



CHANGES IN TODAY'S PLANNED & PREVENTIVE MAINTENANCE

BUILDING MAINTENANCE CONFERENCE-2021, KL 23RD JUNE

2021

**Jeyanandan
Kumar**

B.Eng. M.B.A

JEYANANDAN KUMAR

- GRADUATE ELECTRICAL ENGINEER, B.ENG. FROM NIT, INDIA AND M.B.A FROM GRADUATE SCHOOL OF BUSINESS, UNIVERSITY MALAYA, MALAYSIA
- 30+ YEARS EXPERIENCE IN PLANT & FACILITY MAINTENANCE; PROJECT & ENERGY MANAGEMENT;
- EXECUTED MORE THAN 50 ENERGY, POWER QUALITY & SAFETY AUDITS; ENERGY & MAINTENANCE MANAGEMENT SYSTEM IMPLEMENTATIONS.

ABOUT ME

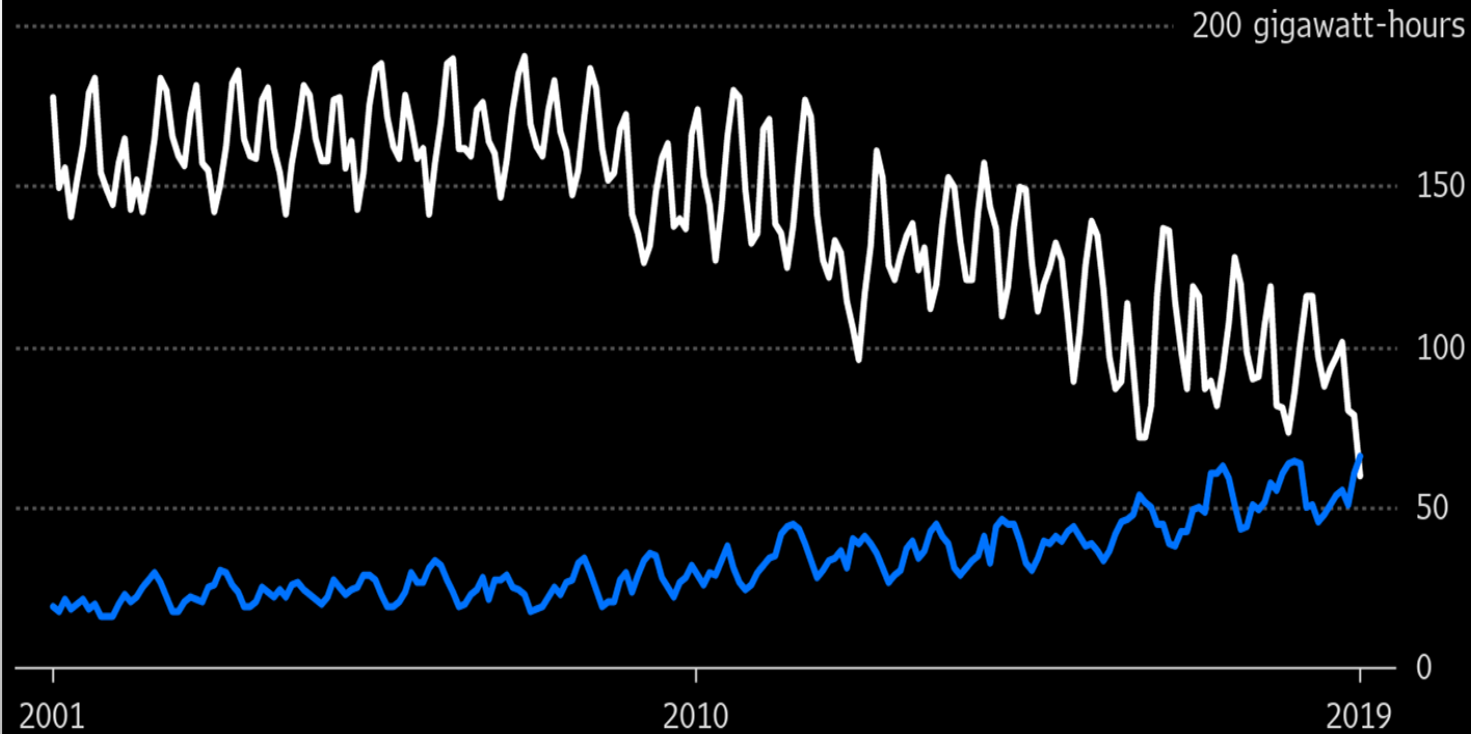
ENERGY EFFICIENCY-ENVIRONMENT-
ENGINEERING

WE NOW LIVE IN A RENEWABLE ENERGY ECONOMY

U.S. Renewables Eclipse Coal

Solar, wind, hydroelectric plants surpassed American coal in April

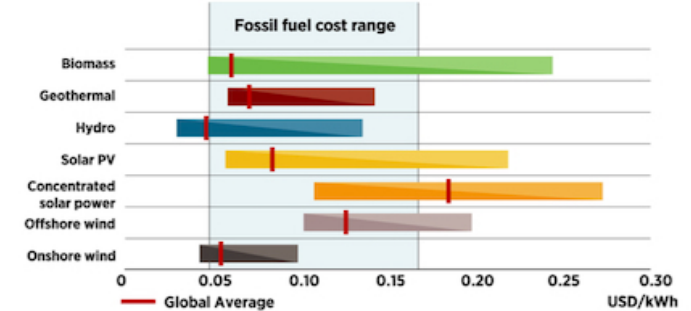
Coal Renewables



Source: Energy Information Administration

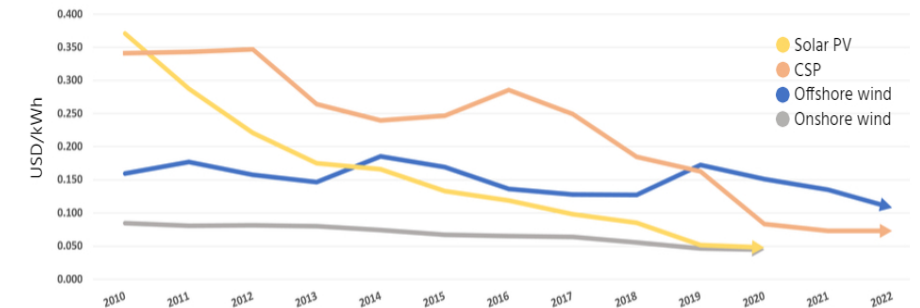
Bloomberg

Today, the cost of electricity from renewables is cheaper or within the range of fossil fuels



RENEWABLE POWER GENERATION COSTS IN 2018 IRENA International Renewable Energy Agency

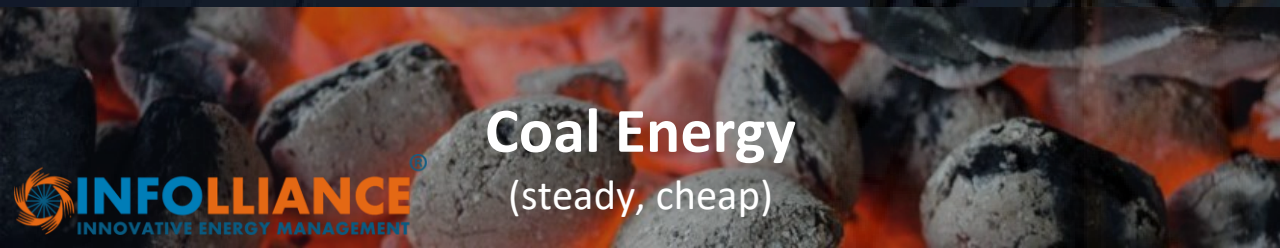
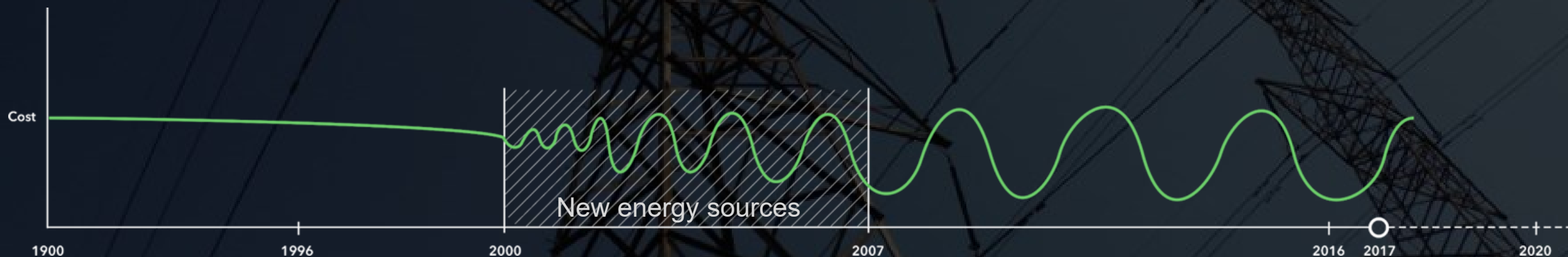
By 2020, **onshore wind** and **solar PV** will be a less expensive source of new electricity than the cheapest fossil fuel alternative.



