PLANT OPERATIONAL AUDIT & OPTIMIZATION

IDEA CONFERENCE DUBAI 2018

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AGENDA

02 Introduction

Energy and District Cooling.

04 BB-03 Case Study

Implementation of Method

06 Resources

01 Objective

03 Energy Audit

Introduction and Simple Energy Audit Method

05 Conclusion

OBJECTIVE

1. Highlight the importance of Energy Audit in optimizing the operation methodology.
2. Provide the method and technique of implementing the energy audit.

Introduction to Energy

Demand

Over the last 10 years, demand on energy increased by 17% with an increase of 11% in CO2 emissions.

Resources

Fossil Fuel Dominates
1-85% of global primary energy in 2017
2-86% in 2016

Problems

1- Reserves are decreasing
2- Environmental problems

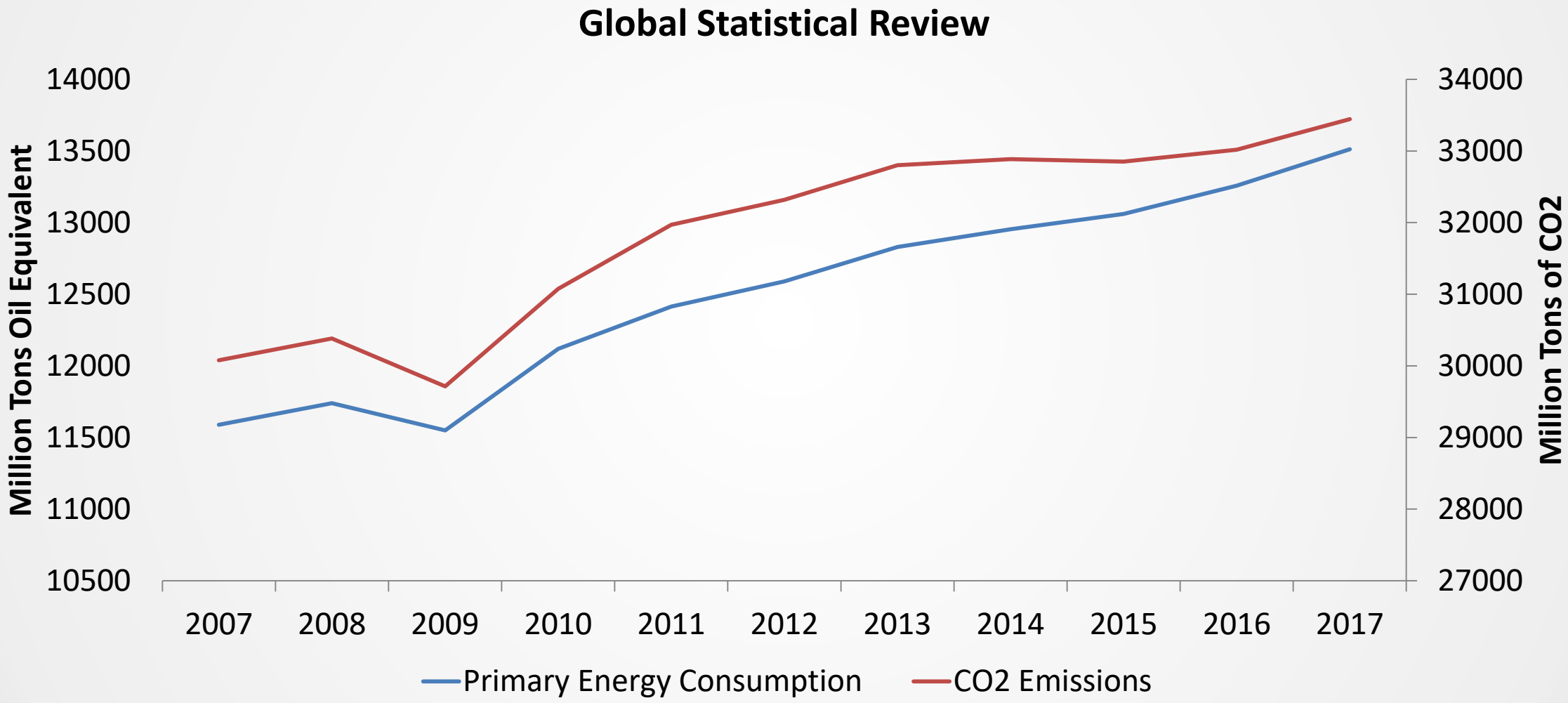
Importance

Energy supply became a vital important service for every country and every human.

bp

"The failure to make any inroads into the power sector since the turn of the century should be both a cause for concern and a focus for future action." - Bob Dudley – Group Chief Executive

Introduction to Energy



District Cooling

01

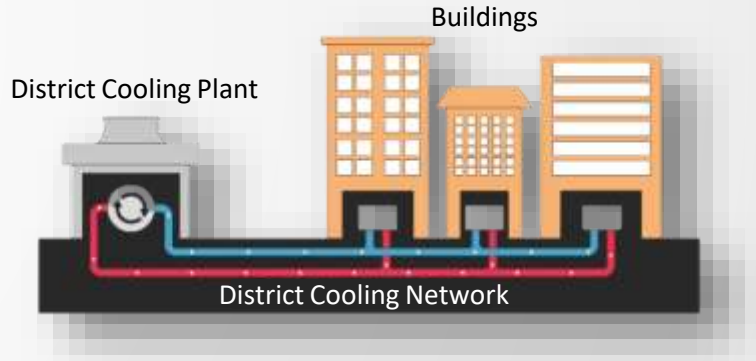
With Conventional AC

Power Demand reaches up to 70% in Summer for AC.

02

With District Cooling

kW/TR is reduced from 1.5/1.8 to 0.9 kW/TR.
Almost 50% reduction in power demand.



03

Saving of Energy

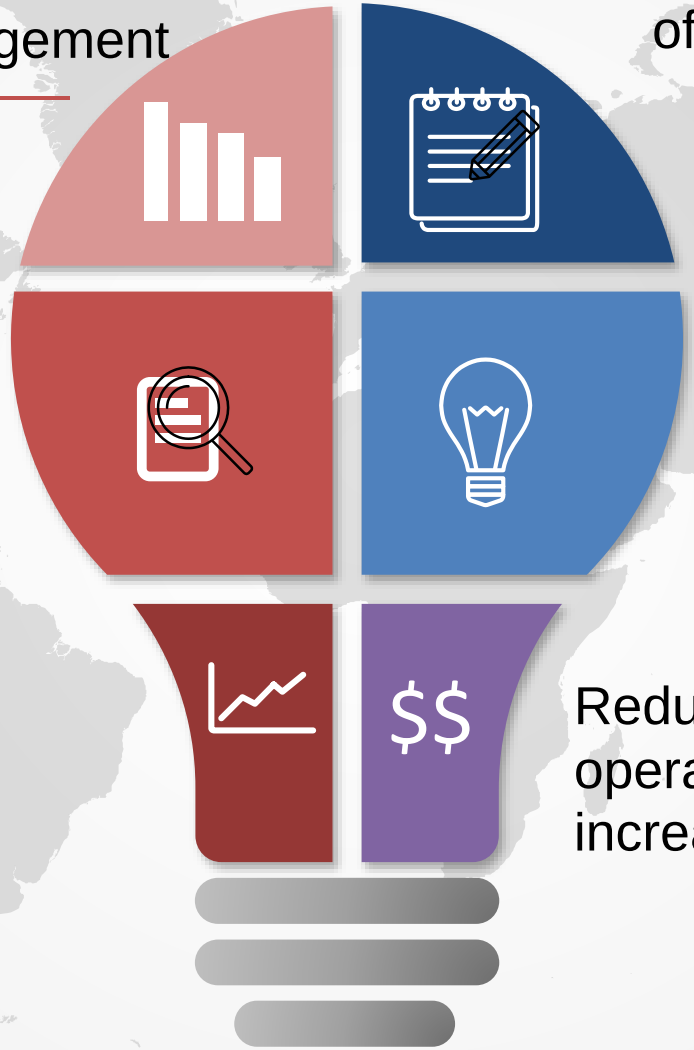
1) Million Tons of fuel saved for the Government.
2) Billions of Dirhams for the Government.
3) Hundred Thousands of Dirhams for developers.
4) Energy Efficient.

