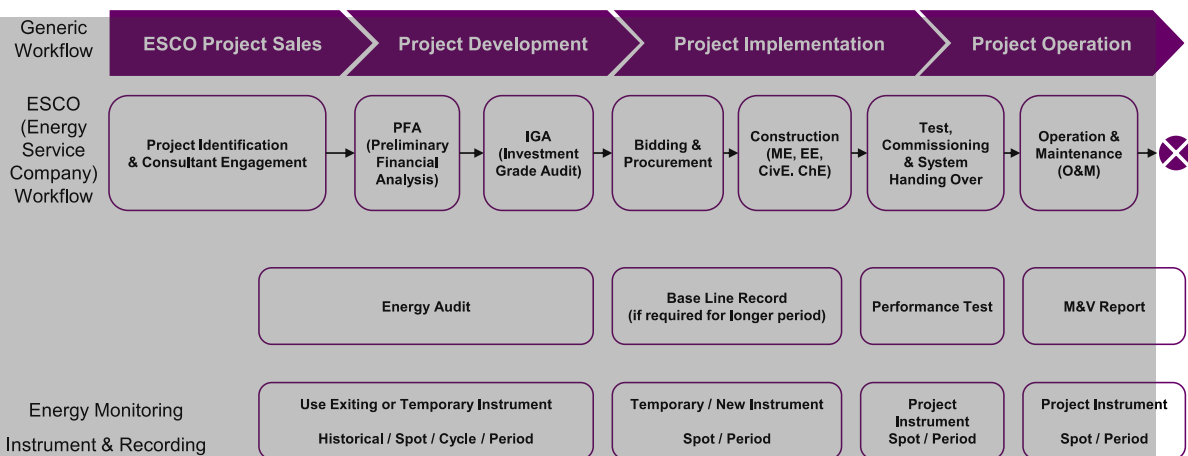
Maintenance Manual

M&V Report



# Project Operate-> End of Contract

- End of contract
- Receipt and release



Q&A.....Thank you