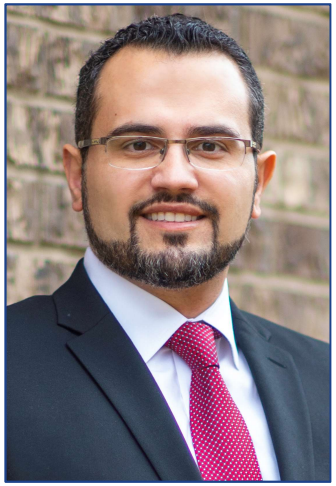
Smart Decision-Making: Understanding Value Streams Beyond Efficiency for HVAC Systems

Thursday, July 11th, 2019

2:00 pm—3:30 pm

Session Panel



Sal Alhelo

JCPenney

Miles Hayes

National Renewable Energy Lab

Cedar Blazek

(Moderator)

Department of Energy

Miles Hayes

NREL

U.S. DEPARTMENT OF ENERGY

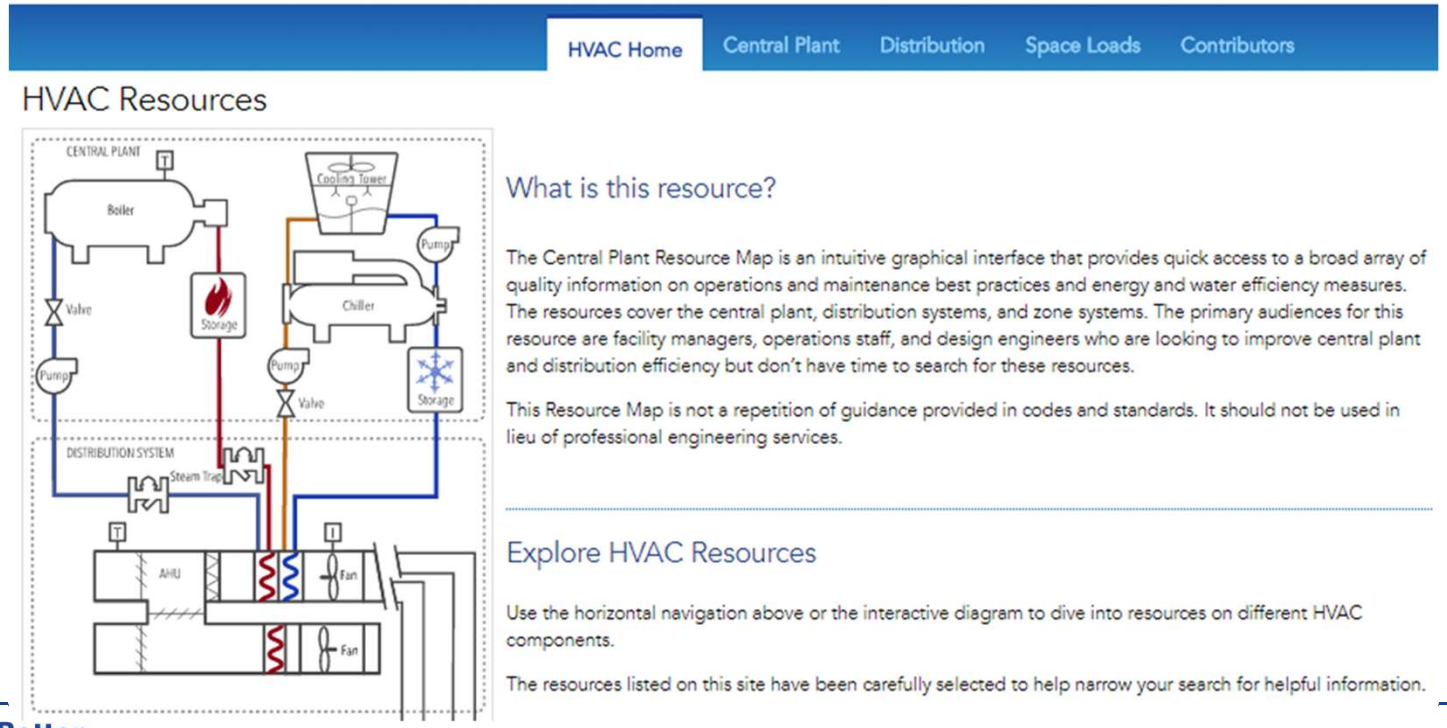
Agenda

- Space Conditioning Team updates
- Advanced RTU Campaign updates
- Automated Fault Detection & Diagnostics for RTU Technology

New Resources

- High-efficiency smart motors
  - High Rotor Pole Switched Reluctance Motors
    - https://www.nrel.gov/docs/fy19osti/72476.pdf
- Cooling tower water treatment
  - Chemical Free Cooling Tower Water Treatment Technologies
    - https://www.nrel.gov/docs/fy19osti/73911.pdf
  - GSA Proving Grounds
    - Advanced Oxidation Process
    - Salt-Based & Chemical Inhibition
    - Catalyst-Based Scale Prevention
    - Electrochemical

HVAC Resource Map



Quick access to

- Basic definitions
- Efficiency Measures
- O&M
- Procurement
- Case studies

New Content

- Updated fan info
- New training links
- Lab HVAC (coming)

Advanced RTU Campaign

2019 Recognition Awards

Walgreens
H&M
McDonald's
TARGET
mass save
Savings through energy efficiency
Energy Solutions
transformativewave
TRI-PACIFIC HEATING & A/C,L.P.