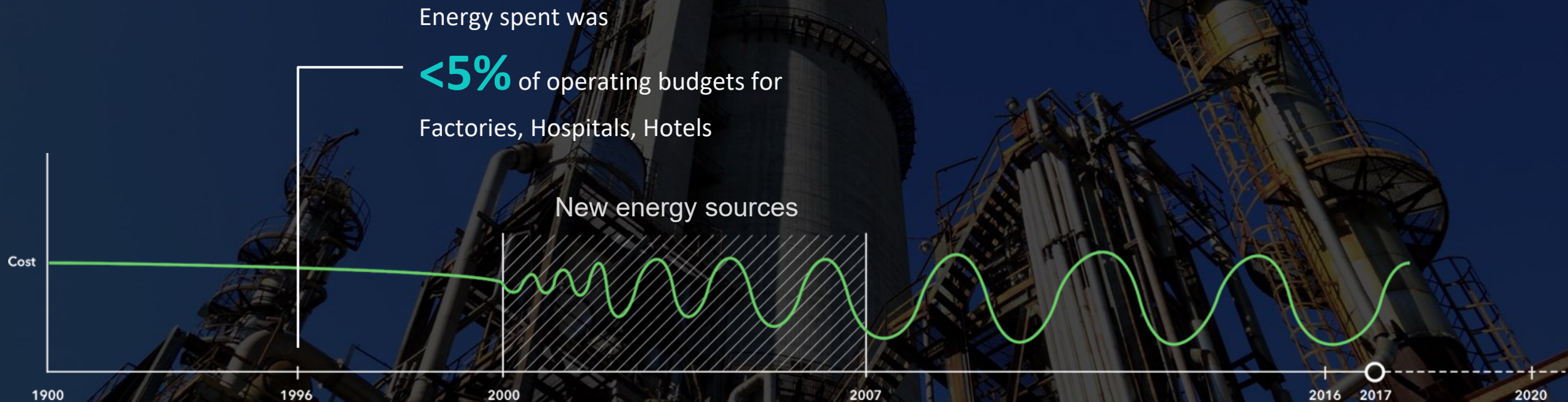
RENEWABLE POWER GENERATION COSTS IN 2018 IRENA International Renewable Energy Agency

A massive shift is happening from Conventional Power Generation to Renewable alternatives, due to environmental concerns.

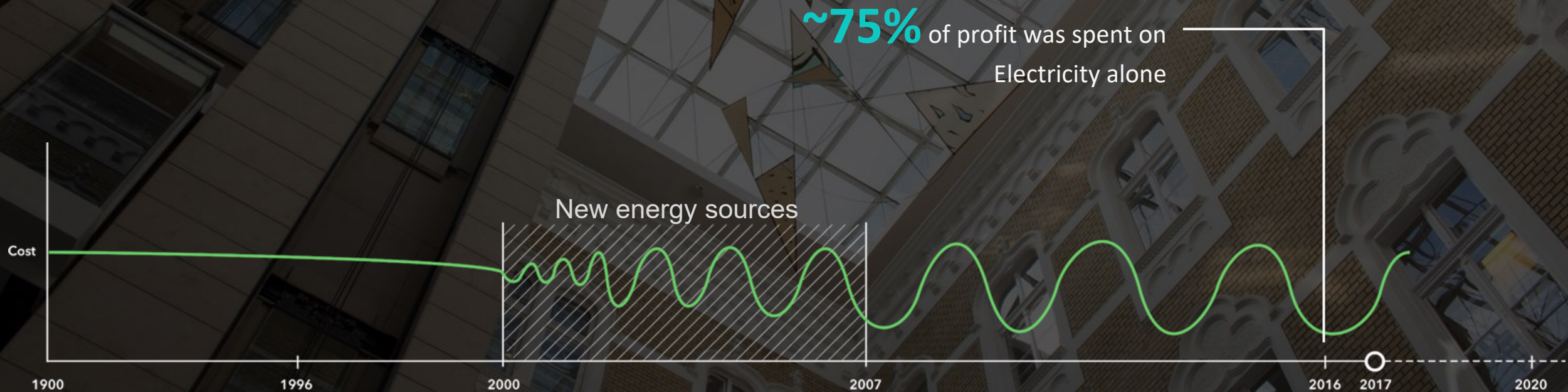
- the first time since the invention of the grid



Healthy companies were built on steady, cheap reliable energy over the last 100 years

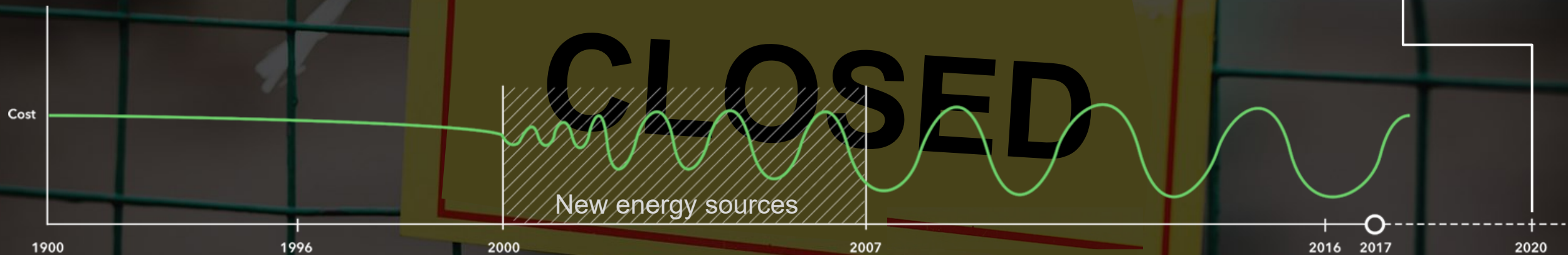


Now those companies are sick/at risk.
Before 2000, energy is cheap & reliable.
After 2000, environmental concern bring new energy source
and make more fluctuating price in the market.



Within the next decade 1 in 3 will close business due to energy fluctuating risk that beyond control.

Changing energy demand in 5 years will force 1 in 3 companies out of business

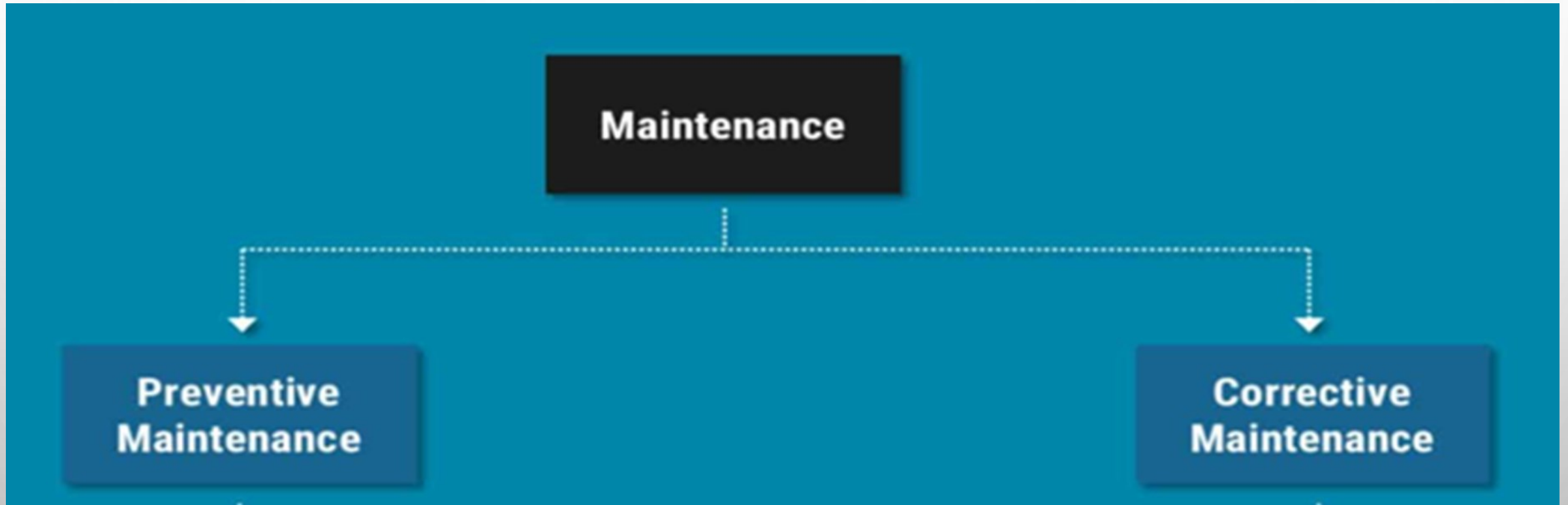


How is it connected with Maintenance Operation?

