

# Vibration Energy Harvesting

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Roy Freeland, President

An aerial photograph of the Ormen Lange gas field in Norway. The image shows a large industrial complex with numerous buildings, storage tanks, and processing units, all situated in a snowy, mountainous landscape. A large offshore platform is visible in the water to the right. The entire scene is covered in snow, with some evergreen trees scattered throughout.

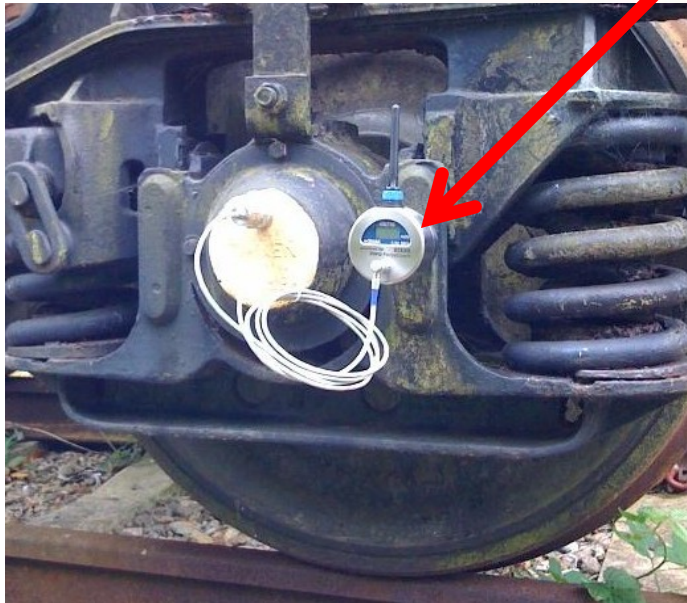
## Shell - Ormen Lange Major New Gas Field

GE Bently Wireless Condition Monitoring  
Powered by Vibration Energy Harvesters

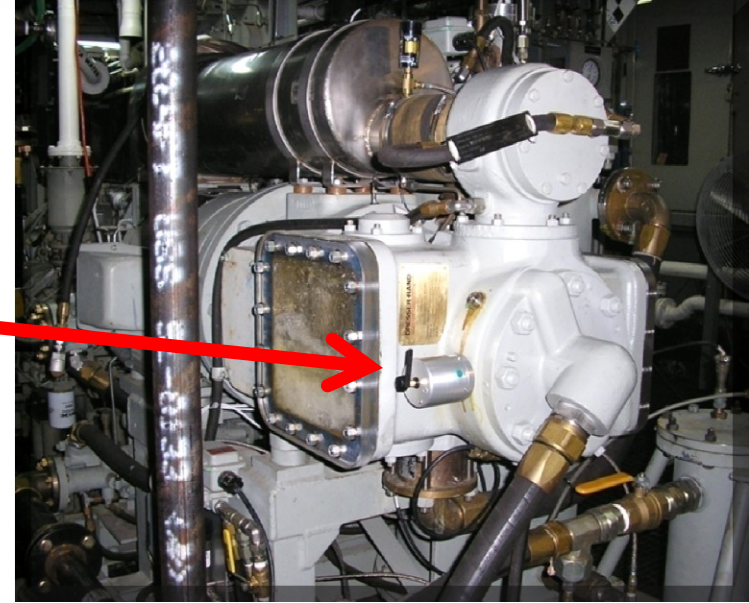


# “Power for Life”

## Vibration Energy Harvester Wasted Vibrations -> Usable Electrical Power



wSNAK on bogie



US Navy - Compressor

- Low vibration levels (25mg)
- ATEX Zone 0 Certified
- High reliability design
- MTTF – 892 years