Energy Audit

01 Essential Tool of Energy Management

02 An investigation into the energy used in the plant

03 A track for the energy flow



04 Pinpoints Areas of improvement

05 Leads to investments in energy efficiency

06 Reduces operating cost & increases profit

Simple Energy Audit Method

Focus will be on Electrical Consumption

5

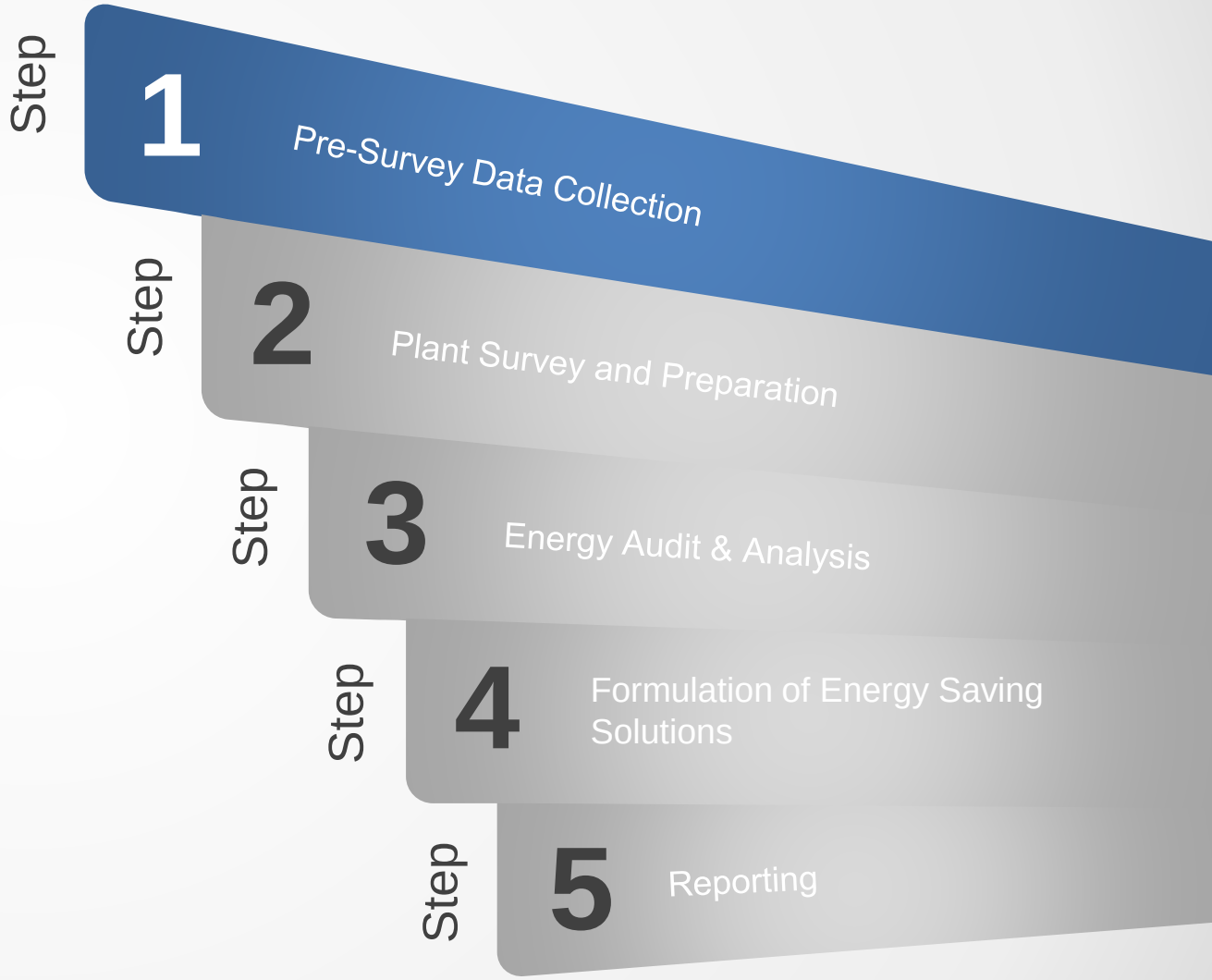
STEPS CONCEPT

Apply these steps and I promise you will make a change…

STEP 01

The information collected during this phase may include the following:

1- Utility Bills or Old Plant Energy Reports
2- Electrical As Built Single Line Diagrams and Plans