- THE INSTALLED EQUIPMENTS DECIDE ENERGY CONSUMPTION PATTERN.
- AND, EFFICIENT OPERATION & MAINTENANCE: KEYS TO BETTER ENERGY MANAGEMENT



TYPES OF MAINTENANCE



DEFINITION



Preventive maintenance can be defined as “an equipment maintenance strategy based on replacing, or restoring, an asset at a fixed interval regardless of its condition. Scheduled restoration tasks and replacement tasks are examples of preventive maintenance tasks.” 1

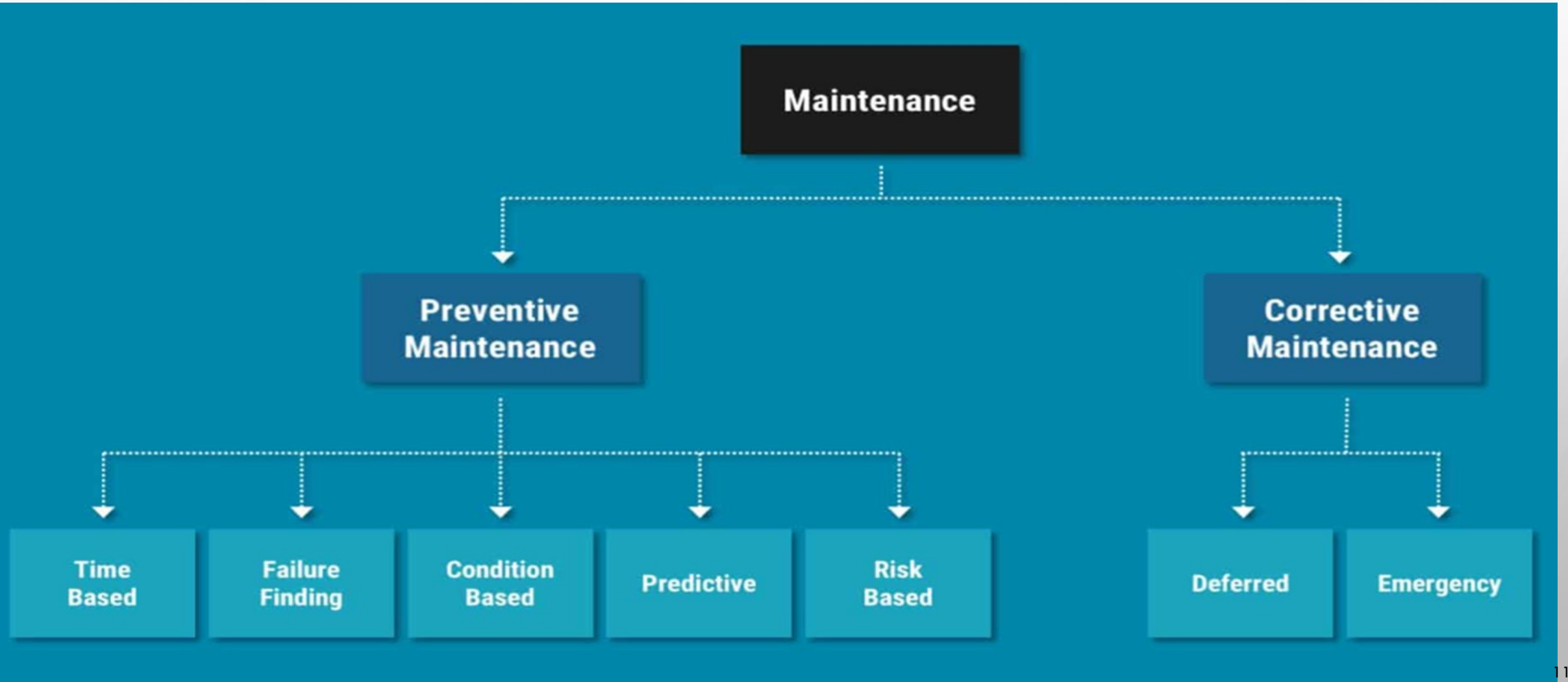


Preventive maintenance is basically a type of maintenance that is done at a regular interval while the equipment is still functioning with the objective of preventing failure or reducing the likelihood of failure.



Preventive maintenance can be time based i.e. every week, every month or every three months. But preventive maintenance can also be based on usage e.g. every 150 cycles, every 10,000hrs or like your car: service every 10,000km.

TYPES OF MAINTENANCE



TYPES OF MAINTENANCE

- **TIME-BASED MAINTENANCE (TBM)**
- REFERS TO REPLACING OR RENEWING AN ITEM TO RESTORE ITS RELIABILITY AT A FIXED TIME, INTERVAL OR USAGE REGARDLESS OF ITS CONDITION.
- **FAILURE FINDING MAINTENANCE (FFM)**
- FFM AIMED AT DETECTING HIDDEN FAILURES TYPICALLY ASSOCIATED WITH PROTECTIVE FUNCTIONS. EX.SAFETY VALVES, TRIP TRANSMITTERS ETC.. IT DOES NOT PREVENT FAILURE BUT SIMPLY DETECT.
- **RISK BASED MAINTENANCE (RBM)**
- RISK BASED MAINTENANCE (RBM) IS WHEN YOU USE A RISK ASSESSMENT METHODOLOGY TO ASSIGN YOUR SCARCE MAINTENANCE RESOURCES TO THOSE ASSETS THAT CARRY THE MOST RISK IN CASE OF A FAILURE (REMEMBERING THAT $RISK = LIKELIHOOD \times CONSEQUENCE$).
- **CONDITION BASED MAINTENANCE (CBM)**
- CONDITION BASED MAINTENANCE AS A STRATEGY, LOOKS FOR PHYSICAL EVIDENCE THAT A FAILURE IS OCCURRING OR IS ABOUT TO OCCUR.

TYPES OF MAINTENANCE

- **PREDICTIVE MAINTENANCE (PDM)**
- PREDICTIVE MAINTENANCE (PDM) WAS ESSENTIALLY AS A SYNONYM FOR CONDITION BASED MAINTENANCE.
- RECENT EVOLUTION OF ARTIFICIAL INTELLIGENCE, IIOT, MACHINE LEARNING, DATA ANALYTICS MADE HUGE DIFFERENCE APPEARING BETWEEN PREDICTIVE MAINTENANCE (PDM) AND CONDITION BASED MAINTENANCE (CBM).
- THERE ARE A LOT OF (VERY LARGE) COMPANIES ACTIVELY MOVING INTO THIS SPACE.

TYPES OF MAINTENANCE

- **CORRECTIVE MAINTENANCE (CM)**
- A RUN TO FAILURE OR CORRECTIVE MAINTENANCE STRATEGY ONLY RESTORES THE FUNCTION OF AN ITEM AFTER IT HAS BEEN ALLOWED TO FAIL. IT IS BASED ON THE ASSUMPTION THAT THE FAILURE IS ACCEPTABLE (I.E. NO SIGNIFICANT IMPACT ON SAFETY OR THE ENVIRONMENT) AND PREVENTING FAILURE IS EITHER NOT ECONOMICAL OR NOT POSSIBLE.
- CORRECTIVE MAINTENANCE IS ALSO THE RESULT OF UNPLANNED FAILURES WHICH WERE NOT AVOIDED THROUGH PREVENTIVE MAINTENANCE.
- **EMERGENCY MAINTENANCE (EM)**
- EMERGENCY MAINTENANCE IS 3 TO 5 TIMES AS EXPENSIVE AS 'NORMAL' PREVENTIVE MAINTENANCE.
- EM TYPICALLY LEADS TO LONGER EQUIPMENT OUTAGES AND IS LESS SAFE.
- EM TO BE AVOIDED AS MUCH AS POSSIBLE.
- WORLD CLASS ORGANISATIONS ENSURE THAT LESS THAN 2% OF THEIR TOTAL MAINTENANCE IS EMERGENCY MAINTENANCE.
- HOW MUCH EMERGENCY MAINTENANCE DO YOU HAVE? HOW TO AVOID??

Preventive VS Corrective Maintenance

**Preventive
Maintenance**

***before a failure
has occurred***

VS

**Corrective
Maintenance**

***after a failure
has occurred***

THE EVOLUTION OF MAINTENANCE STRATEGIES

REACTIVE



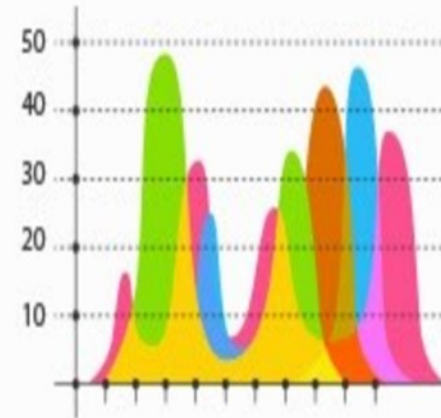
FIX IT WHEN IT BREAKS!

PREVENTIVE



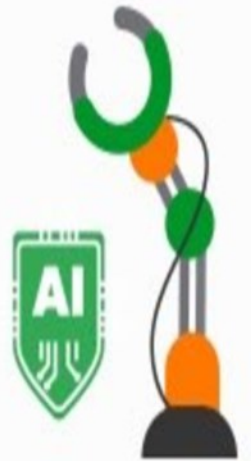
MAINTAIN IT AT REGULAR
INTERVALS SO IT DOESN'T BREAK!

PREDICTIVE



PREDICT EXACTLY WHEN IT WILL
BREAK AND AND FIX IT
ACCORDINGLY!

PRESCRIPTIVE




LET THE MACHINES HELP YOU
DECIDE HOW TO AVOID
PREDICTED FAILURES!