Impact

- Over 350 engaged partners
- 160,000 RTU installations and retrofits,
- 1.1 billion kWh savings annually

Resources

- 6 Tool kits and dozens of resources

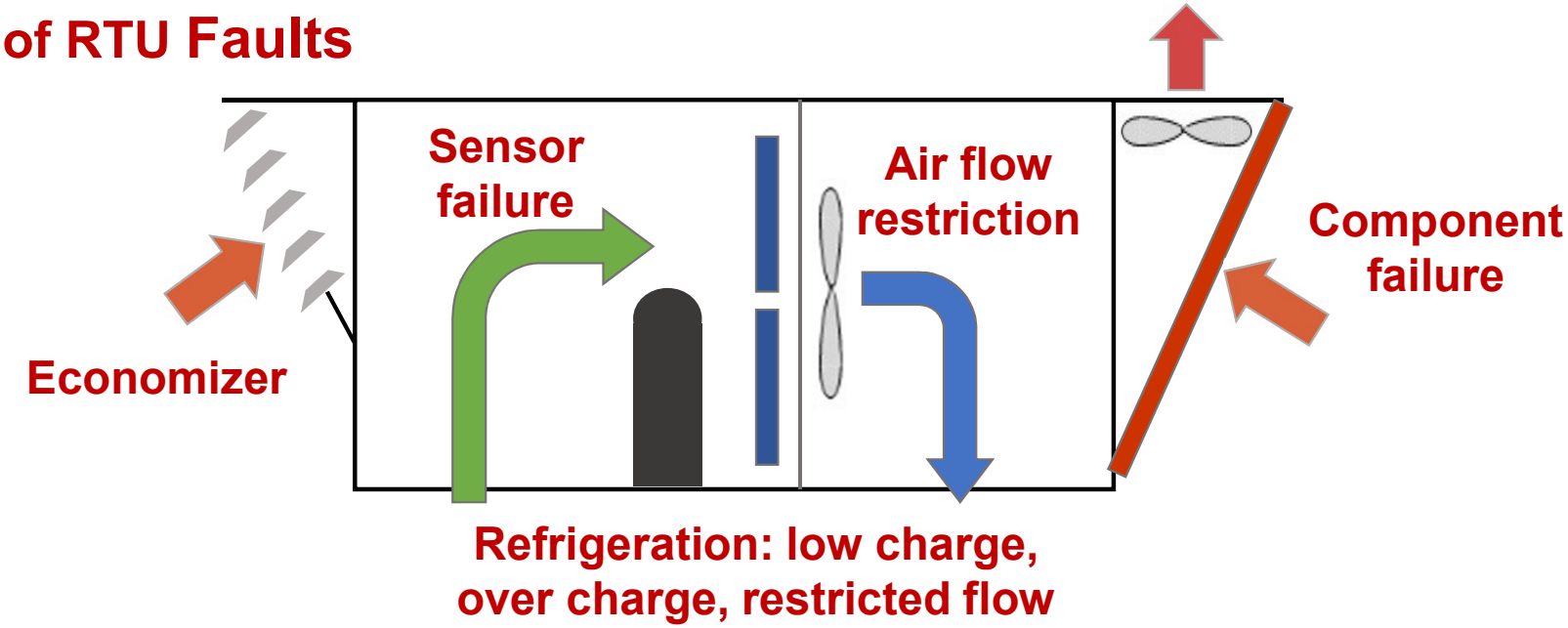
2019 is the Final Year

www.AdvancedRTU.org

RTU AFDD (Automated Fault Detection and Diagnostics)

Continuous monitoring of the health of RTUs, diagnosing faults, and communicating the results

Types of RTU Faults



RTU AFDD Characterization

Level of AFDD capability	1. Basic FDD and communications 2. Prioritize faults, store and trend data 3. Estimate and trend performance, quantify impact of faults 4. Detect simultaneous faults, automated FDD mode, adjust operations to minimize impact of faults

AFDD location	• Embedded on-board controller • Retrofit controller • Building automation system	• Cloud • Handheld device • Combination of above

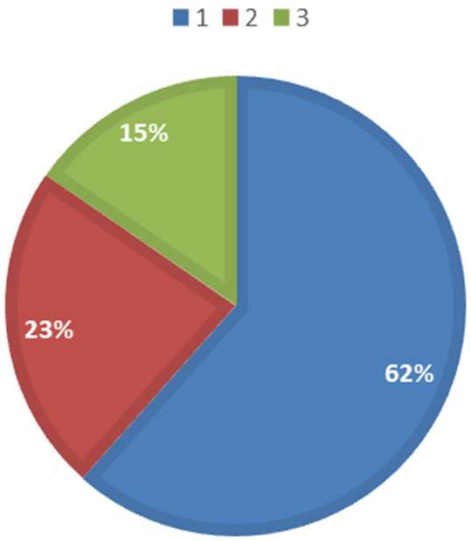
RTU functions monitored	• Economizer • Air systems • Refrigerant • Power	• Sensors • Scheduling • Zone cooling/heating

RTU AFDD Landscaping Study

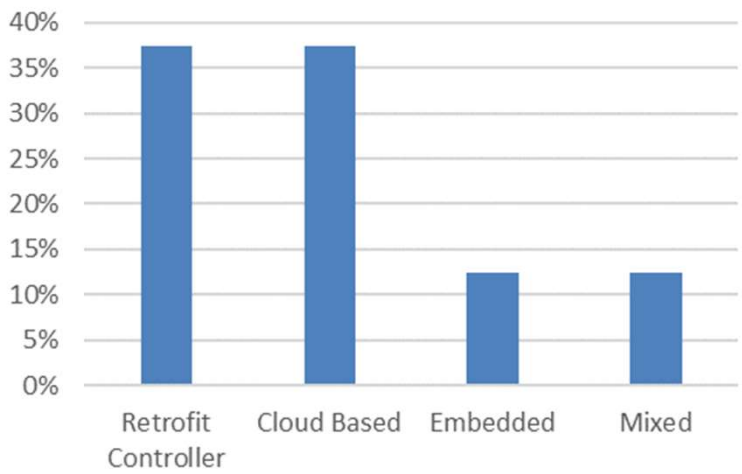
- Objectives:
  - Characterize and document RTU AFDD systems
  - Identify market barriers to RTU AFDD technology
  - Identify research opportunities to improve performance
- Study participants
  - Building owners (6)
  - AFDD developers (10)
  - RTU OEMs (2)