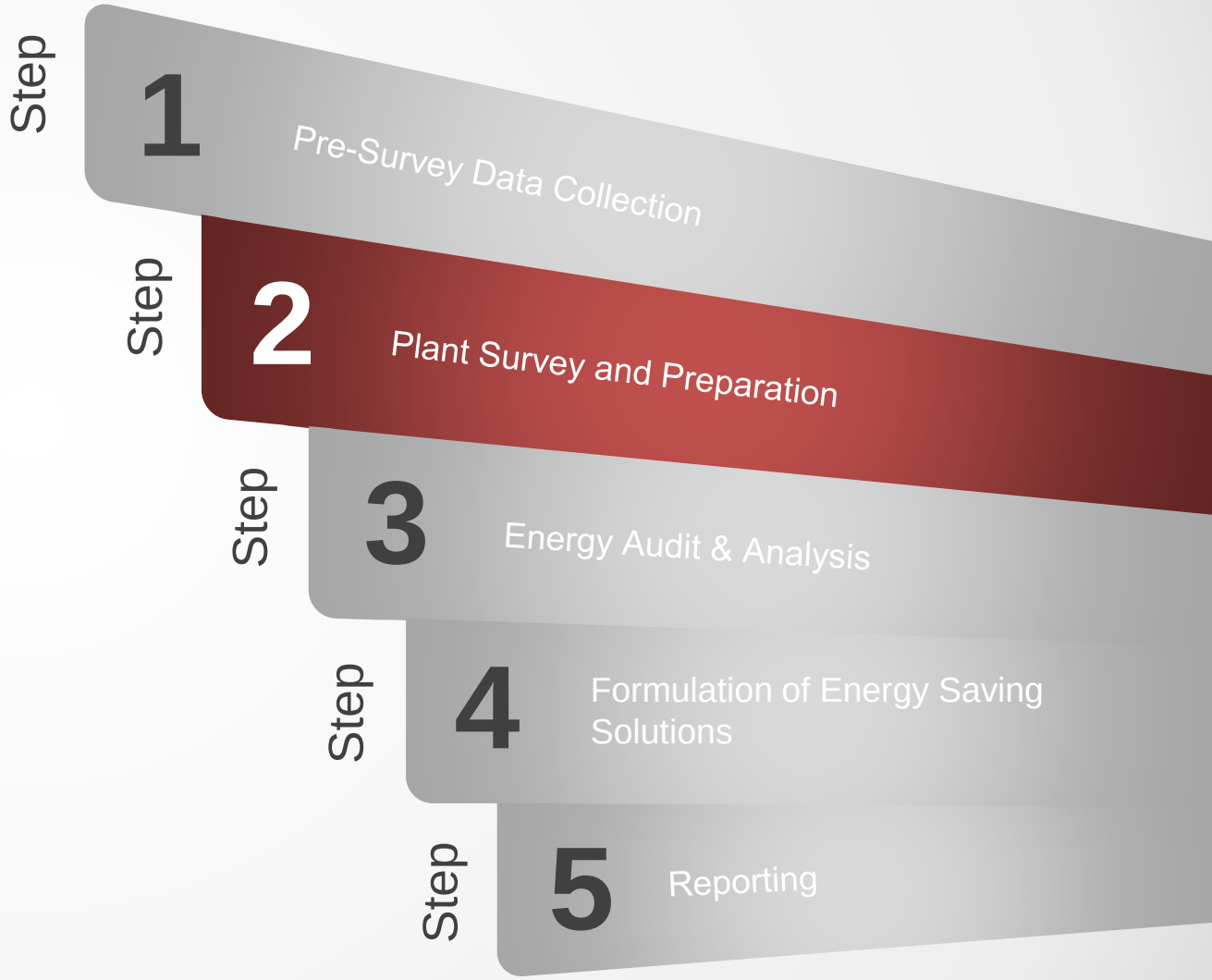


STEP

02

Includes a walk through survey to do the following

1- Trace the electrical path from the main incomers to all the main energy consumers.
2- Check the availability of the meters, their credibility and classes.
3- Create a monitoring and tracking data sheet
4- Set a timeframe and route for the process of data collection.

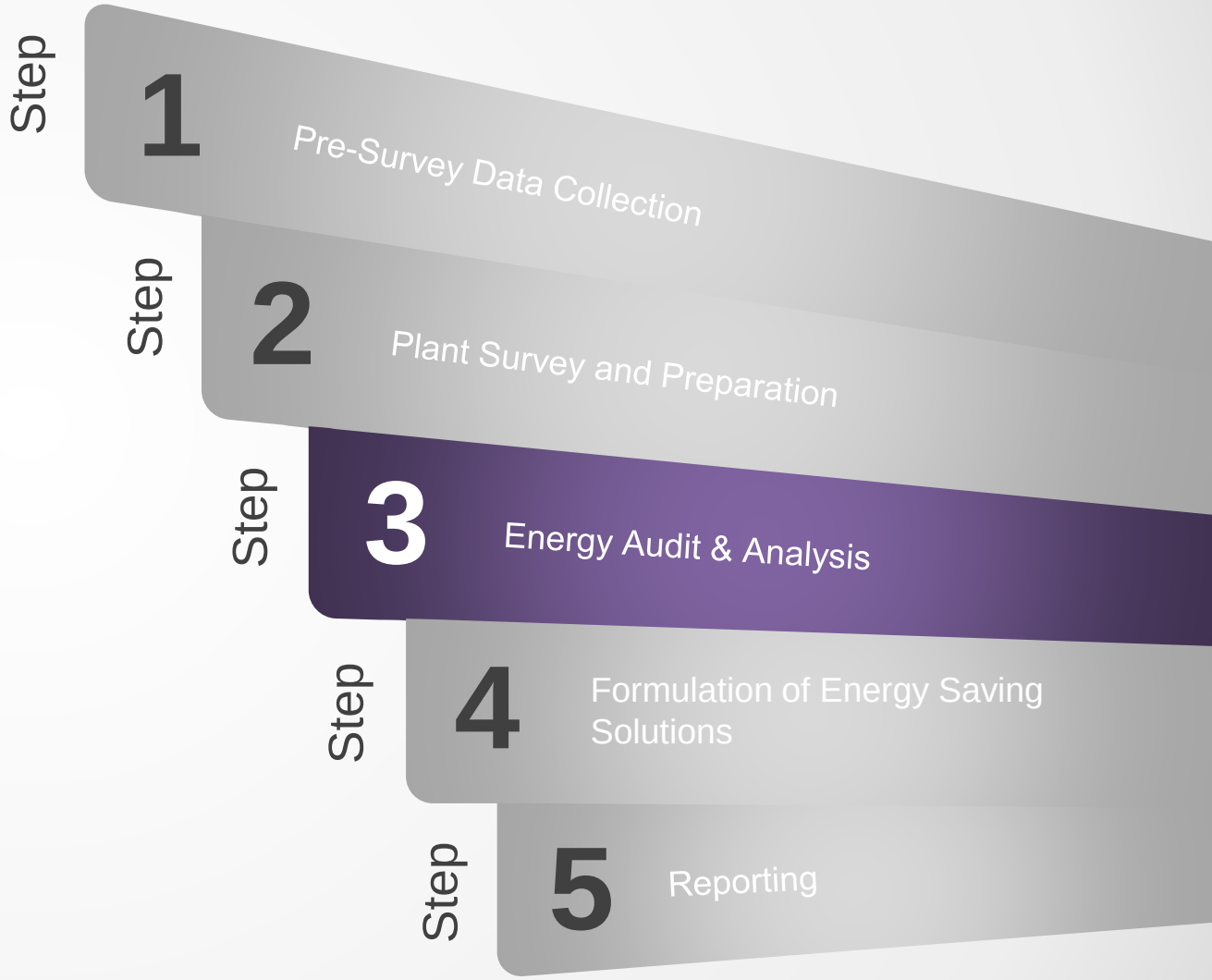


STEP

03

1- Start collecting kWh & equipment running hours every 24 hours.
2- Have the data represented in either tables or graphs as a supporting tool for auditing.
3- Detect any irregular behavior of energy consumption.
4- Investigate through different exercises for further analysis.
5- Benchmark the site energy performance against similar premises.

Note: If you require the help of someone to reduce the human error, then do so.