Self Analysis



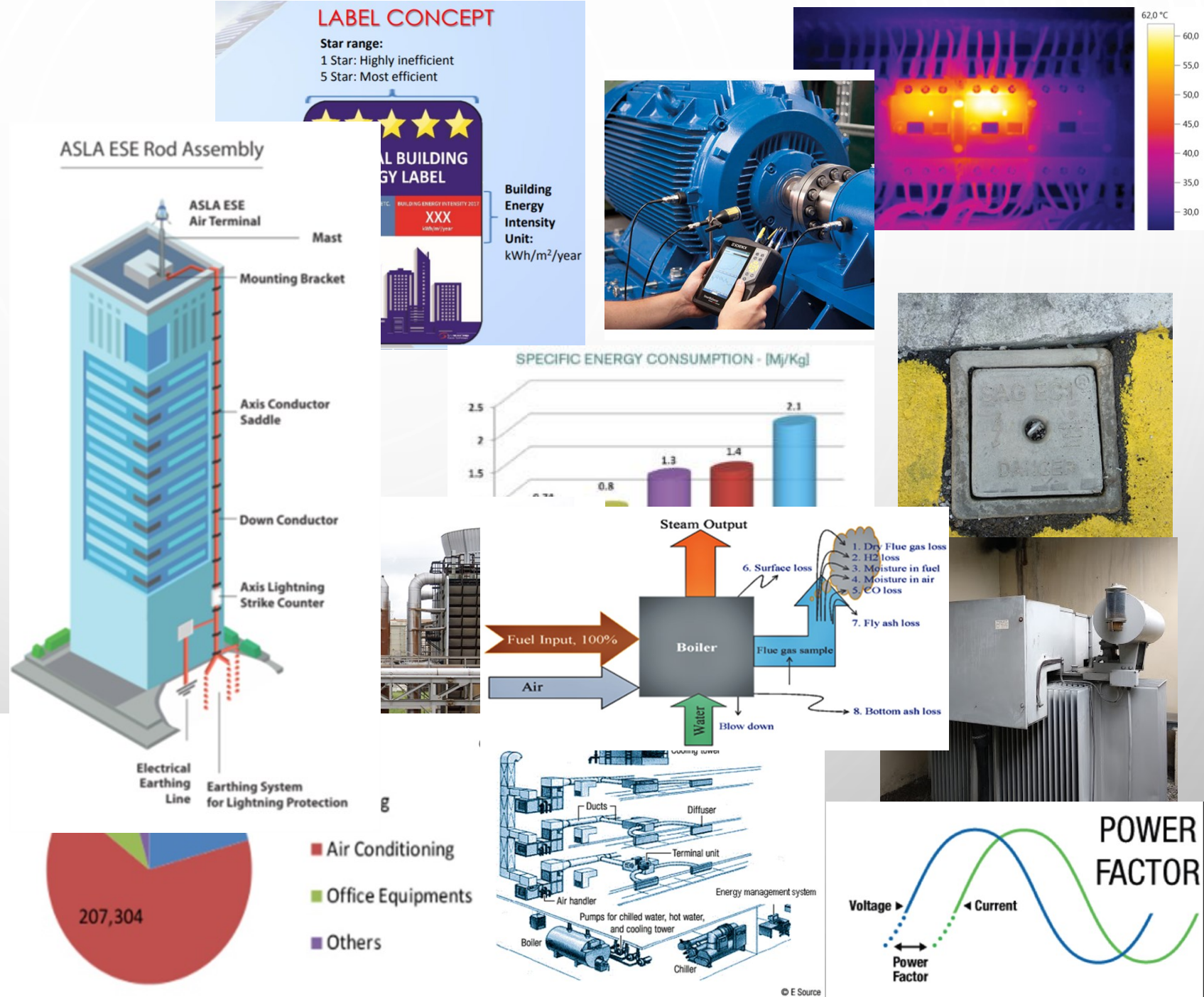


**"Addressing
small details can
add up to huge
improvements in
appearance and
functionality."**

- Bob Clarke

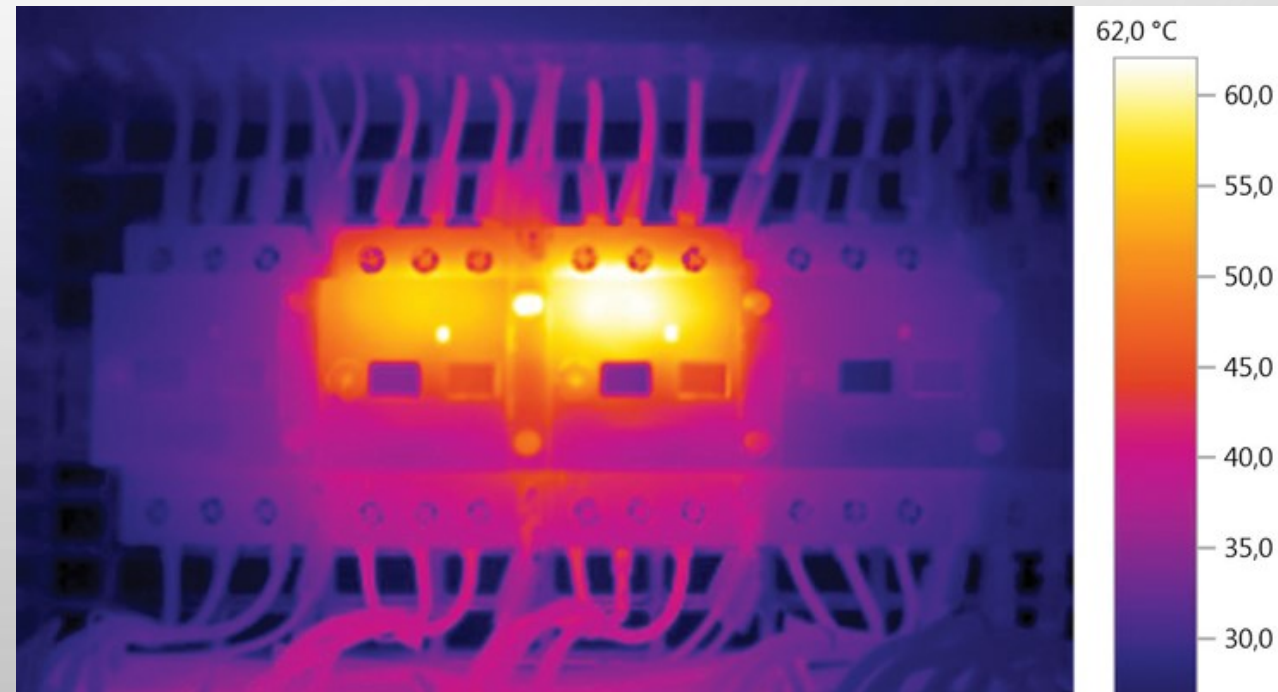
CHECK POINTS

- Fuse blown/MCB trip
- Motor burn/abnormal heat/sound
- Earth Pit locations/conditions
- BEI (Building Energy Index)
- SEC (Specific Energy Consumption)
- Energy Apportioning
- Transformer Load Factor
- Chiller energy Performance
- Cooling Tower Performance
- Boiler Energy Performance
- Lighting usage
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- Power Factor
- Human Capital (iILU / KPI)
- Maintenance Records
- 5S



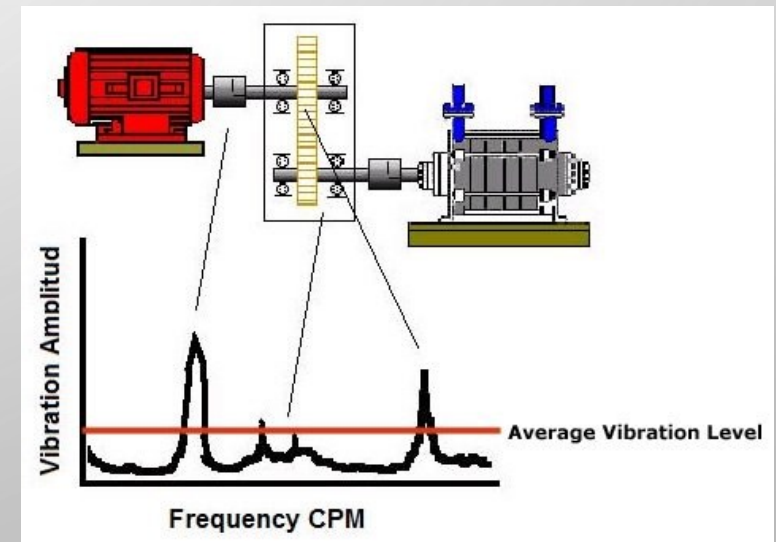
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WHAT IS BEI ?

