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Success Factors for Practical Energy Harvesting Applications

Roy Freeland - C.E.O. Perpetuum

Choose the Right Harvester

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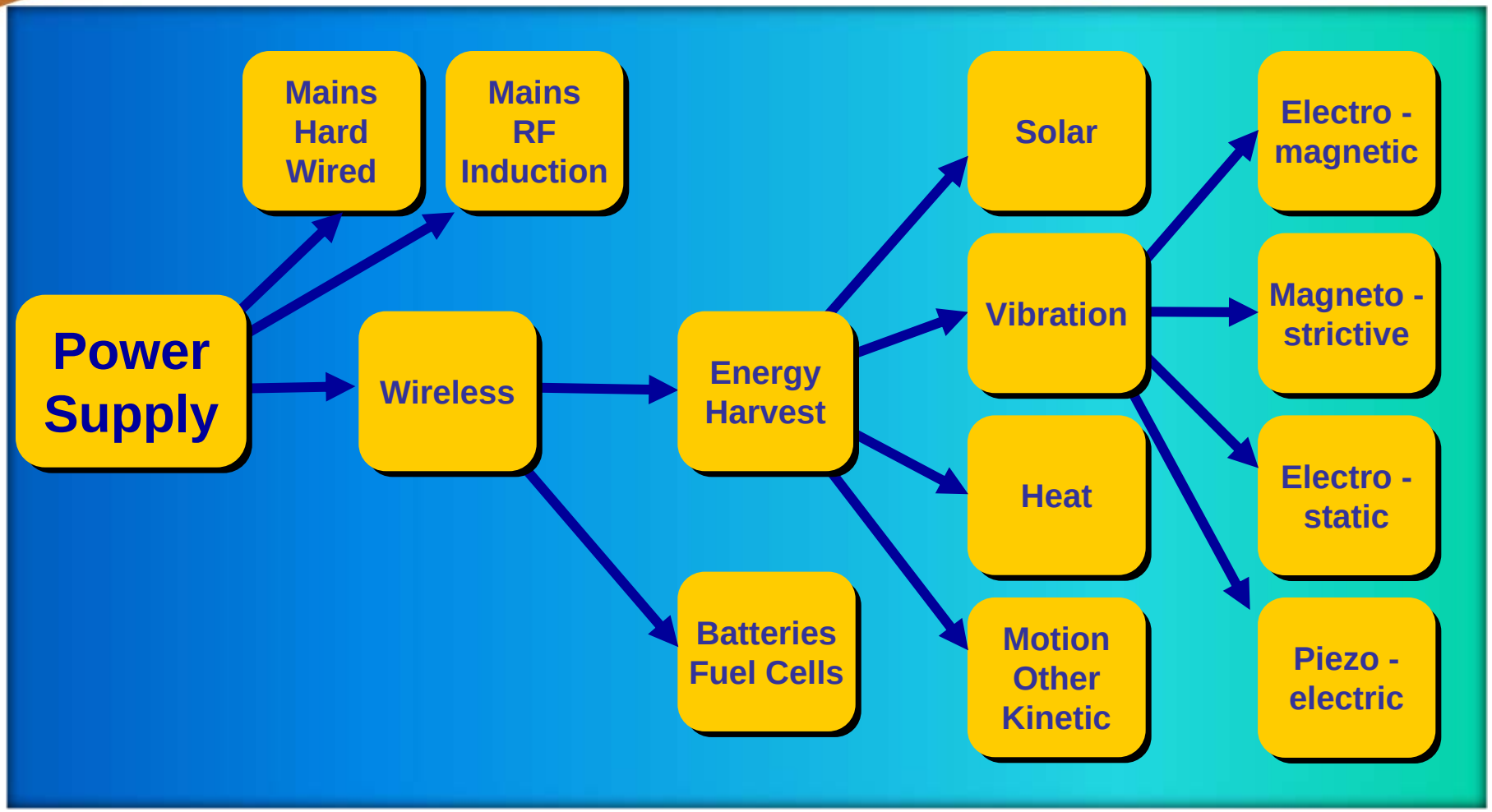

Success Factors for E.H.