STEP

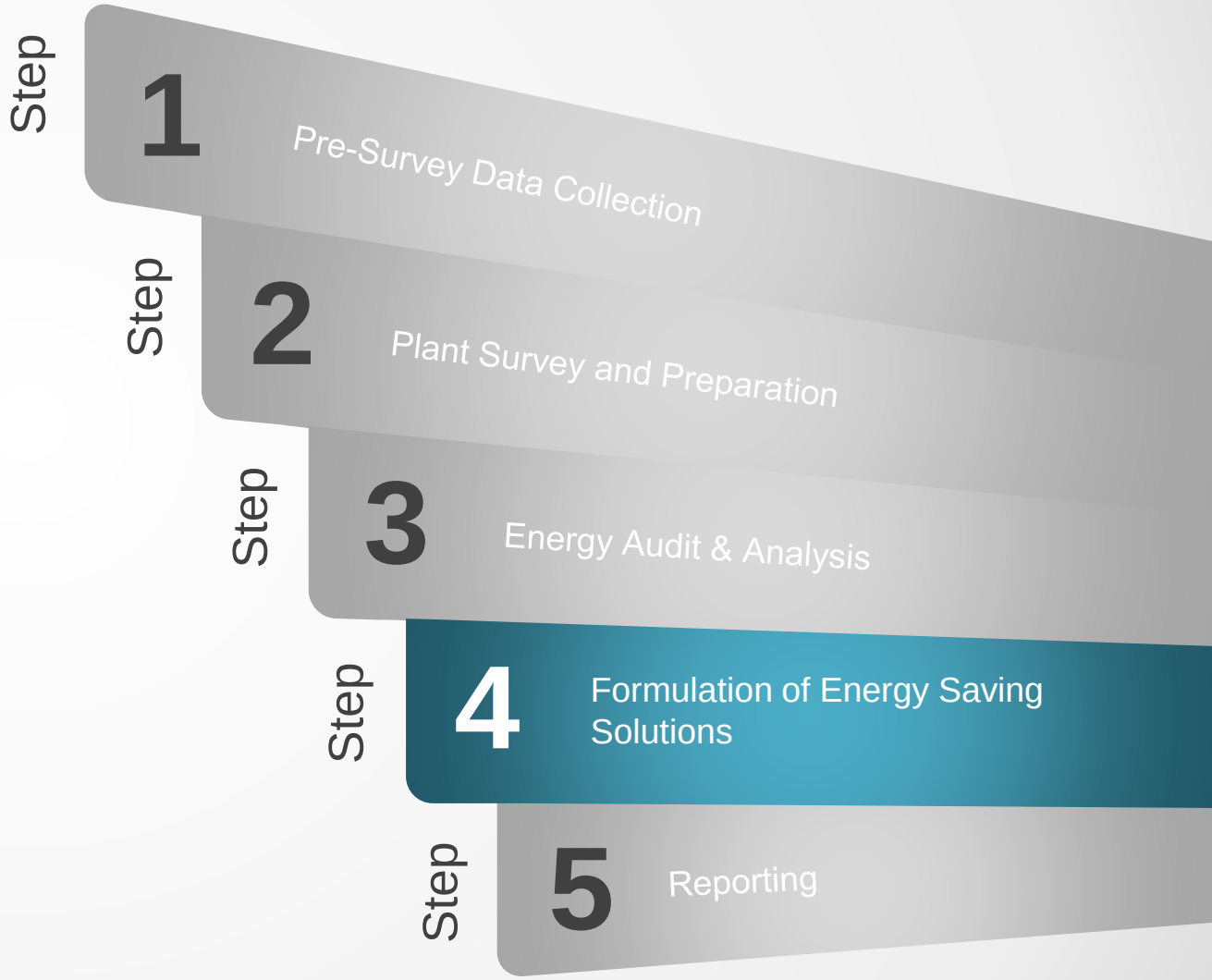
04

Identify a range of energy and cost saving opportunities including either:

1- No cost solutions
2- Highly engineered and costly measures

Selection of measures should depend on the following:

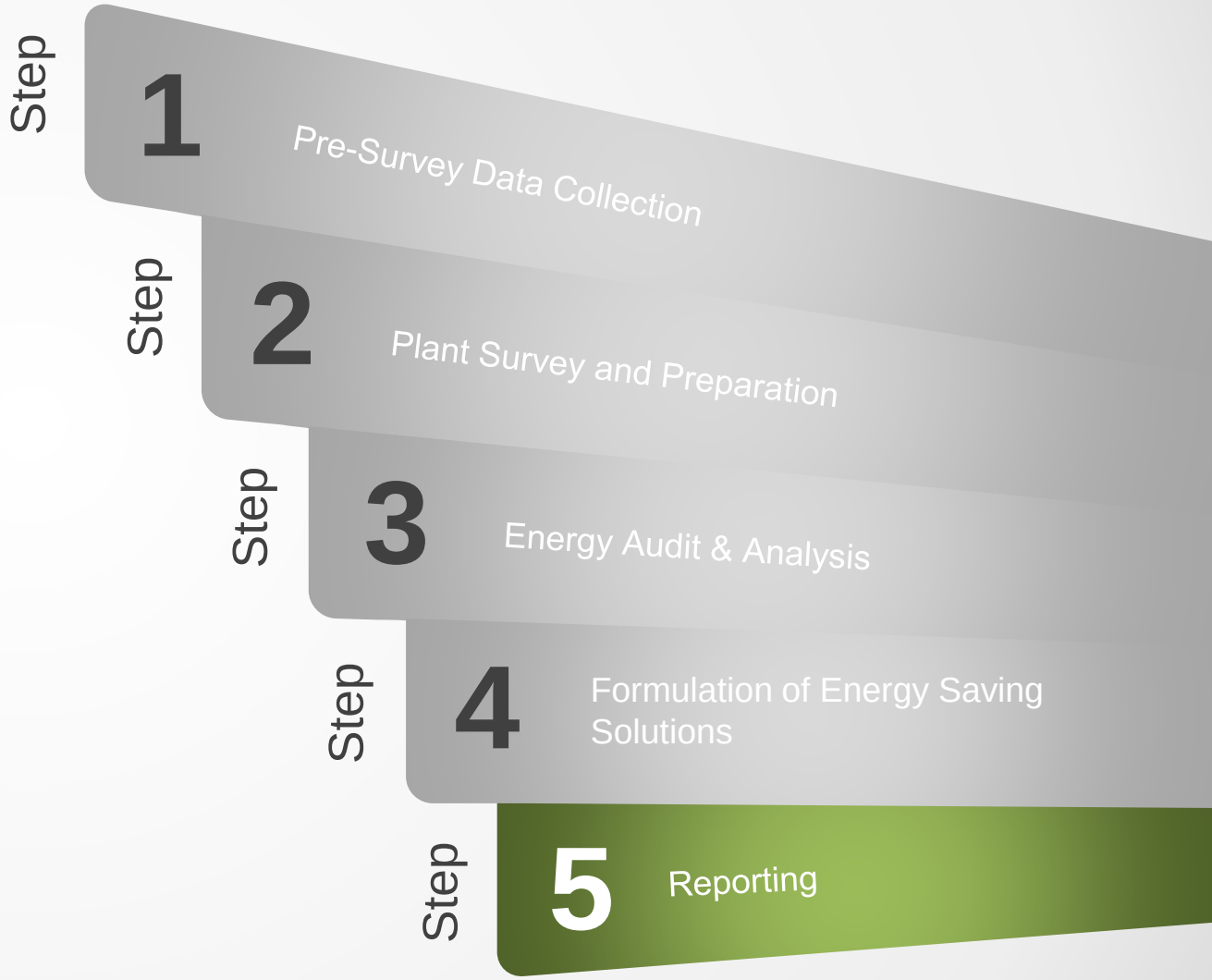
1- Technical Considerations
2- Cost Effectiveness
3- Capital Cost
4- Energy Management Strategy