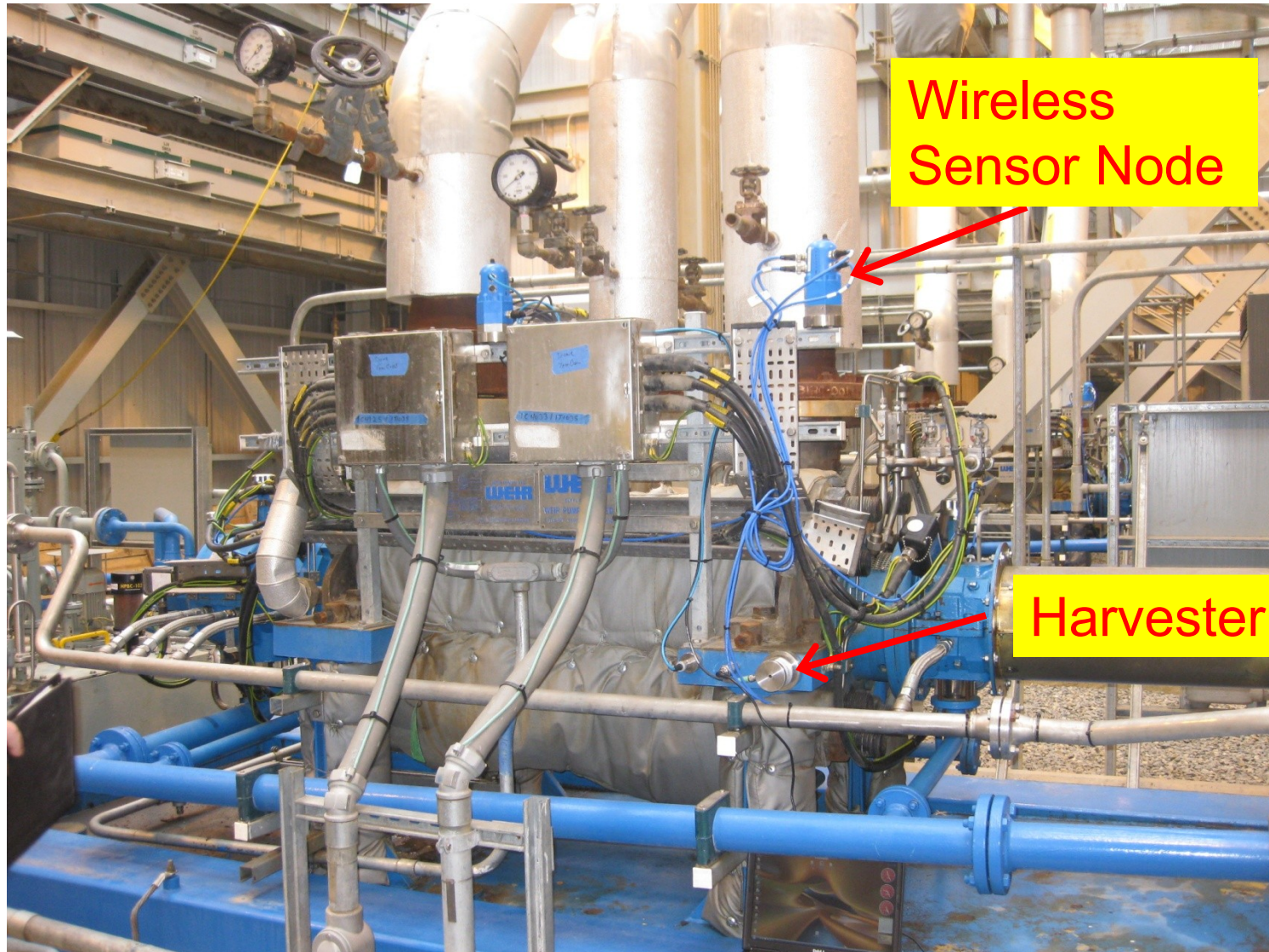
## “Insight.mesh” Wireless Condition Monitoring System

- 4 Sensors per node
- “Power for Life with Energy Harvester”
- “Target of three years with batteries”