AFDD Field Study Results

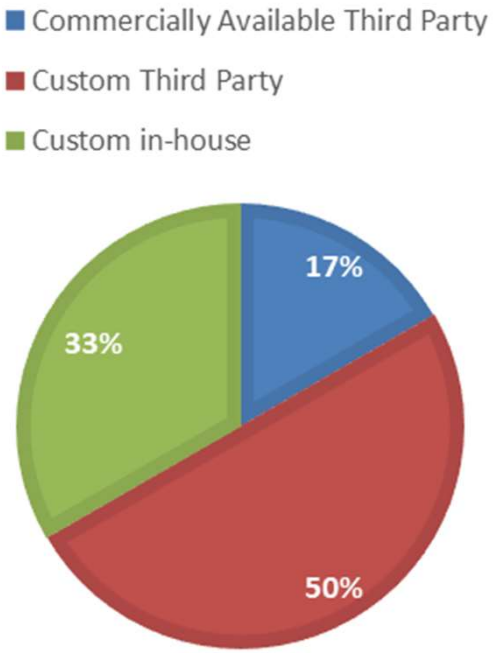
AFDD Capability Level



AFDD Analysis Location

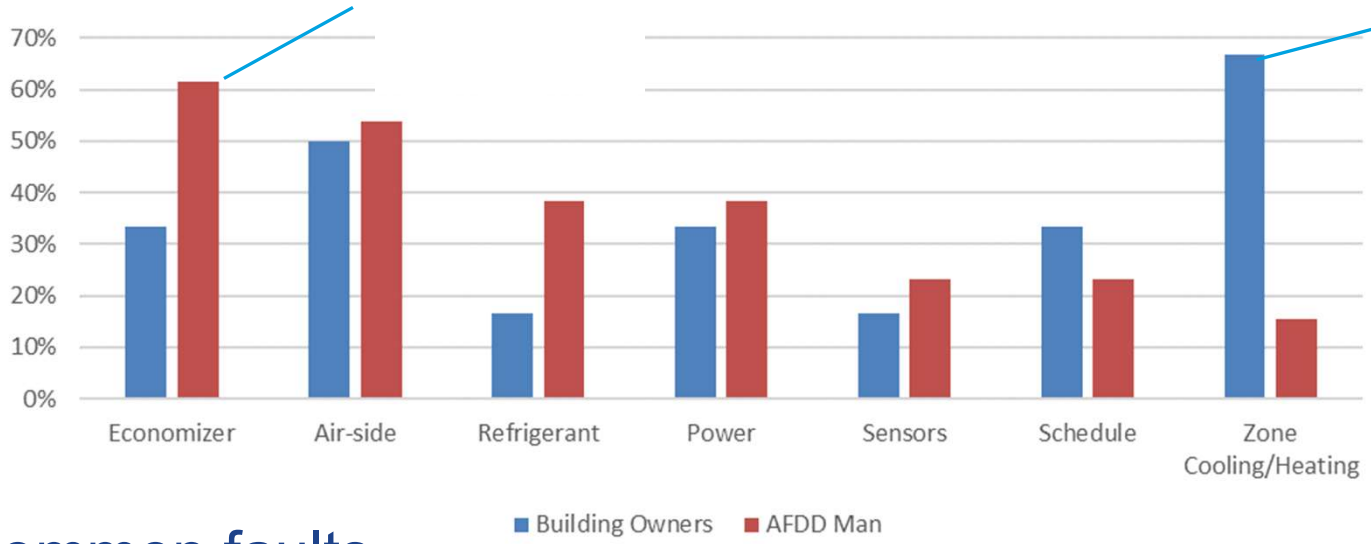


AFDD Solution for Building Owners



AFDD Field Study Results (2)

AFDD system fault detection categories



Owner's highest priority

Most common faults

1. Economizer/OA damper
2. Zone cooling/heating

Building Owner AFDD Wish List

- Impact of failures
- Manage and prioritize alarms
- Link with service providers
- Trend and save data
- Access to RTU sensor data
- Product that works with old and new RTUs and not specific to a single manufacturer

RTU Manufacturer AFDD Wish List

- Validation of performance of AFDD systems
- Standard measurement of performance
- Better understanding of the economic proposition
- Raise awareness of AFDD with owners and utilities
- Understand how owners and service providers react to faults
- Incentives for AFDD

RTU AFDD Performance

- Document AFDD performance with large scale data collection
- Objectives
  - Define and quantify benefits of RTU AFDD
  - Improve effectiveness of RTU AFDD
  - Support expanded utilization of RTU AFDD
  - Inform R&D efforts
- Types of Questions
  - RTU faults/month – type and number
  - Work orders generated
  - Faults input to scheduled maintenance
  - Changes to scheduled maintenance

Sal Alhelo

JCPenney

U.S. DEPARTMENT OF ENERGY

JCPenney

Better Buildings Summit 2019

Smart Decision-Making:

UNDERSTANDING VALUE STREAMS BEYOND EFFICIENCY FOR HVAC SYSTEMS

By:

Sal Alhelo, PE, LEED AP (BD+C)

Energy Programs Manager - JCPenney

JCPenney's HVAC Program

- +850 stores
- +7,500 major HVAC asset
- Almost every HVAC system type you can think of
- 49 states
- 8,000-300,000sq.ft.
- Equipment new to original to the building

Common Models:

JCPenney

Priority= (Age Factor) + (Criticality Factor) + (Condition Factor) + (Other)

OR

Priority= (Age Factor) x (Criticality Factor) x (Condition Factor) X (Other)

- Each factor ranked from 1 to 20.
- 20 is the highest priority, and 1 is the lowest priority.
- Weights:
  - Age Factor = 1
  - Criticality Factor = 0.5
  - Condition= 0.8
  - Other = 0.4

Underlying Assumption ➔ The impact of each factor on priority is independent of the other factors at all points (i.e. the weight of each factor is constant along the life of the asset).