- A benchmarking tool in monitoring building energy performance by indicating the intensity of energy used per meter square area of the building
- The Index is calculated by taking the ratio between annual energy consumption of a building (kWh/year) and nett floor area of the building (NFA)

$$BEI (kWh/m^2/year) = \frac{\text{Annual Energy Consumption (kWh)}}{NFA (m^2)}$$

LABEL CONCEPT

Star range:
1 Star: Highly inefficient
5 Star: Most efficient

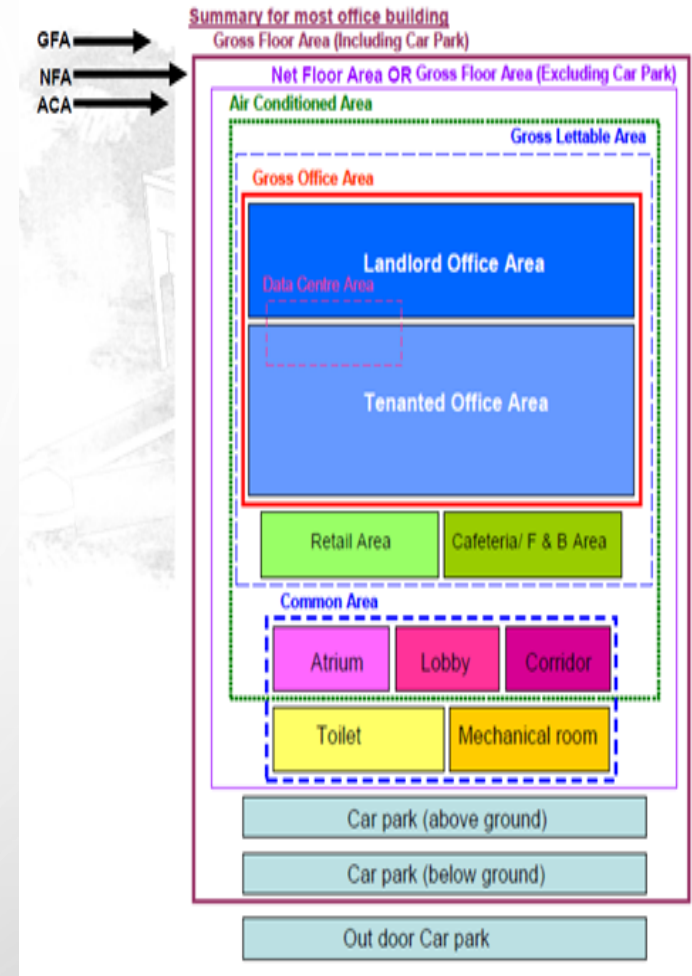
NATIONAL BUILDING ENERGY LABEL

CATEGORY: OFFICE/HOSPITAL/ETC. BUILDING ENERGY INTENSITY 2021

Building's Name: XXX kWh/m²/year

Building categories:
Office/
Hospital/
University/
School & etc.

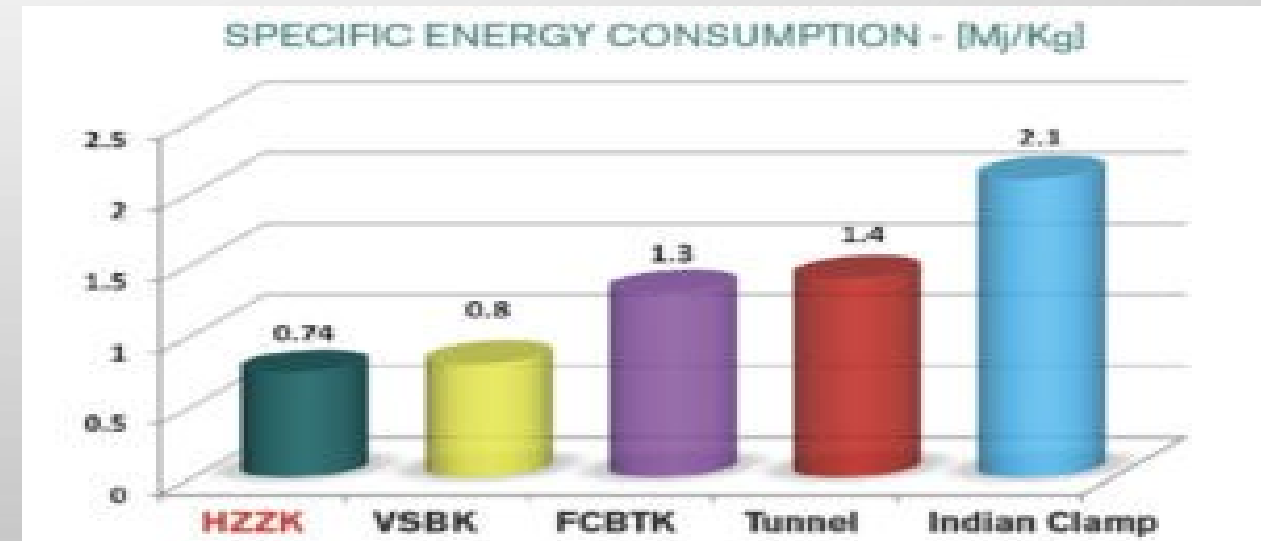
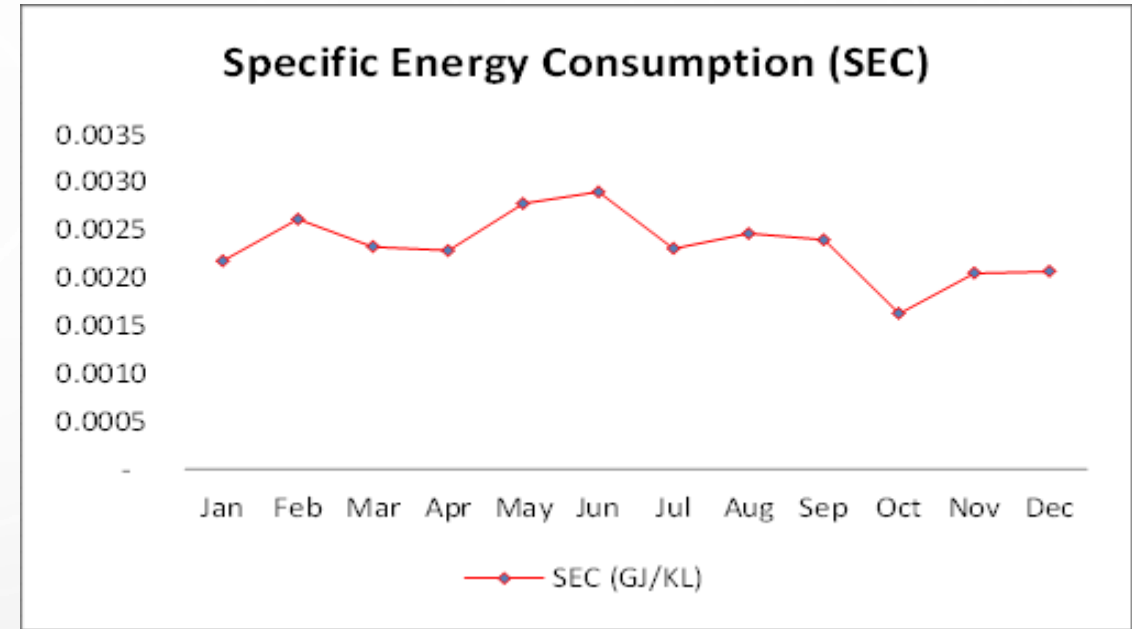
Building Energy Intensity Unit:
kWh/m²/year



STAR	BEI Range*
5-Star	BEI ≤ 100
4- Star	100 < BEI ≤ 130
3- Star	130 < BEI ≤ 160
2- Star	160 < BEI ≤ 250
1- Star	BEI > 250

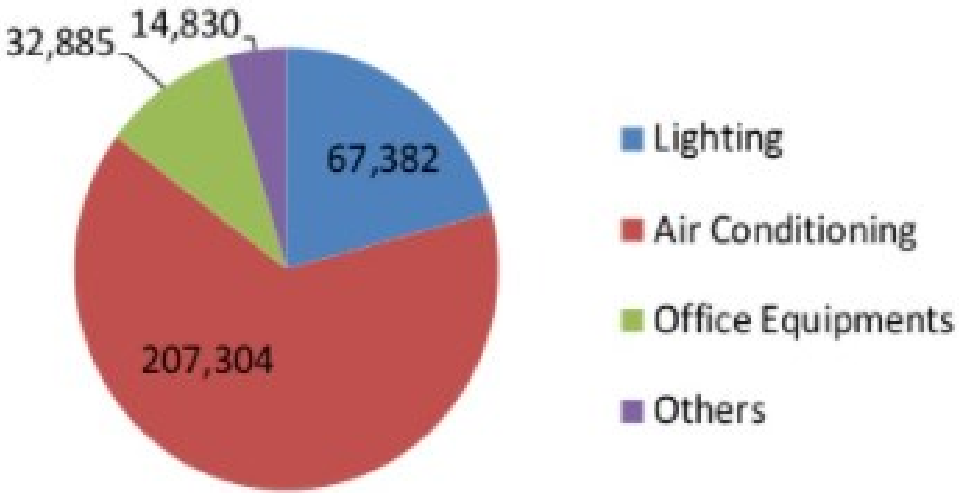
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TARIFF B - LOW VOLTAGE COMMERCIAL TARIFF

For the first 200 kWh (1 -200 kWh) per month	43.5 sen/kWh
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For the next kWh (201 kWh onwards) per month	50.9 sen/kWh
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The minimum monthly charge is RM7.20

TARIFF C1 - MEDIUM VOLTAGE GENERAL COMMERCIAL TARIFF

For each kilowatt of maximum demand per month	30.3 RM/kW
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For all kWh	36.5 sen/kWh
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The minimum monthly charge is RM600.00