# Power Generation Plant





# Power Station Pump





Pruftechnik GmbH

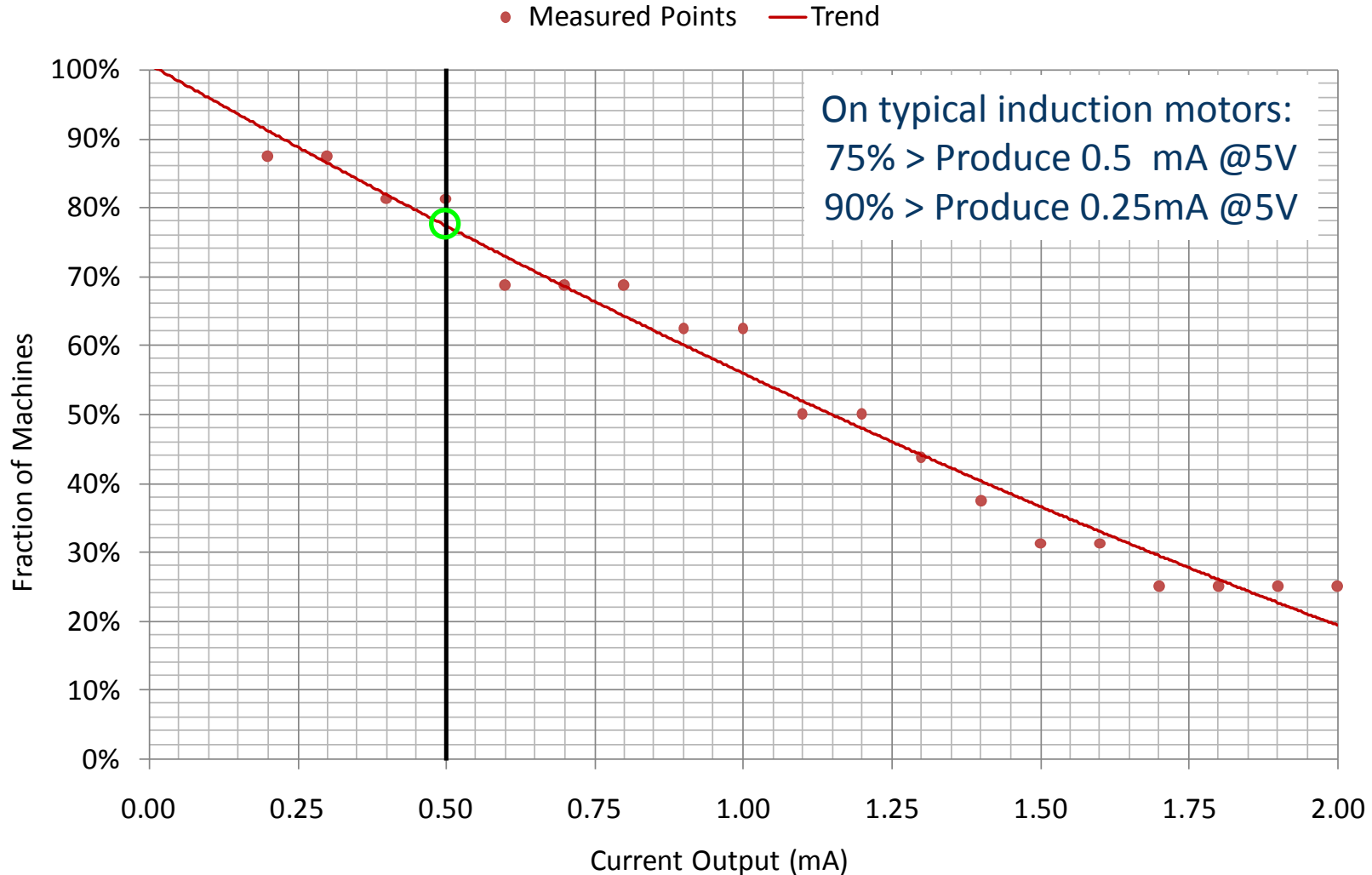
Vibnode RFA Wireless  
Condition Monitoring System