Example:

Unit #1 (Salon)

Unit #2 (Office)

Example:

Unit #1 (Salon)

Unit #2 (Office)

Age:	7.6	(x1)
Criticality:	16	(x0.5)
Condition:	8	(x0.8)
Other:	15	(x0.4)
Priority=	28.0	

Age:	15.5	(x1)
Criticality:	5	(x0.5)
Condition:	9	(x0.8)
Other:	7	(x0.4)
Priority=	28.0	

Example:

JCPenney

Unit #1 (Salon)

Age:	7.6	(x1)	7.6
Criticality:	16	(x0.5)	16
Condition:	8	(x0.8)	12
Other:	15	(x0.4)	15
Priority=	28.0		Priority= 31.2

+ 3.2

Unit #2 (Office)

Age:	15.5	(x1)	15.5
Criticality:	5	(x0.5)	5
Condition:	9	(x0.8)	13
Other:	7	(x0.4)	7
Priority=	28.0		Priority= 31.2

+ 3.2

Example:

Unit #1 (Salon)

Age:	7.6	(x1)	7.6
Criticality:	16	(x0.5)	16
Condition:	8	(x0.8)	12
Other:	15	(x0.4)	15
Priority=	28.0		Priority= 31.2

+ 3.2

+ 1,167.4

Priority= 2,334.7 → Priority= 3,502.1

Unit #2 (Office)

Age:	15.5	(x1)	15.5
Criticality:	5	(x0.5)	5
Condition:	9	(x0.8)	13
Other:	7	(x0.4)	7
Priority=	28.0		Priority= 31.2

+ 3.2

+ 347.2

Priority= 781.2 → = 1,128.4

Example:

Unit #1 (Salon)

Age:	7.6	(x1)	7.6
Criticality:	16	(x0.5)	16
Condition:	8	(x0.8)	12
Other:	15	(x0.4)	15
Priority=	28.0		Priority= 31.2

+ 3.2

+ 1,167.4

Priority= 2,334.7 → Priority= 3,502.1

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+ 347.2

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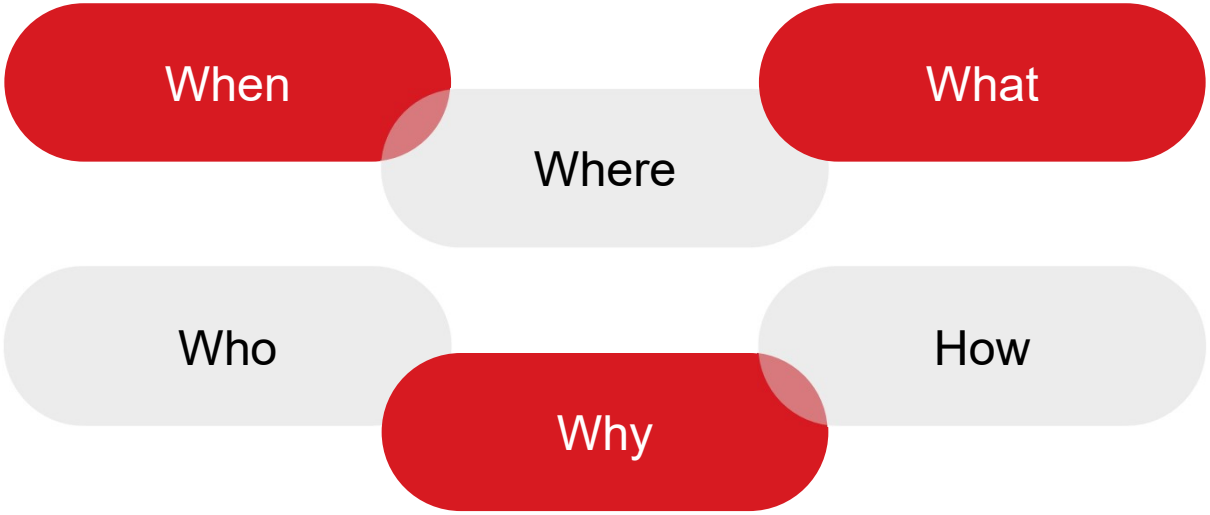
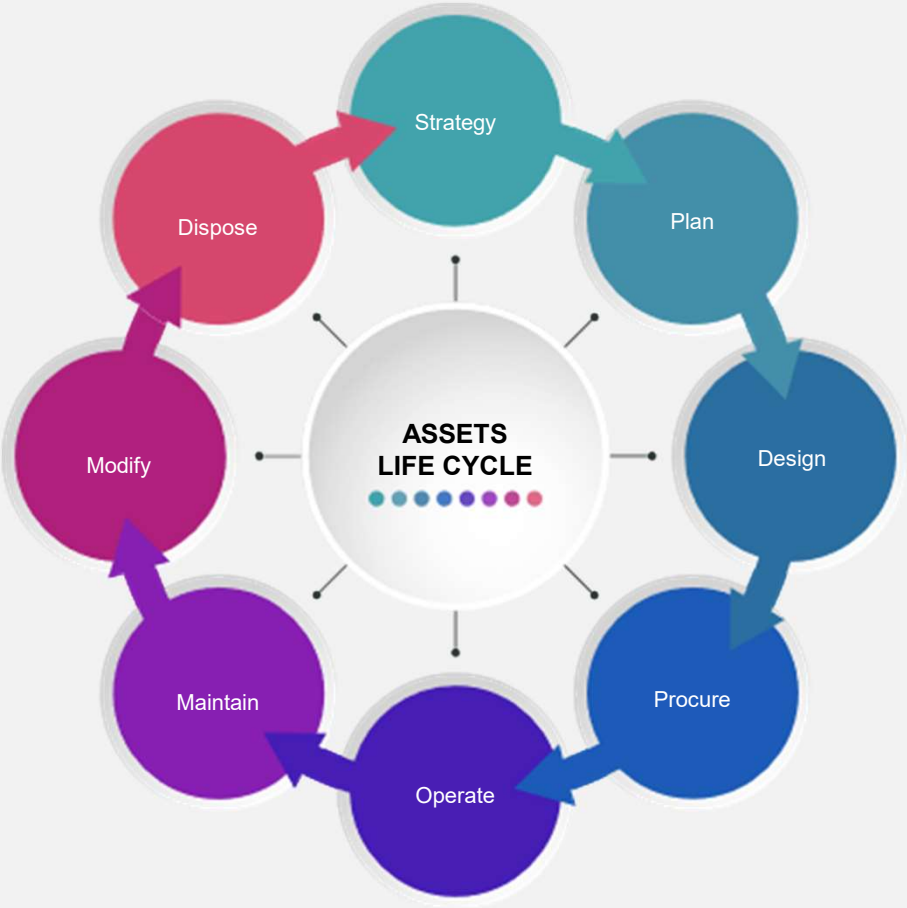
WHAT