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1. Enough Power
2. Adequate lifetime - No/low maintenance
3. Easy to install
4. Good coverage
5. Interchangeability
6. Meet application requirements e.g. ATEX
7. Strong Business Case

1. Enough Power

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- Does harvester produce enough average power with the actual energy available?
- Vibration Energy Harvester Output depends on
  - Amplitude of Vibration
  - Frequency – Induction Motor or Rail Wagon
  - Bandwidth
  - Mass
- Apply the laws of Physics
  - Taxpayers money wasted on human devices
  - Impossible claims e.g. RF Harvesting to recharge mobile phones
  - E.g. If 1.5g needed to generate 1mW, then you don't need a CM system

Petrochemical Plant

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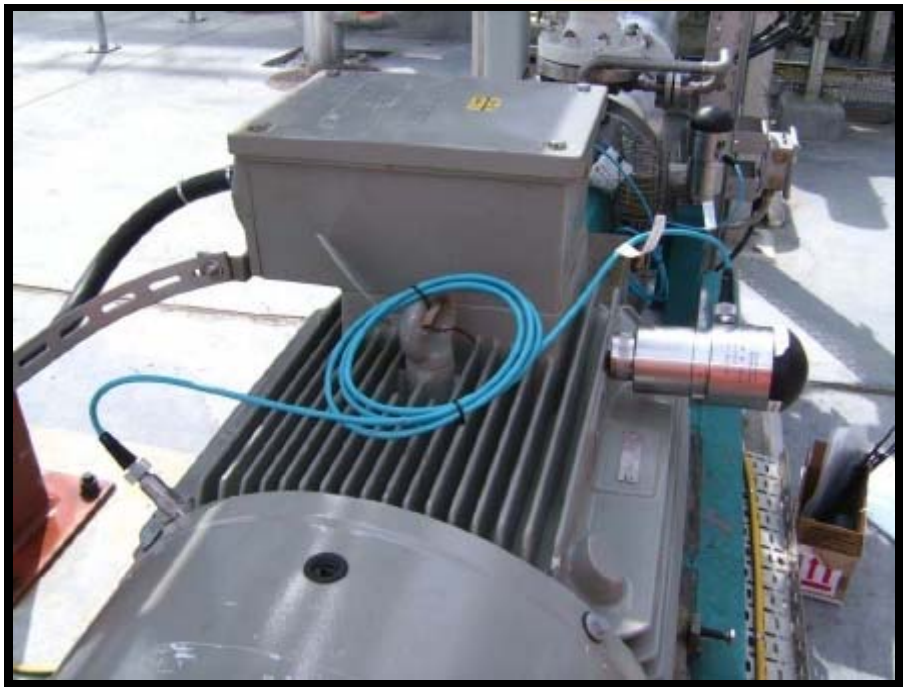
First System

One harvester Powers WSN with one accelerometer



GE Bently Nevada Condition Monitoring

GE Bently Nevada

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"Insight.mesh"
Wireless Condition Monitoring System

4 Sensors per node

"Power for Life with Energy Harvester"
"Target of three years with batteries"