STEP 05

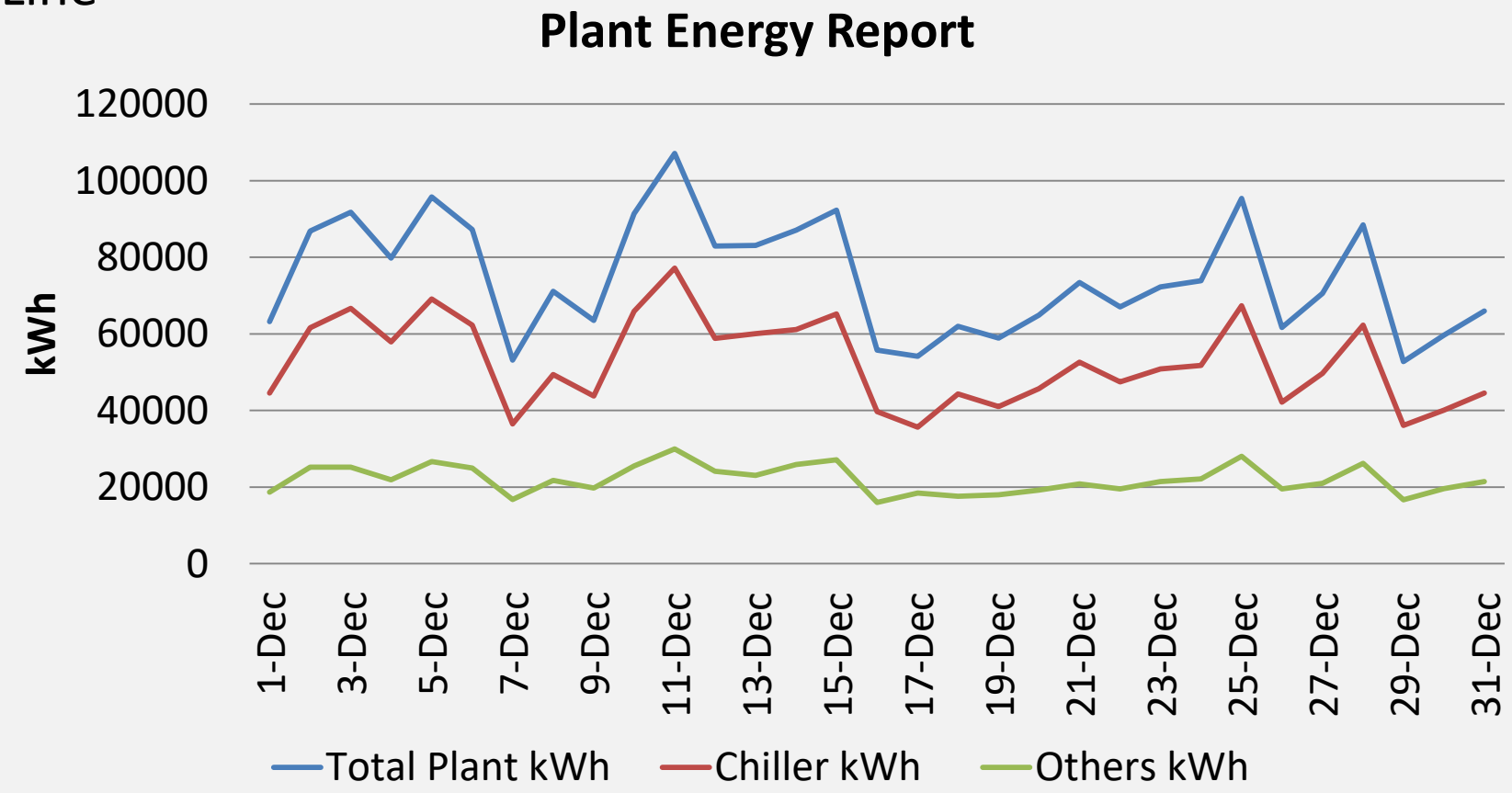
Prepare a report with the following:
1- Identification of the waste that can be saved
2- Identification of the money that can be saved.

Present this report for the management’s review..



1- Pre-Survey Data Collection (BB-03 Case Study)

- ☑ Utility bills or old plant energy consumption reports.
- ❑ Electrical AS Built Single Line Diagrams or Plans



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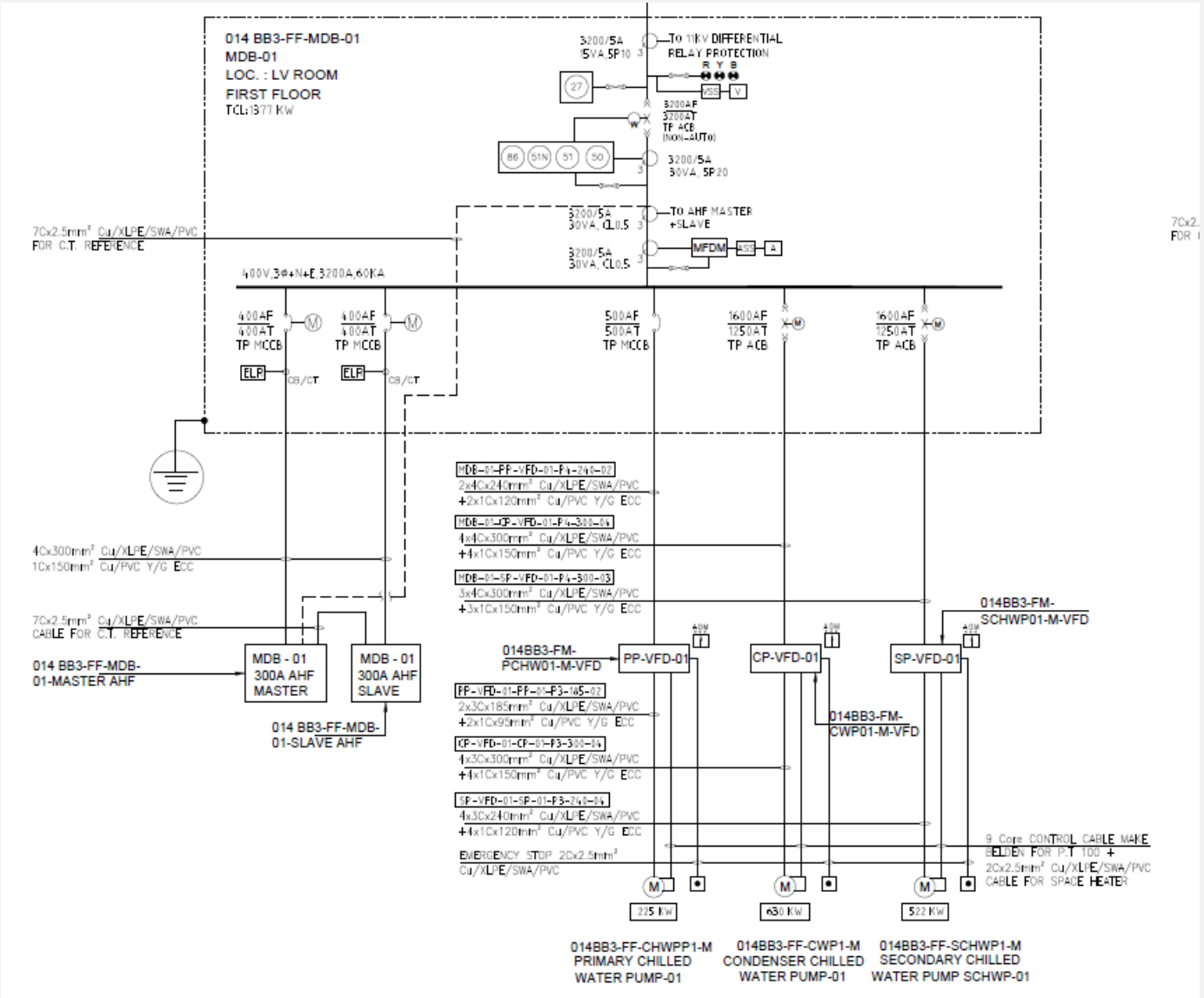