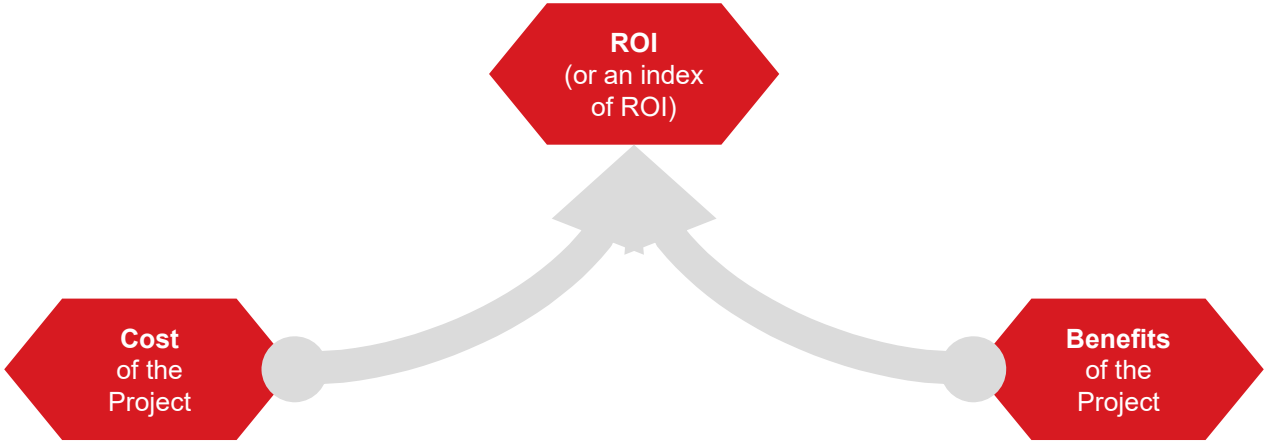

When
What
Where
Who
How
Why


ASSETS
LIFE CYCLE
Strategy
Plan
Design
Procure
Operate
Maintain
Modify
Dispose

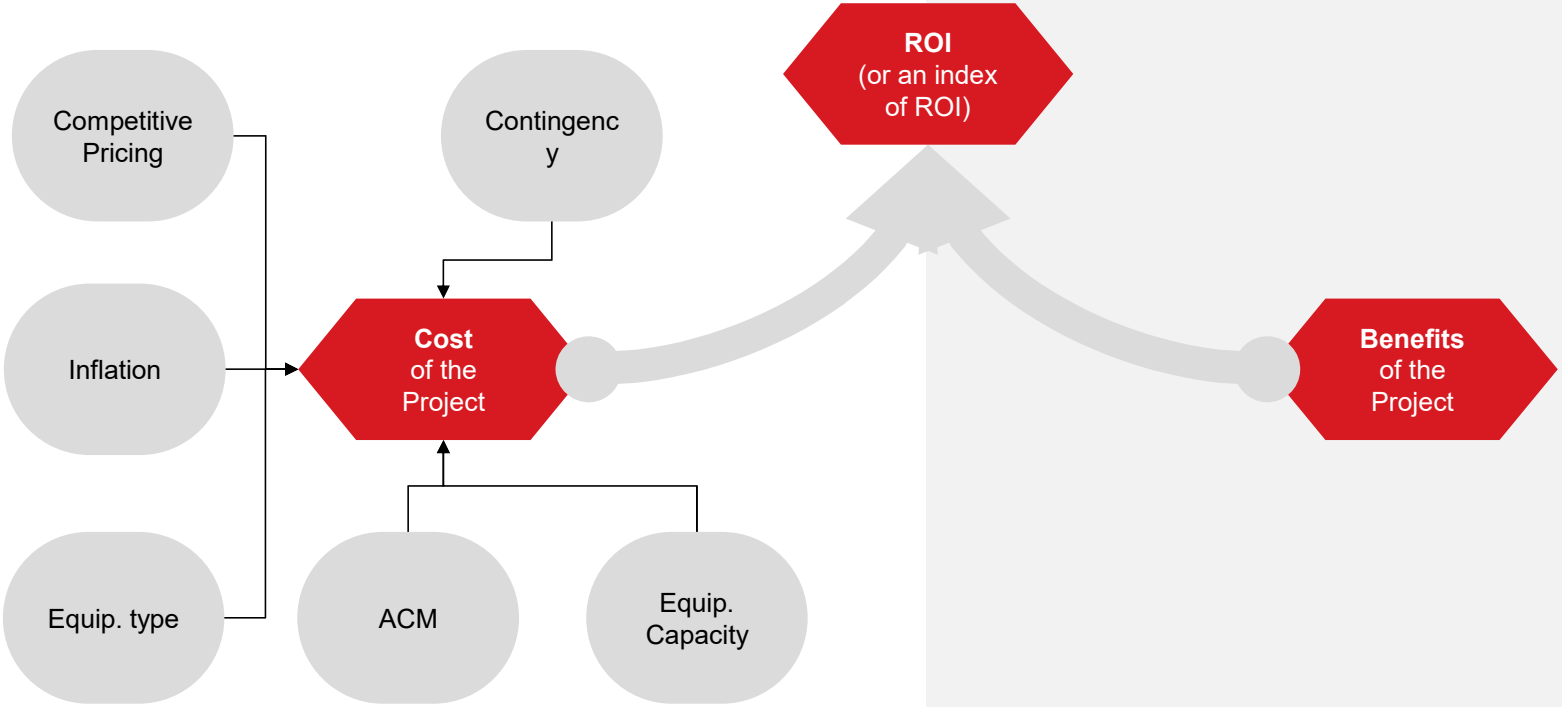
If You define the problem correctly.
You almost have the solution.