Power Generation Plant

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Design Flexibility

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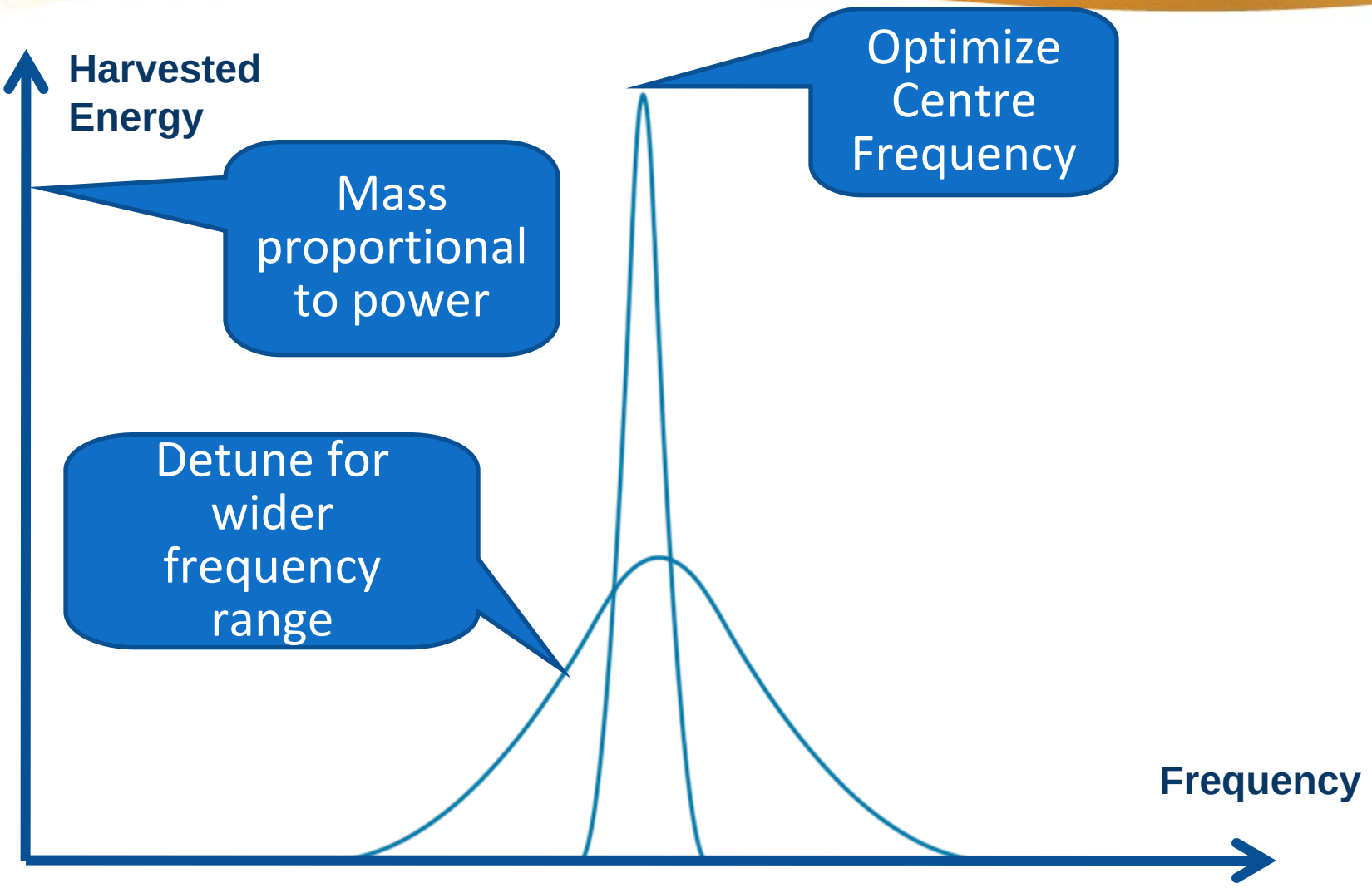

2.Lifetime – No maintenance

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- Power Source should exceed equipment life
  - PMG FSH Free Standing Harvester
    - Designed for high reliability
    - 890 years MTTF (MIL standard)
  - Rejected materials with 200million cycles:- means <7 weeks life @50Hz
- Maintenance :-
  - difficult, undesirable, impossible
- Power Solution must be “Fit and Forget”