2- Plant Survey & Preparation (BB-03 Case Study)

Sun	Mon	Tue	Wed	Thu	Fri	Sat
26	27	28	29	30	01 12 :00 p.m.. Start Data Reading	02 12 :00 p.m.. Start Data Reading
03 12 :00 p.m.. Start Data Reading	04 12 :00 p.m.. Start Data Reading	05 12 :00 p.m.. Start Data Reading	06 12 :00 p.m.. Start Data Reading	07 12 :00 p.m.. Start Data Reading	08 12 :00 p.m.. Start Data Reading	09 12 :00 p.m.. Start Data Reading
10 12 :00 p.m.. Start Data Reading	11 12 :00 p.m.. Start Data Reading	12 12 :00 p.m.. Start Data Reading				

Most Important Aspects

- ✓ Create the monitoring sheet.
- ✓ Set a timeframe and route for the process of data collection

MDB-1 kWh Losses

Date	PP-1	CP-1	SP-1	Total	MDB-1	Difference
1-Dec						
2-Dec						
3-Dec						
4-Dec						

MDB-2 kWh Losses

Date	PP-2	CP-2	SP-2	Total	MDB-2	Difference
1-Dec						
2-Dec						
3-Dec						
4-Dec						

December 2017

Primary Pumps MWh Daily Reading

Date	PP 1	PP 2
1-Dec		
2-Dec		
3-Dec		
4-Dec		

Secondary Pumps MWh Daily Reading

Date	SP 1	SP 2
1-Dec		
2-Dec		
3-Dec		
4-Dec		

Condenser Pumps MWh Daily Reading

Date	CP 1	CP 2
1-Dec		
2-Dec		
3-Dec		
4-Dec		

MDB kWh Daily Reading

Date	MDB 1	MDB 2
1-Dec		
2-Dec		
3-Dec		
4-Dec		

3- Energy Audit & Analysis (BB-03 Case Study)

- ☑ Start collecting kWh & equipment running hours every 24 hours.
- ☑ Have the data represented in either tables or graphs as a supporting tool for auditing.
- ☑ Detect any irregular behavior of energy consumption.

MDB-1 kWh Losses						
Date	PP-1	CP-1	SP-1	**Total**	**MDB-1**	**Difference**
1-Dec	1,719	3,900	954	6,573	6,647.28	74.28
2-Dec	1,661	0	0	1,661	2,334.60	673.60
3-Dec	0	0	0	0	164.55	164.55
4-Dec	0	0	0	0	172.70	172.70

MDB-2 kWh Losses						
Date	PP-2	CP-2	SP-2	**Total**	**MDB-2**	**Difference**
1-Dec	0	0	335	335	529.50	194.50
2-Dec	28	6,327	33	6,388	6,862.96	474.96
3-Dec	2,918	6,241	458	9,617	9,781.80	164.80
4-Dec	1,870	0	280	2,150	2,847.40	697.40

Most Important Aspects

1- Attend the readings every single day on the same time.

2- Follow the same concept of data collection on daily basis to reduce human error.

3- Start noticing irregularities while taking readings to ease your analysis.

December 2017

Primary Pumps MWh Daily Reading		
Date	PP 1	PP 2
1-Dec	705.761	591.534
2-Dec	707.480	591.534
3-Dec	709.141	591.562
4-Dec	709.141	594.480

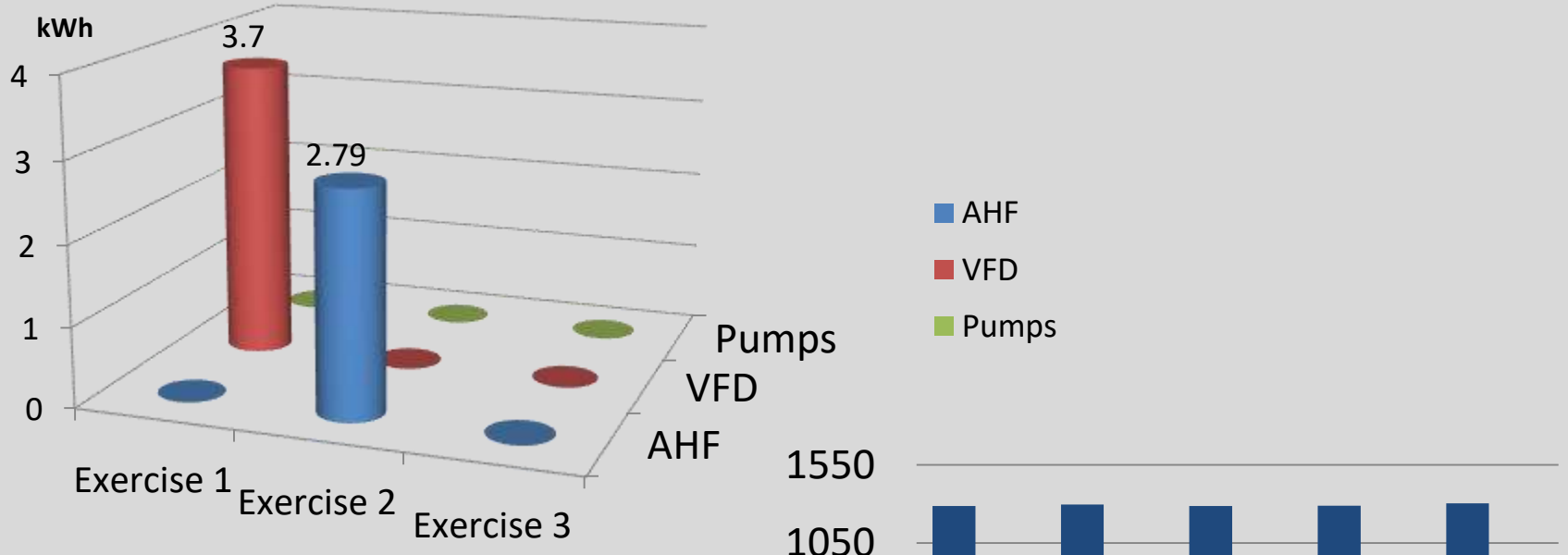
Secondary Pumps MWh Daily Reading		
Date	SP 1	SP 2
1-Dec	712.445	850.580
2-Dec	713.399	850.915
3-Dec	713.399	850.948
4-Dec	713.399	851.406

Condenser Pumps MWh Daily Reading		
Date	CP 1	CP 2
1-Dec	2,374.235	2,355.858
2-Dec	2,378.135	2,355.858
3-Dec	2,378.135	2,362.185
4-Dec	2,378.135	2,368.426

MDB Daily kWh Reading		
Date	MDB 1	MDB 2
1-Dec	3,204,633.37	2,484,981.54
2-Dec	3,211,280.65	2,485,511.04
3-Dec	3,213,615.25	2,492,374.00
4-Dec	3,213,779.80	2,502,155.80

3- Energy Audit & Analysis (BB-03 Case Study)

- ☑ Investigate through different exercises for further analysis..
- ☑ Benchmark the site energy performance against similar premises.