TARIFF C2 - MEDIUM VOLTAGE PEAK/OFF-PEAK COMMERCIAL TARIFF

For each kilowatt of maximum demand per month during the peak period	45.1 RM/kW
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For all kWh during the peak period	36.5 sen/kWh
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For all kWh during the off-peak period	22.4 sen/kWh
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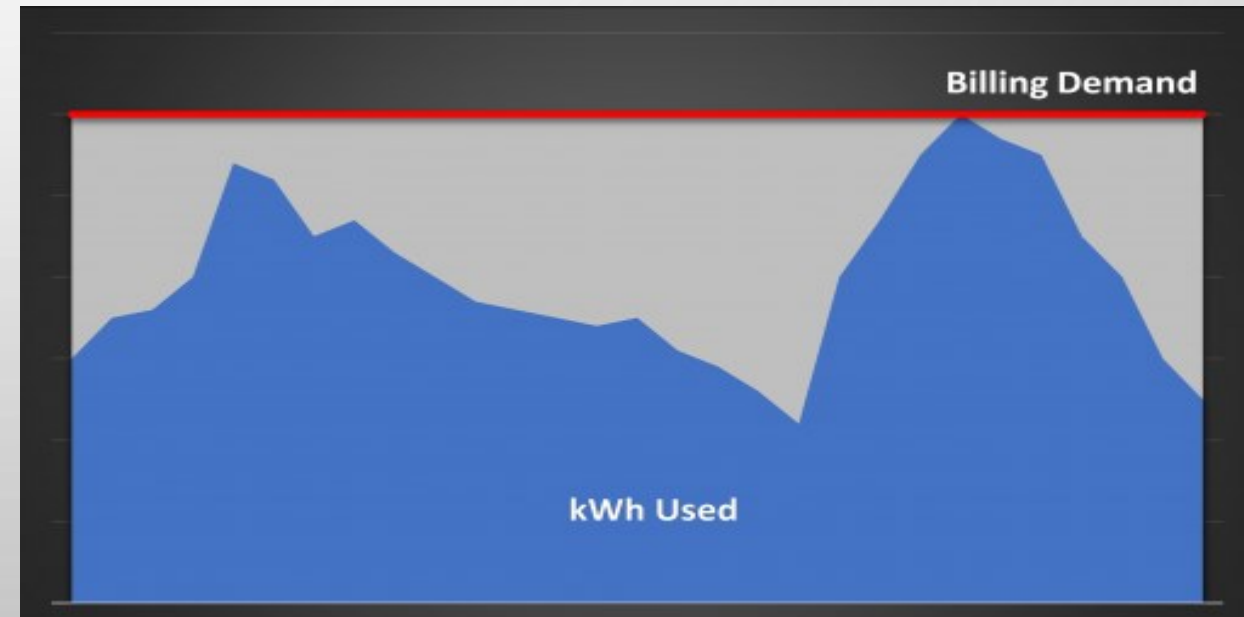
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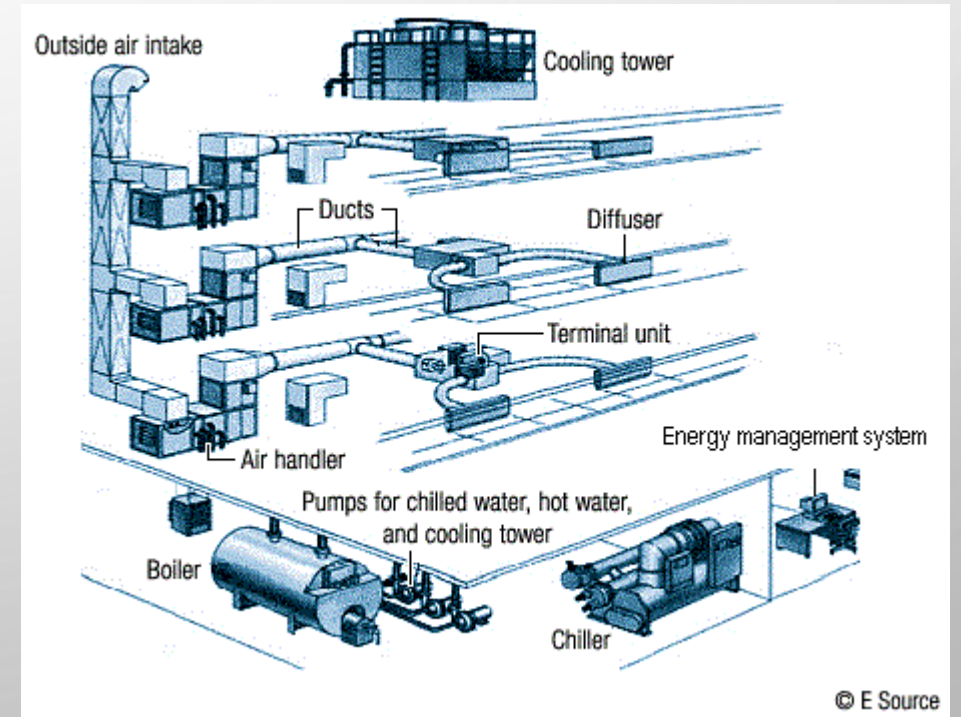
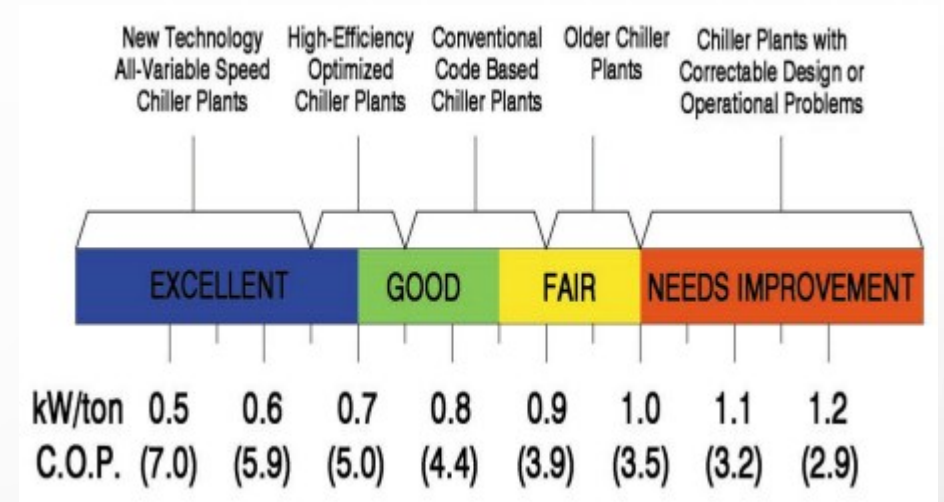
Load Factor Calculation