~ Steve Jobs

Financial Aspect of Planning- ROI



Financial Aspect of Planning- ROI



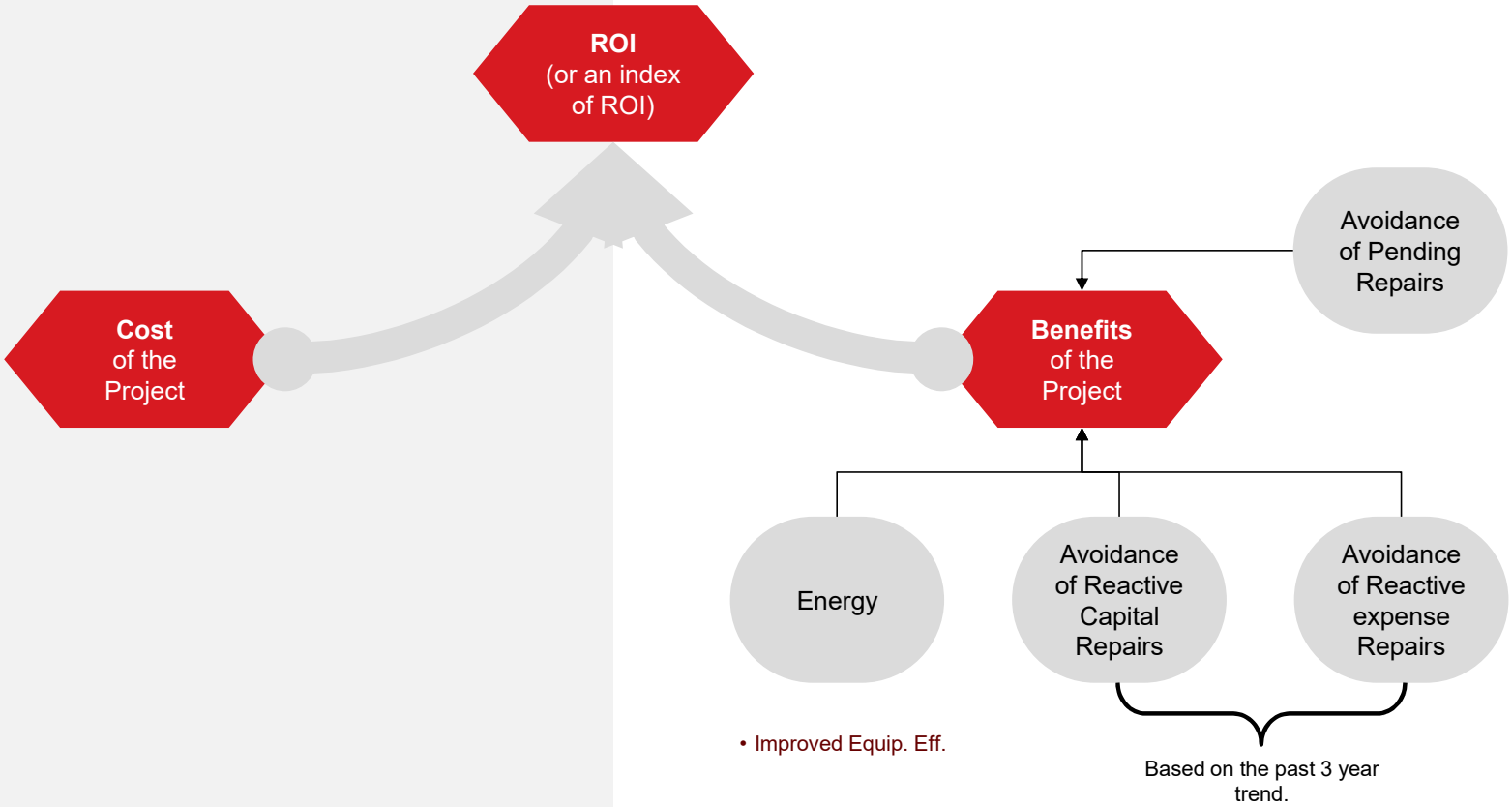
- RTU
- WCCH
- ACCH
- CT
- Boiler

- CU
- AHU
- Generator

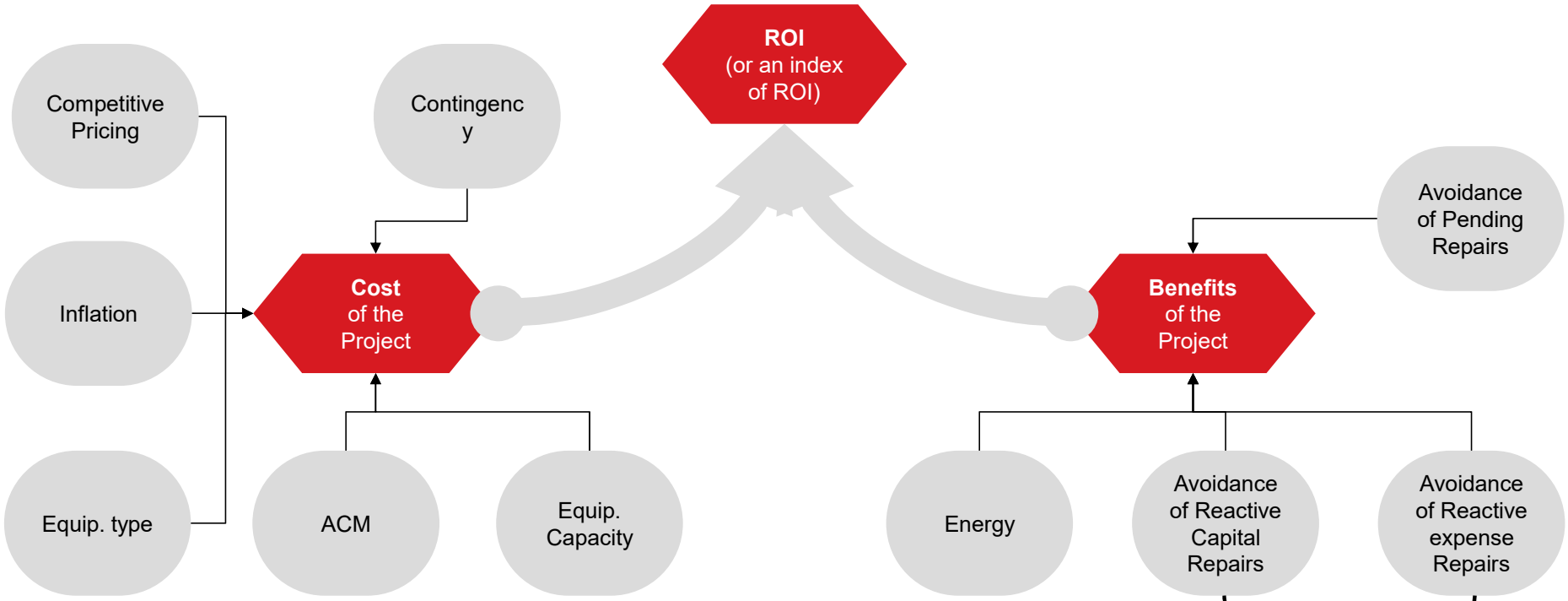
- Cooling Tower
- Duct Insulation
- Fireproofing
- Thermal Insulation
- Other