Electrical Feeder Chart

MDB – Further Electrical Feeder Chart		
MDB #	Pumps	Others
1	SP-1, PP-1 , CP-1	AHF & VFD
2	SP-2, PP-2 , CP-2	AHF & VFD
3	SP-3, PP-3 , CP-3	AHF & VFD
4	SP-4, PP-4, CP-4	AHF & VFD
5	SP-5, PP-5, CP-5	AHF & VFD
6	SP-6, PP-6, CP-6	AHF & VFD
8	SP-7, PP-7, CP-7	AHF & VFD
9	SP-8, PP-8, CP-8	AHF & VFD

4- Formulation of Energy Saving Solution

Recommendation

- ☒ Direct communication from SCADA to VFDs & AHFs that will allow the operator to take control.
- ☒ Air blowers and fans should have temperature set points that will allow them to run only when internal heat is required.
- ☑ VFDs and AHFs must have a sleep mode where they only run when their respective pumps and equipment are running. (AED 0 Cost of Implementation)

As per the manufacturer, the installed Active Harmonic Filters have energy optimization settings.

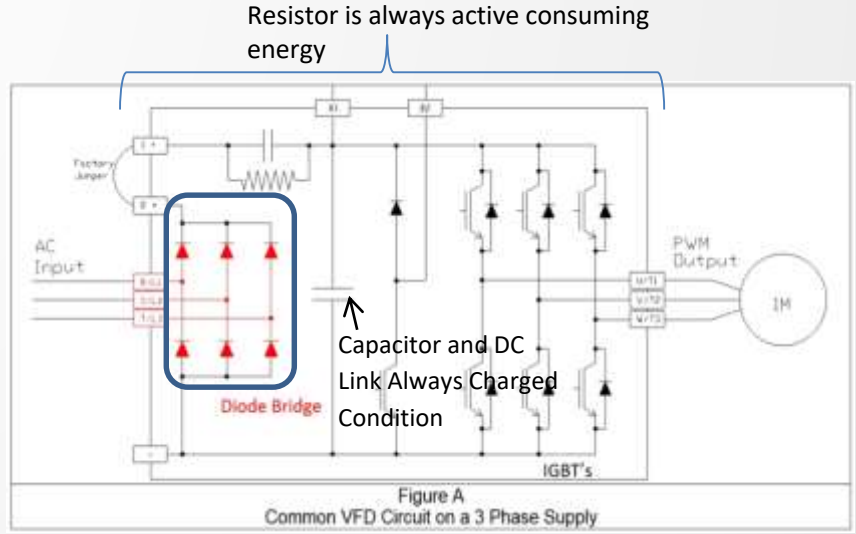
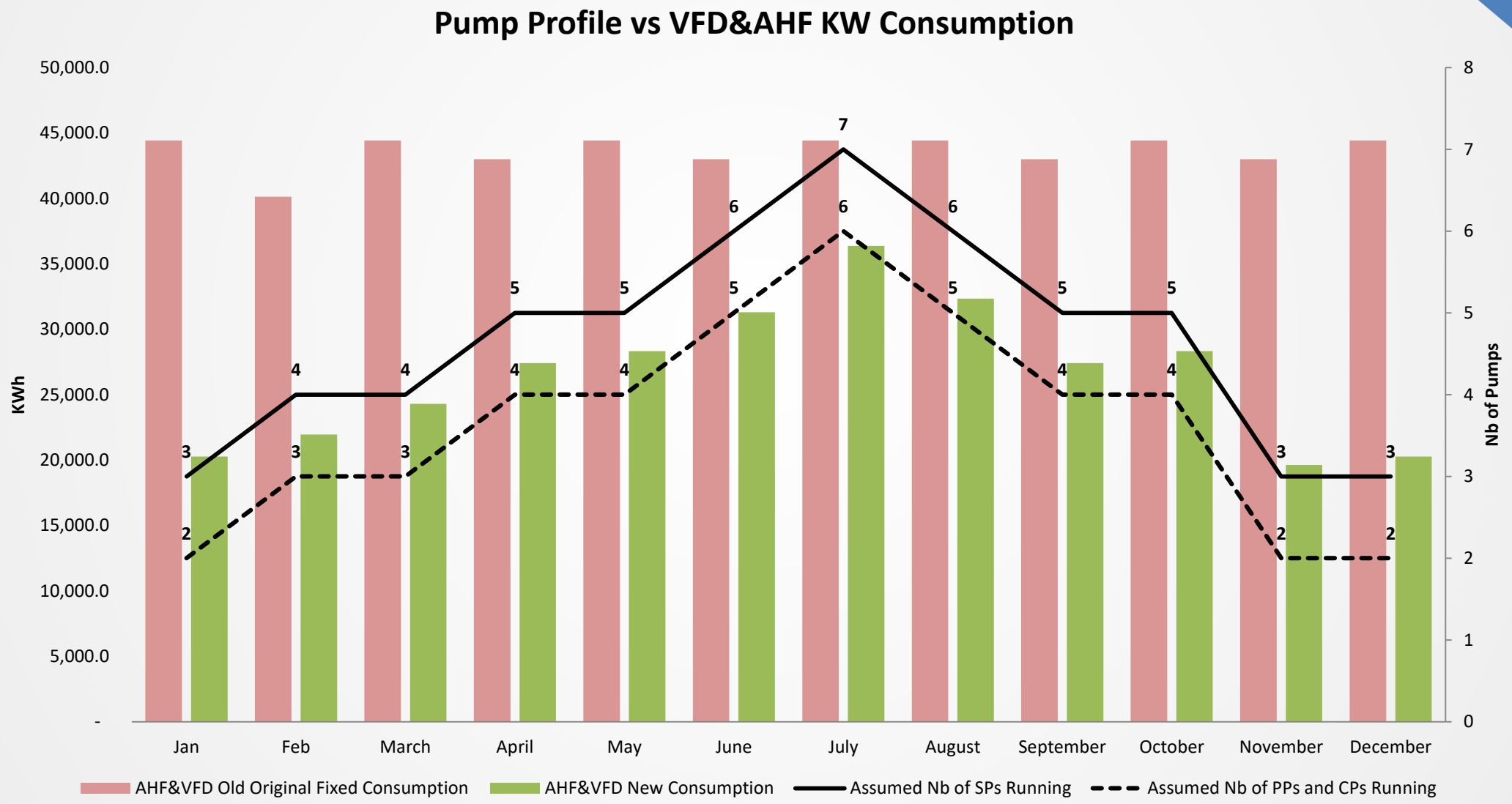


Figure A
Common VFD Circuit on a 3 Phase Supply

5- Reporting (BB-03 Case Study)