3. Easy to Install

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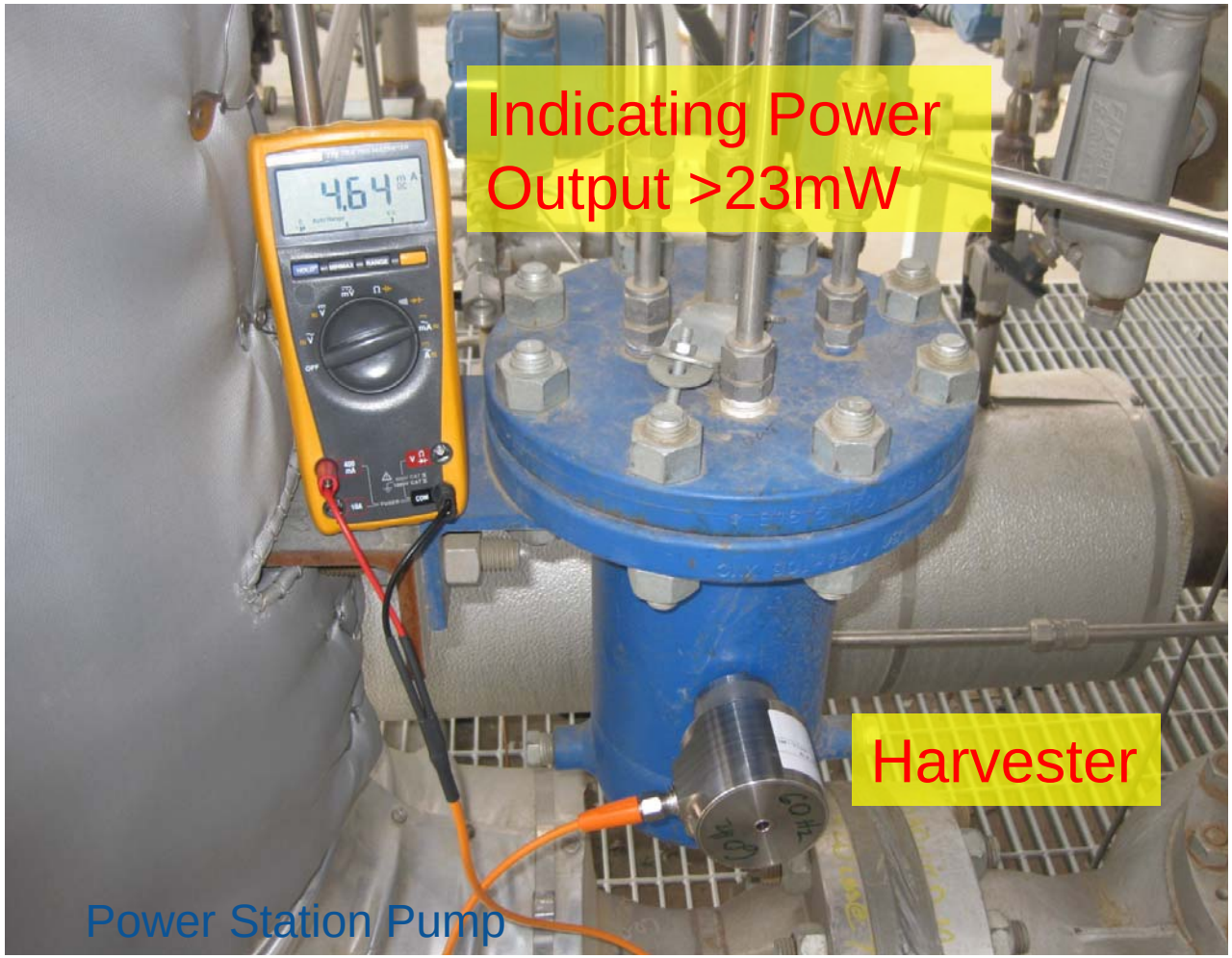