- Corrigo, if known
- Assumptions based on sq.ft., if capacity is unknown

Financial Aspect of Planning- ROI



Financial Aspect of Planning- ROI



- RTU
- WCCH
- ACCH
- CT
- Boiler
- CU
- AHU
- Generator

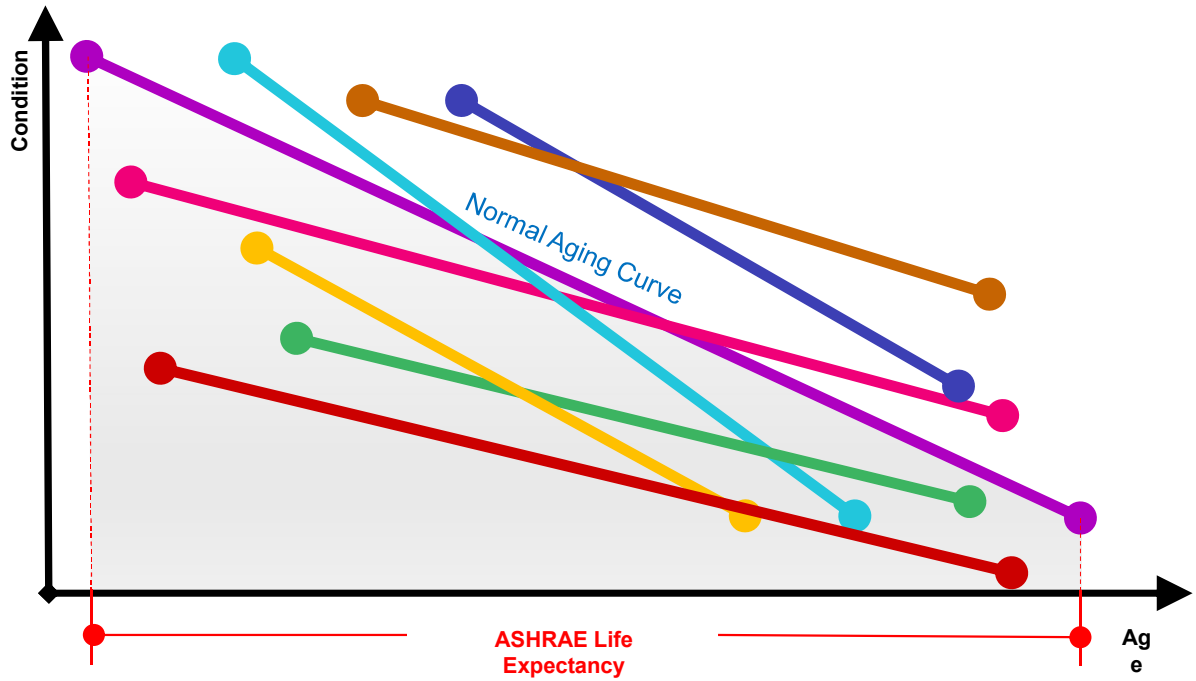
- Cooling Tower
- Duct Insulation
- Fireproofing
- Thermal Insulation
- Other

- Corrigo, if known
- Assumptions based on sq.ft., if capacity is unknown

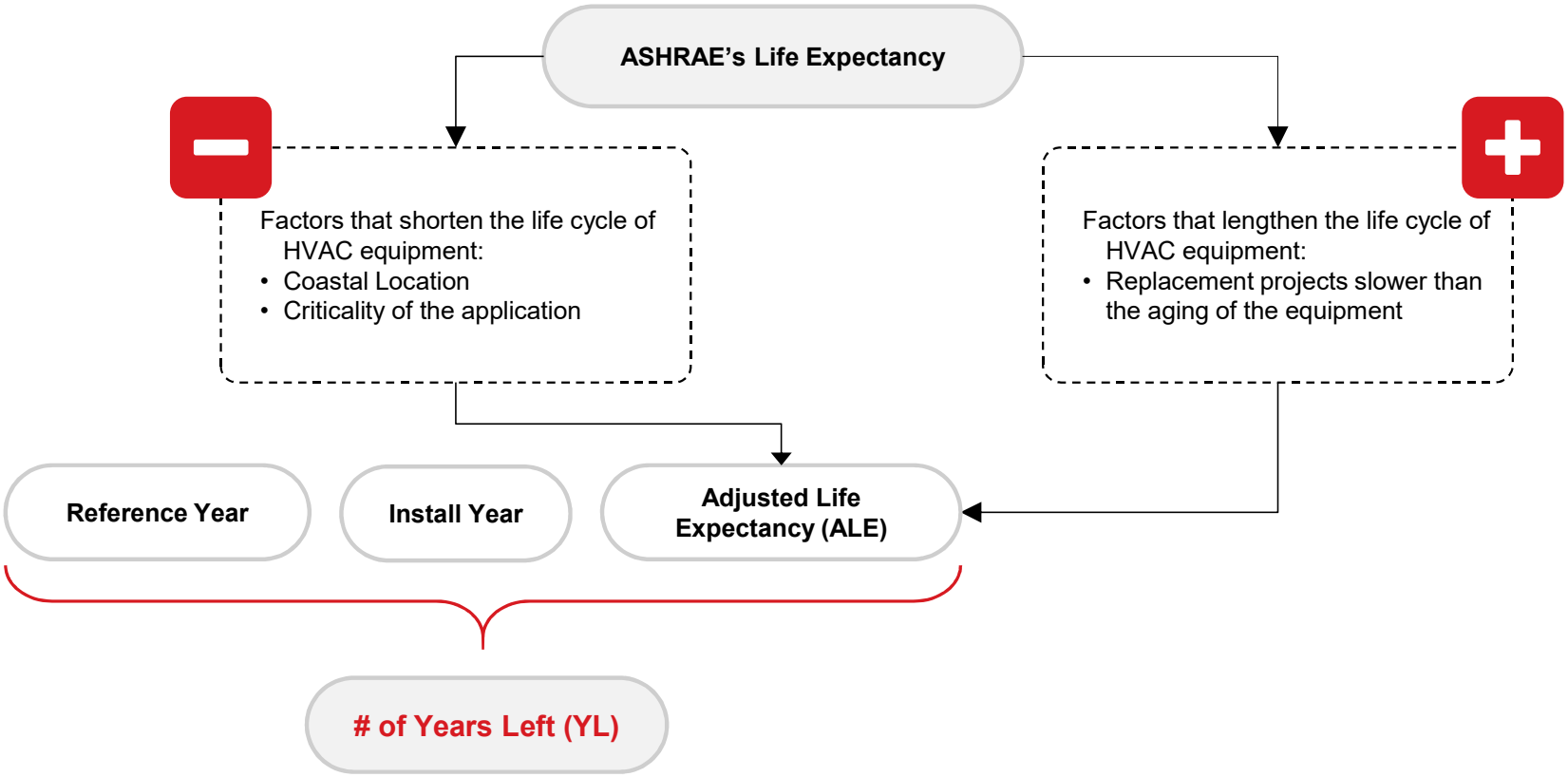
- Improved Equip. Eff.