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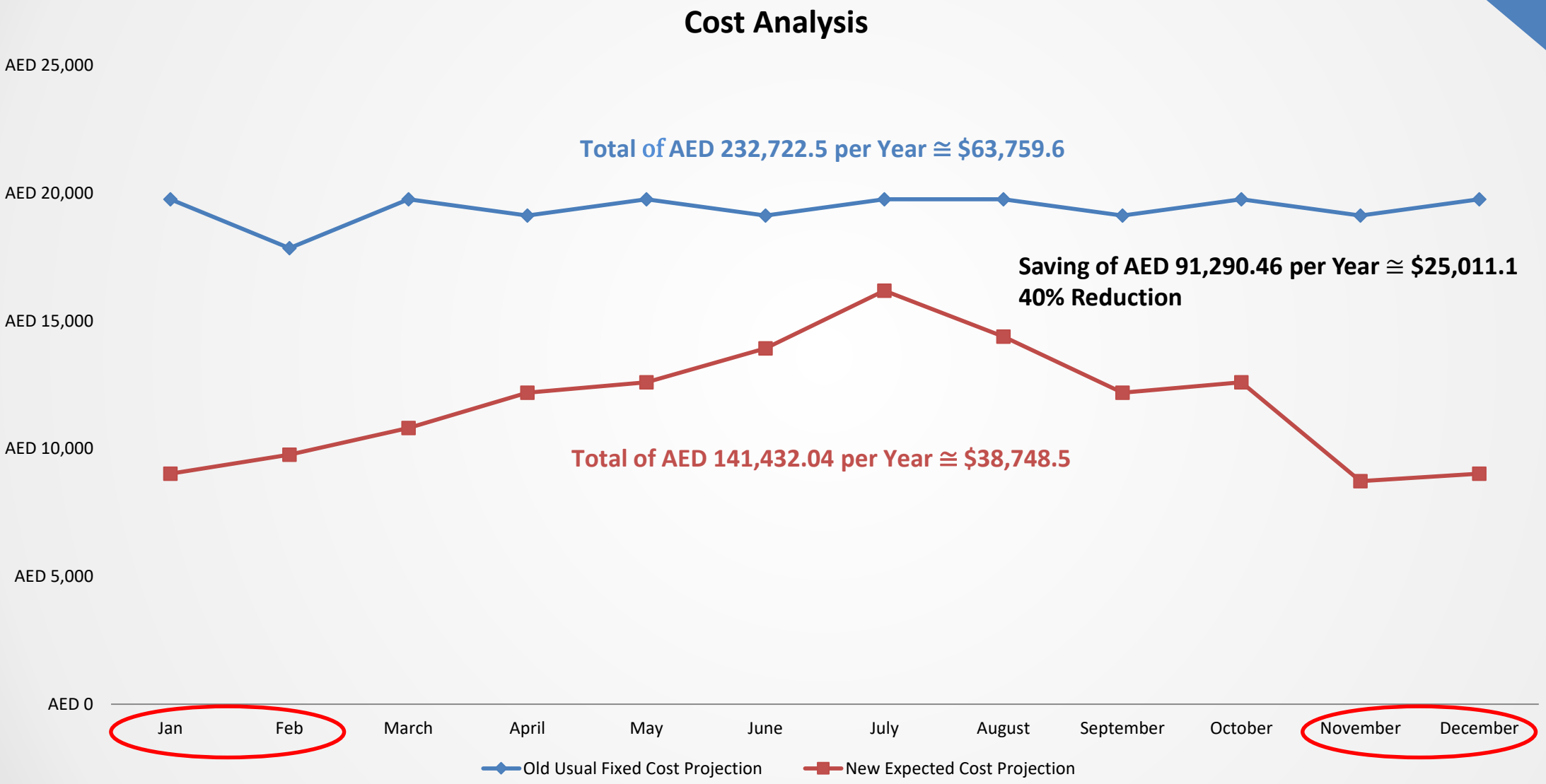

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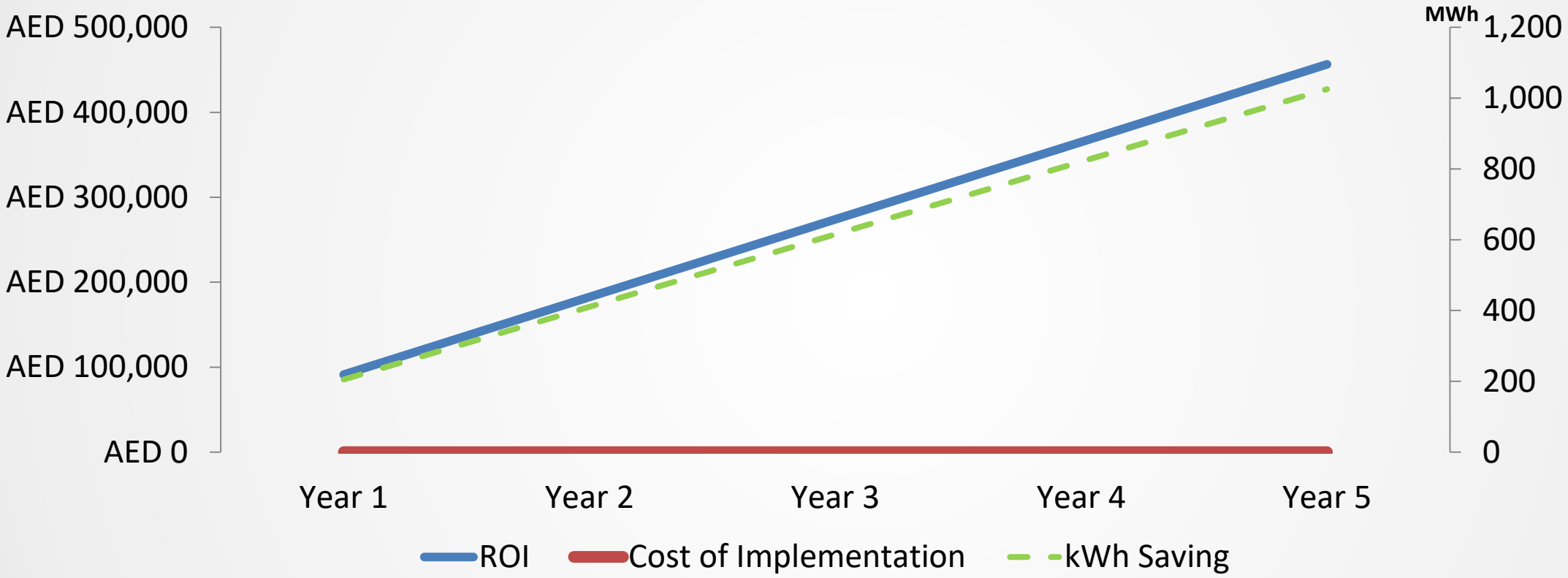

- $205{,}147.101\ kWh/year$ → 18 Houses in UAE/year
- $107{,}620.17\ KgCO_2$ saved.
- What if this issue is the same in multiple other plants?

CONCLUSION

Optimizes Operation Methodology

Leads to investments in energy efficiency

A Tool for Energy Management

Reduces operating cost and improves profits

Thank you!

Any Questions?

SOURCES

1. Hamburg, Arvi. *Energy Supply Problems And Prospects*. 2011,
2. BP Statistical Review of World Energy, 2018,
3. Harris, Douglas. *A Guide to Energy Management in Buildings*. Routledge, 2016.