- Power level seen immediately
- Non – intrusive Installation

4. Coverage – Power from FSH

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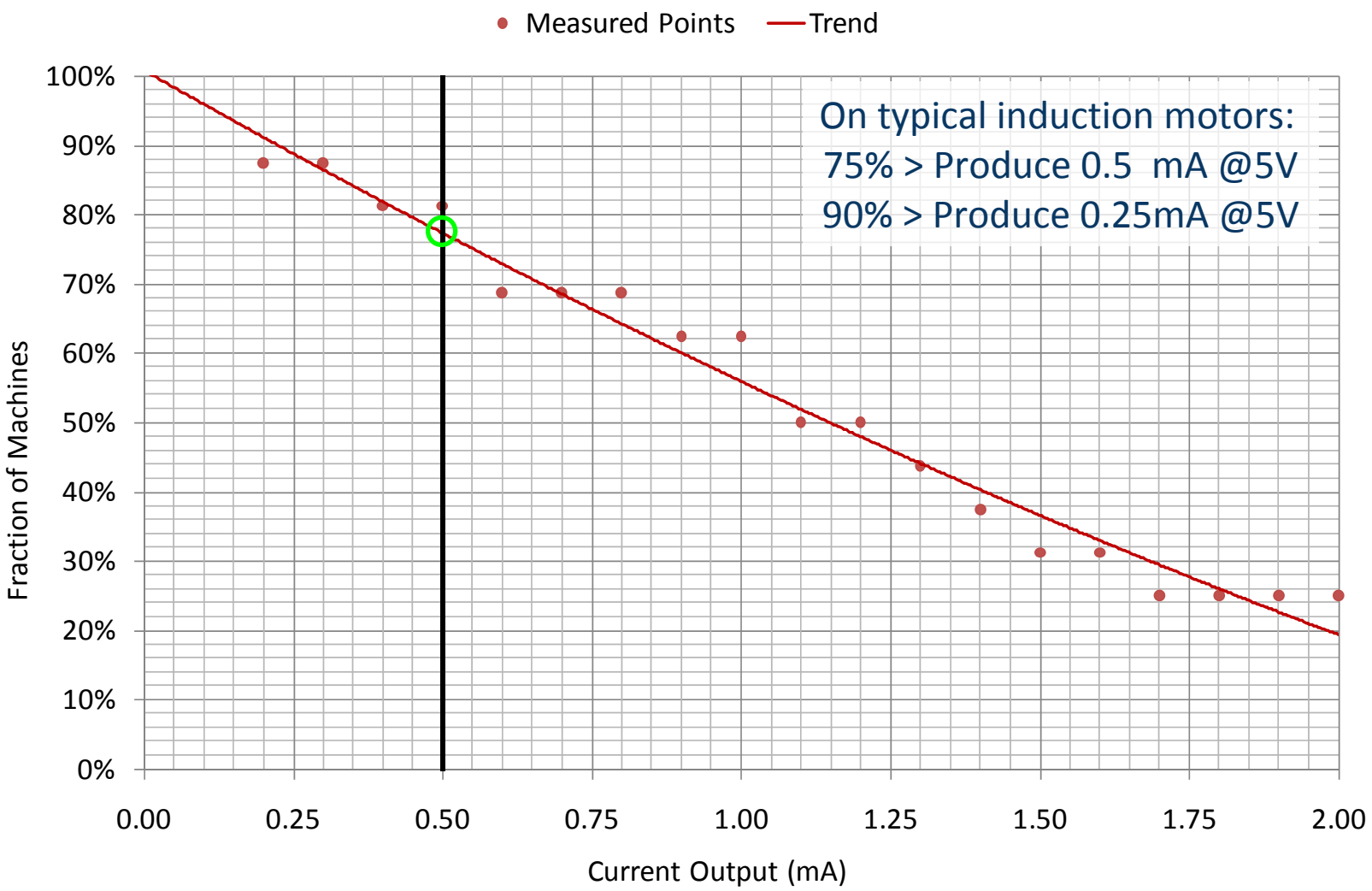

5. Interchangeability

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National Instruments low power Wireless Sensor Node

- Pressure, Temperature
- 4AA batteries
- VEH - Integrated Power Conditioning

Options

- Leave batteries
- Remove batteries
- Plug in Harvester
- Plug in any power source

ISA100.18 Power Sources

Mission

The ISA100.ps Working Group mission is to develop standards to enable users and suppliers to compare, specify and interface power/energy sources for “non line powered, low power, wireless sensor nodes (WSN)”.

•Objectives

–Develop and Publish standards that permit interchangeability of Power Modules for WSN’s.

–Develop and publish standards for specifying performance of power/energy sources

6. Meet Application Requirements

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- Environmental standards
  - E.g. EMC, Train washing
- Temperature range
  - E.g. -40 to +85
- Shock
  - E.g. 30G
- Hazardous Zones
  - E.g ATEX Certification, Zone 0

7. Strong Business Case

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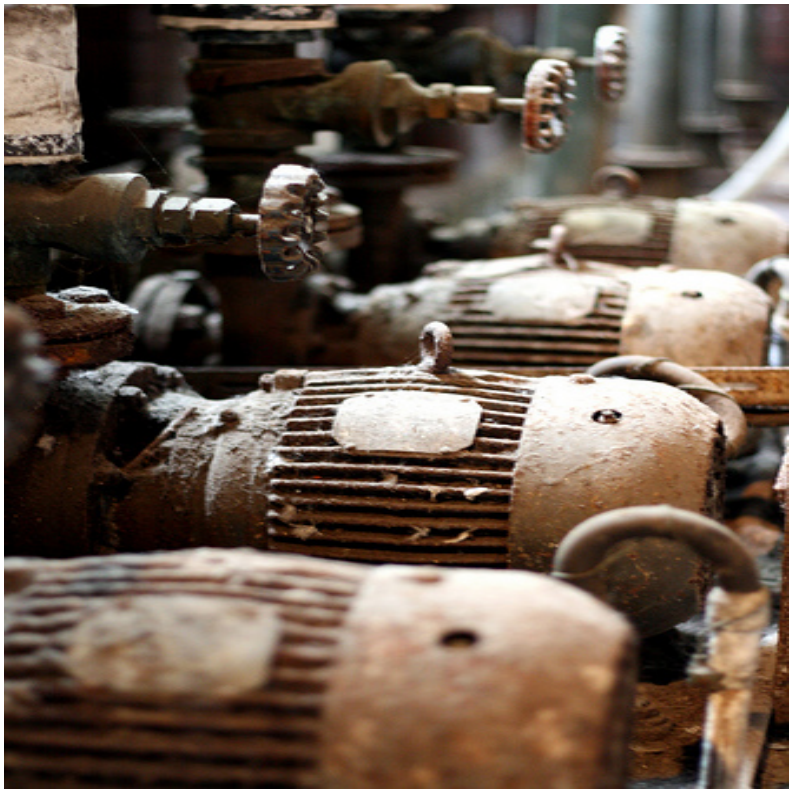
No Monitoring – Run to Failure