Based on the past 3 year trend.

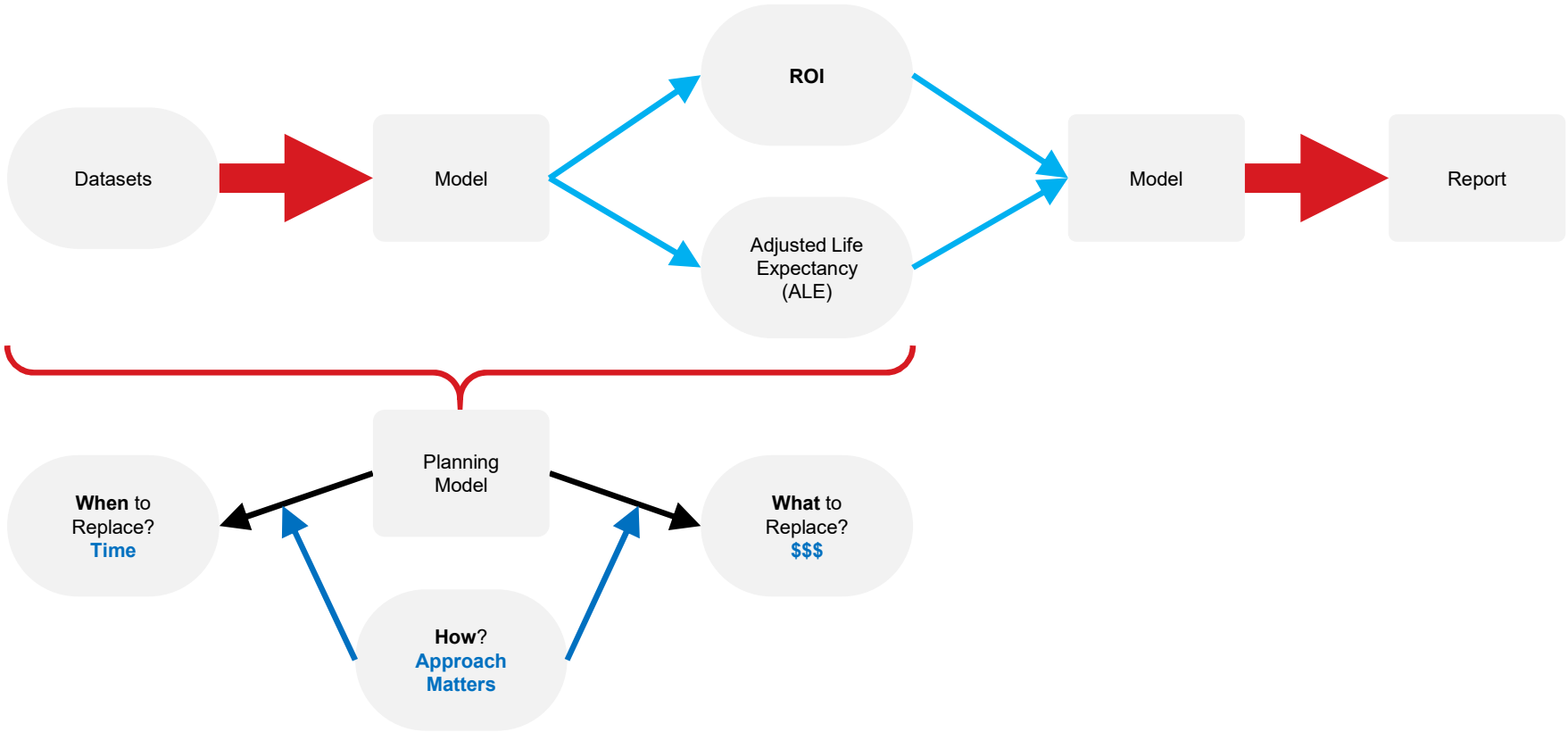
Normal Aging Curve of Equipment



Time Planning



Time Planning



Time Planning

Years Left (+ve)	Years Left (-ve)	Non-operational & Unrepairable
Rank by the # of **Years Left (YL)**	Rank by the # of **Years Left (YL)**	Rank by the # of **Years Left (YL)**
Within the same year rank by the **ROI**	Within the same year rank by the **ROI**	Within the same year rank by the **ROI**
Proactive Replacement	**Deferred Replacement**	**Non-Operational Replacement**

Tableau Dashboard

- **Non operational**
- **Years Left (+ve)**
- **Years Left (-ve)**

Q & A

Thank You!

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