$$\text{Load Factor} = \frac{\text{Average Load}}{\text{Peak Load}}$$



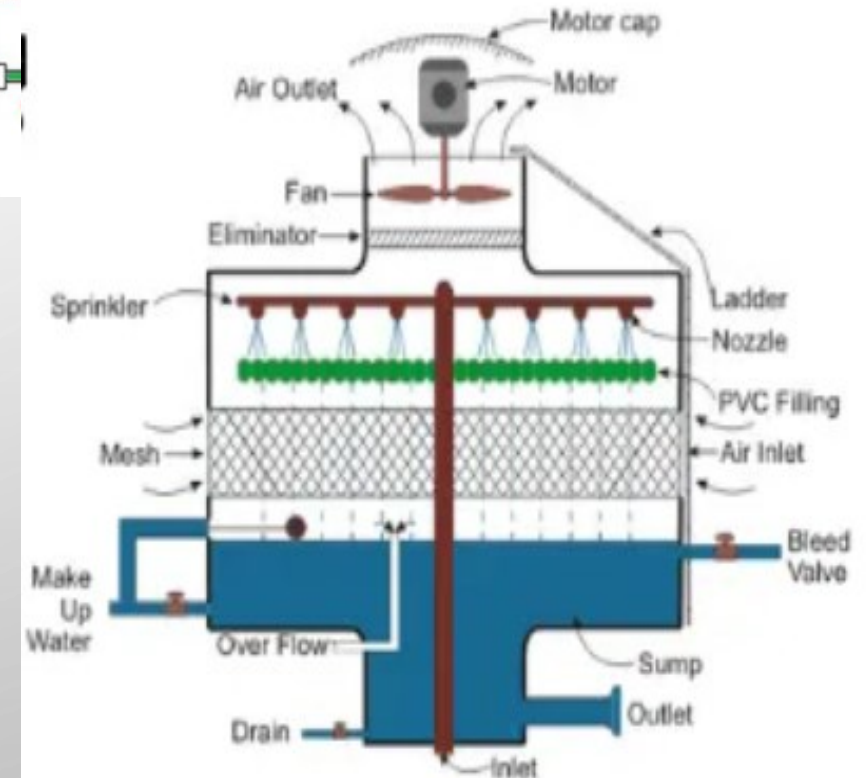
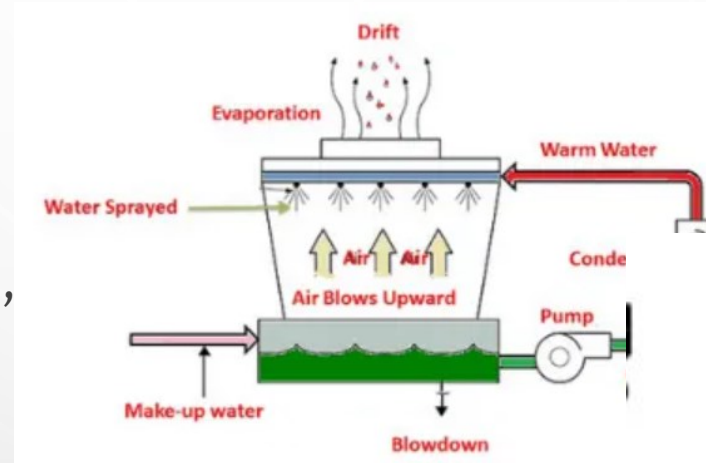
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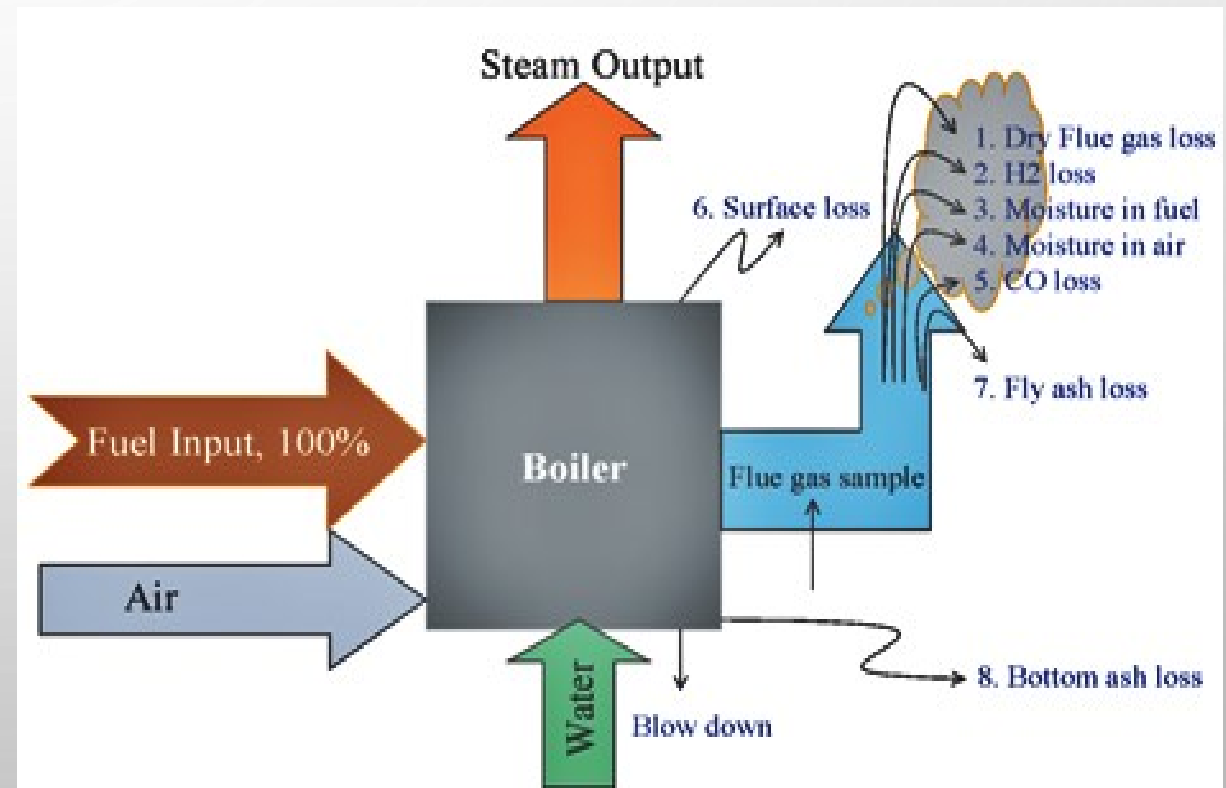
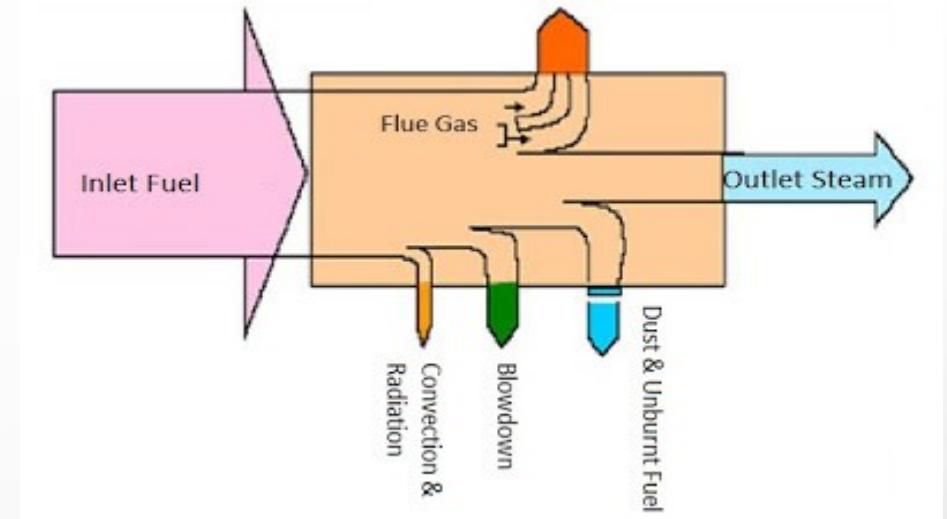
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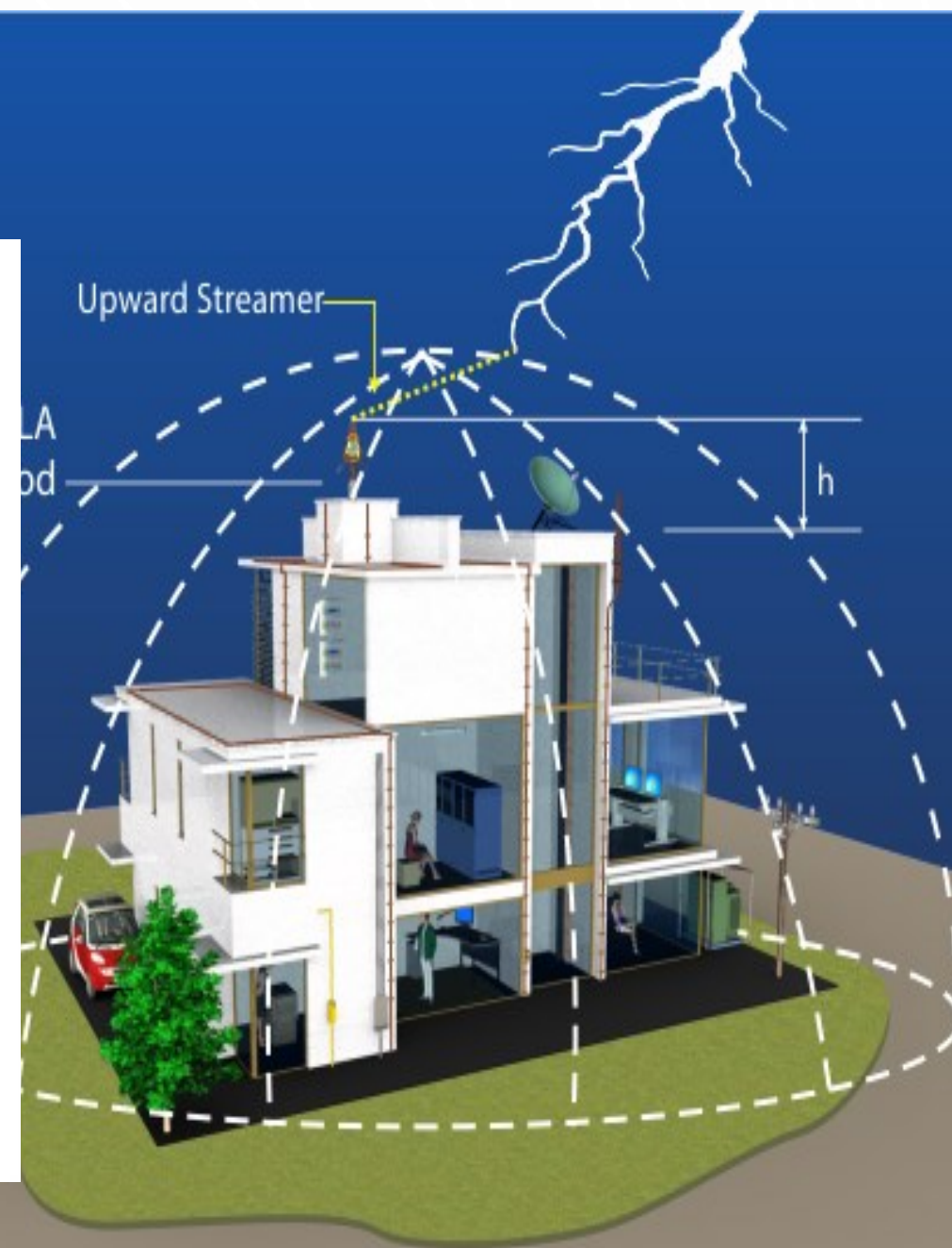
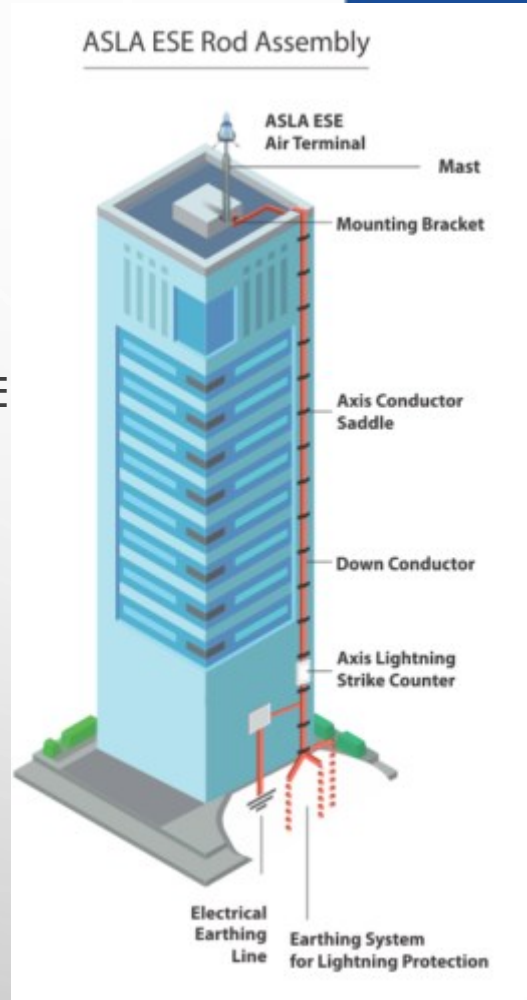
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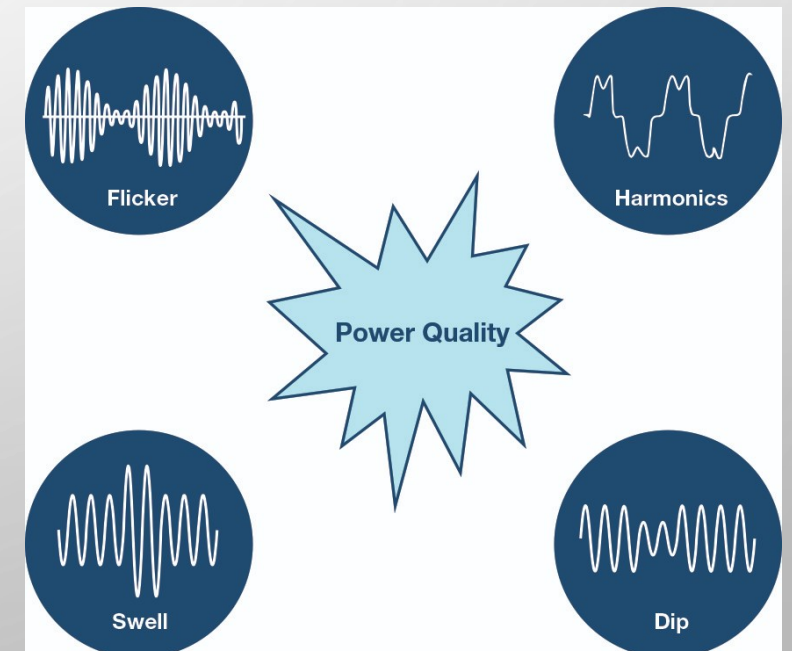
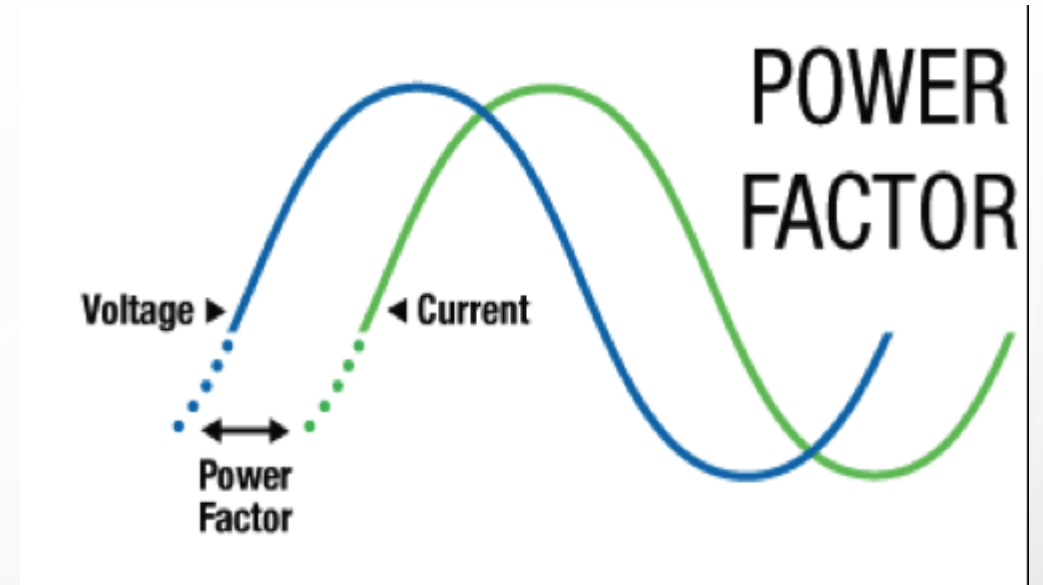
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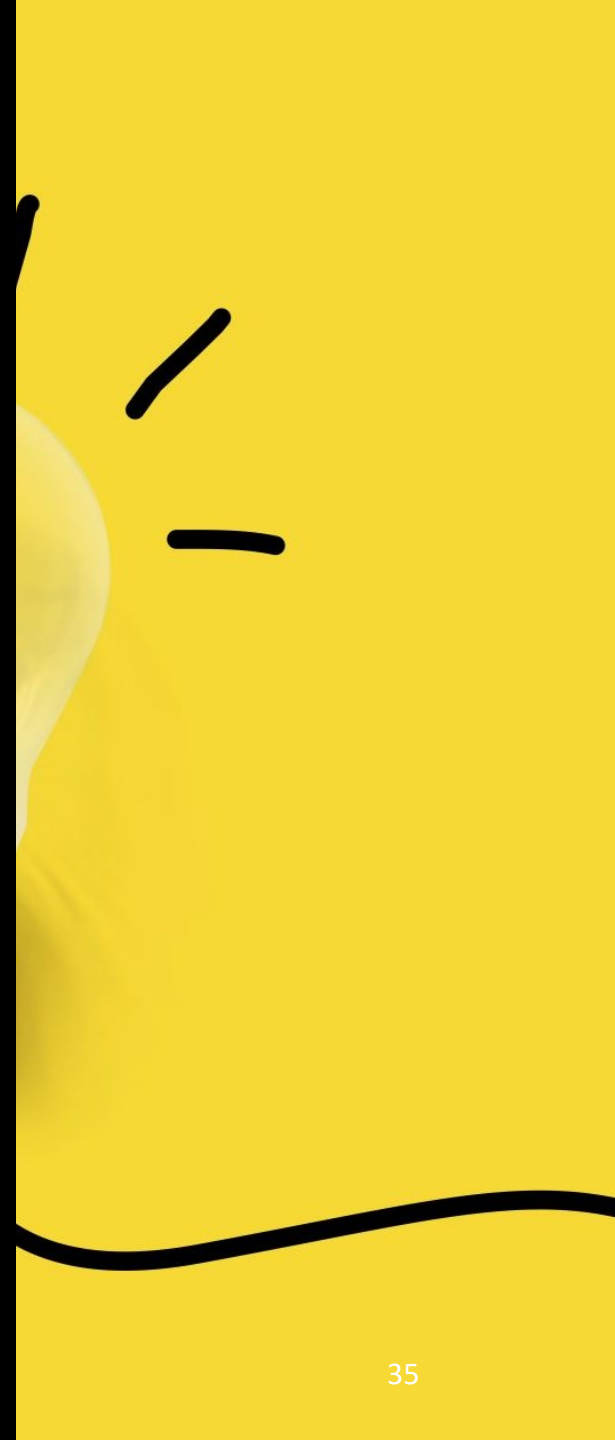
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- **5S – The First Step Toward Workplace Efficiency**





The Solution



CHECK POINTS BASIS & WHERE WE ARE NOW?

REACTIVE



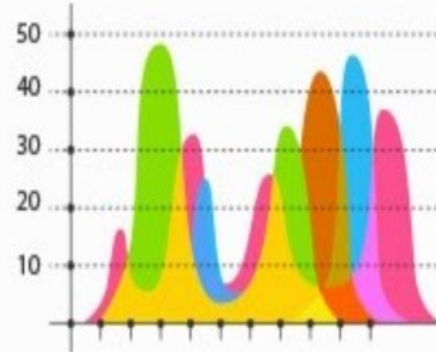
FIX IT WHEN IT BREAKS!

PREVENTIVE



MAINTAIN IT AT REGULAR INTERVALS SO IT DOESN'T BREAK!

PREDICTIVE



PREDICT EXACTLY WHEN IT WILL BREAK AND AND FIX IT ACCORDINGLY!

PRESCRIPTIVE



LET THE MACHINES HELP YOU DECIDE HOW TO AVOID PREDICTED FAILURES!



THANK YOU

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+60 11 1063 7987



JEYA@INFOLLIANCE.COM



INFOLLIANCE.COM