- Economically redundant
- Reactive maintenance operations
- Unplanned / Unscheduled maintenance
- Safety & environmental issues
- Excess waste generation

Handheld walk around

- Infrequent monitoring cycles
- Quality of repeatable measurements uncertain
- Inefficient for large number of machines
- Potential safety risks
- Reactive maintenance operations

Business Case

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Pruftechnik GmbH

Wireless Condition Monitoring System
At Water Treatment Plant

- 6 units installed in 40 minutes
- Wiring would need 6-8 man weeks and plant shutdown
- Unhealthy Working Environment

Business Case -Summary

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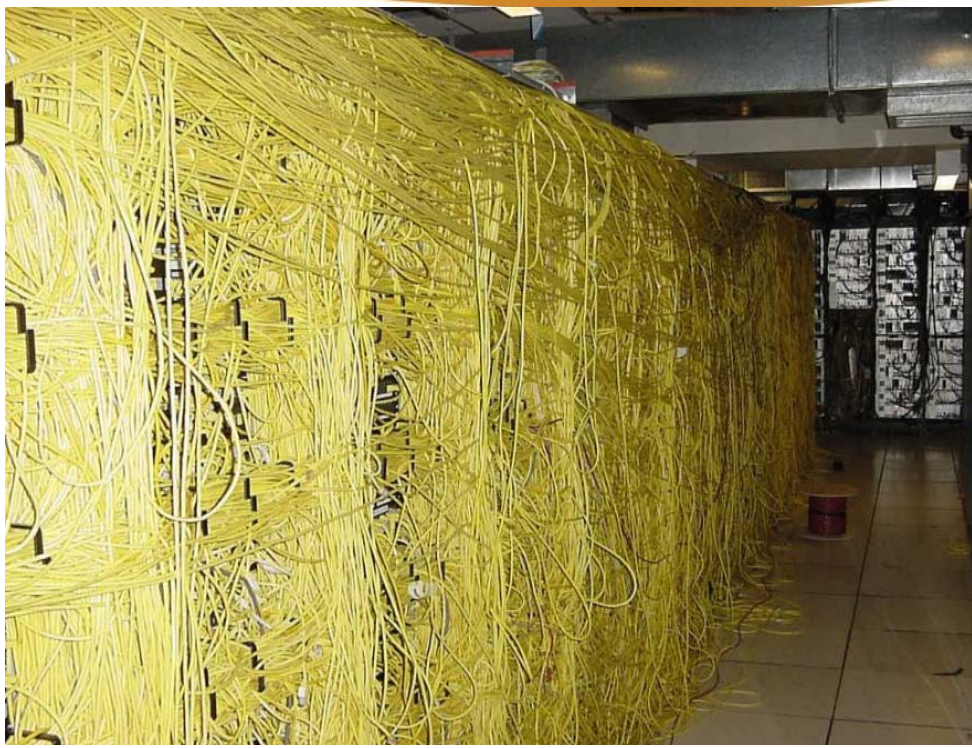
Wiring-expensive and unreliable



Wireless Sensing needs wireless power

No alternative power available

No maintenance

Summary

- Energy Harvesting is key to massive potential for wireless sensing/monitoring/tracking without batteries
- Perpetuum has practical working solution for billions of locations using vibration sources
- Select the right harvester
- Energy Harvesting – Fit and Forget

Success = Ensuring enough power

PMG FSH ATEX/IECEx/CSA