Blackburn Meadows  
Water Treatment Plant

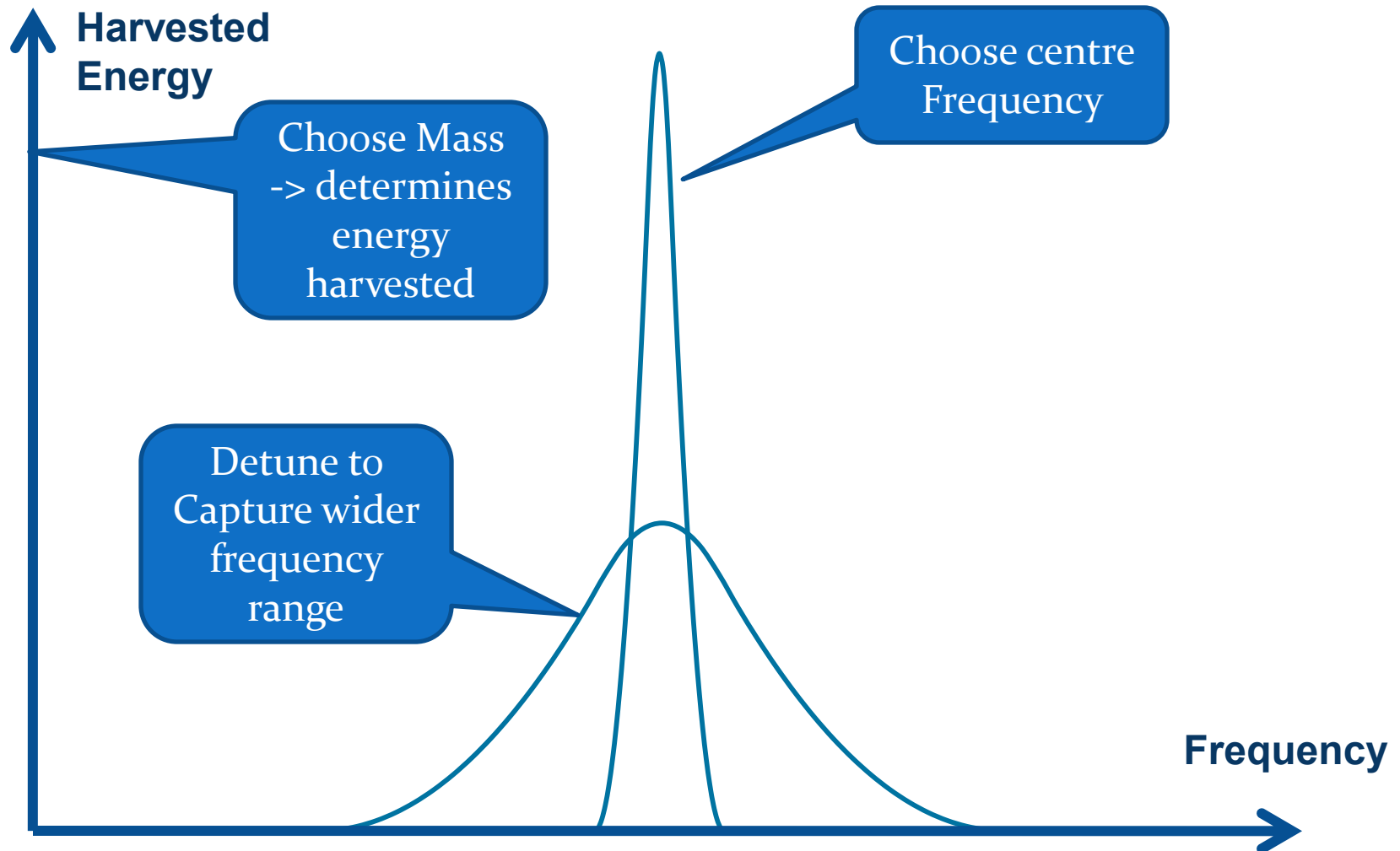


# Coverage – Power from PMG FSH





# Perpetuum Design Flexibility



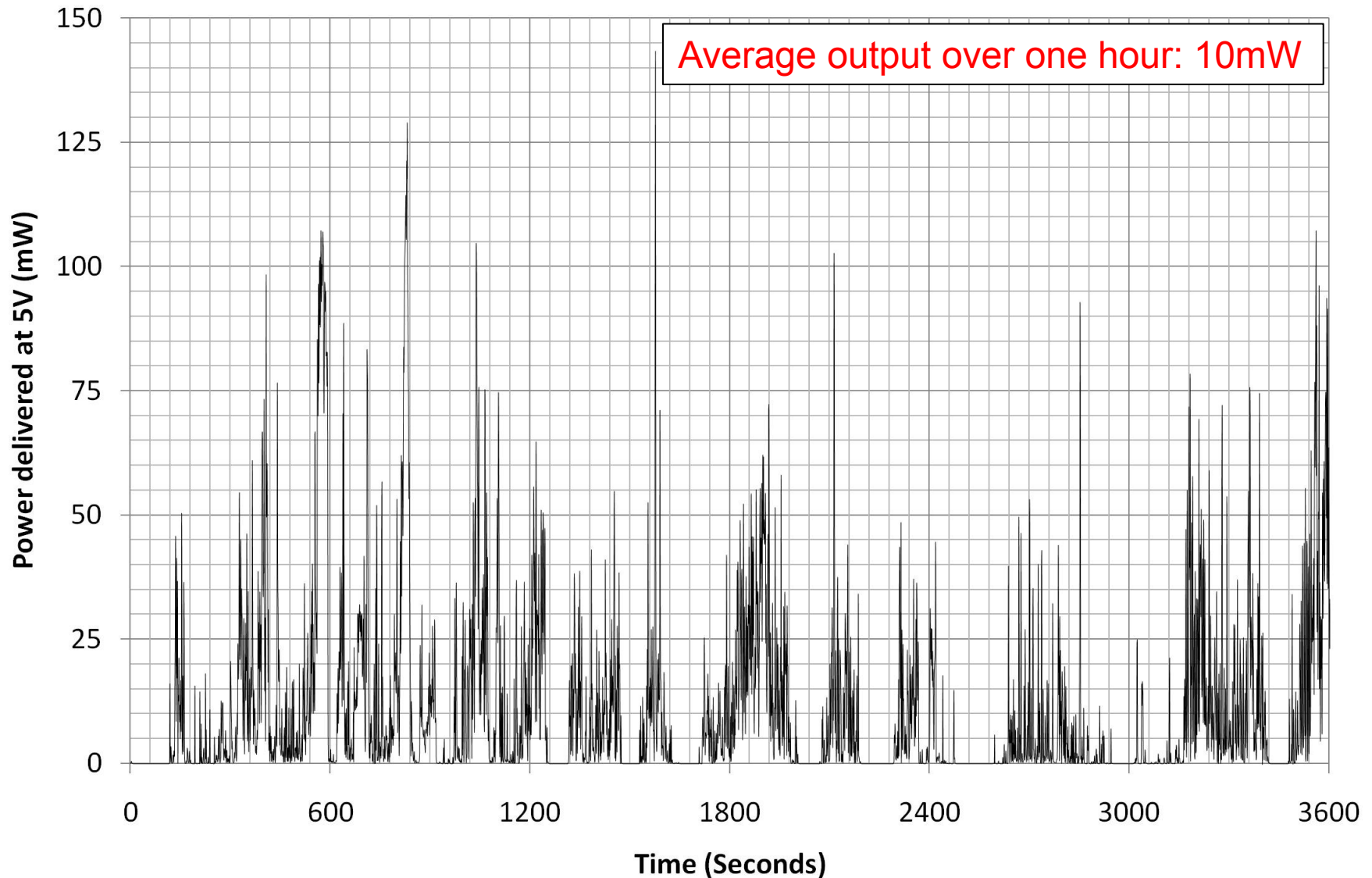
# Vibration Harvesting from Rail Wagons

- Rail Wagons – Very High Levels of Vibration
- Frequency pattern and train speed change require wide bandwidth
- Mounting locations affect power output
- A maintenance free power source while train is in motion
- High levels of power for
  - Sensing
  - Wireless Communications
- Typical Power Levels from trials
  - Express 12-15mW
  - HST 30-50mW



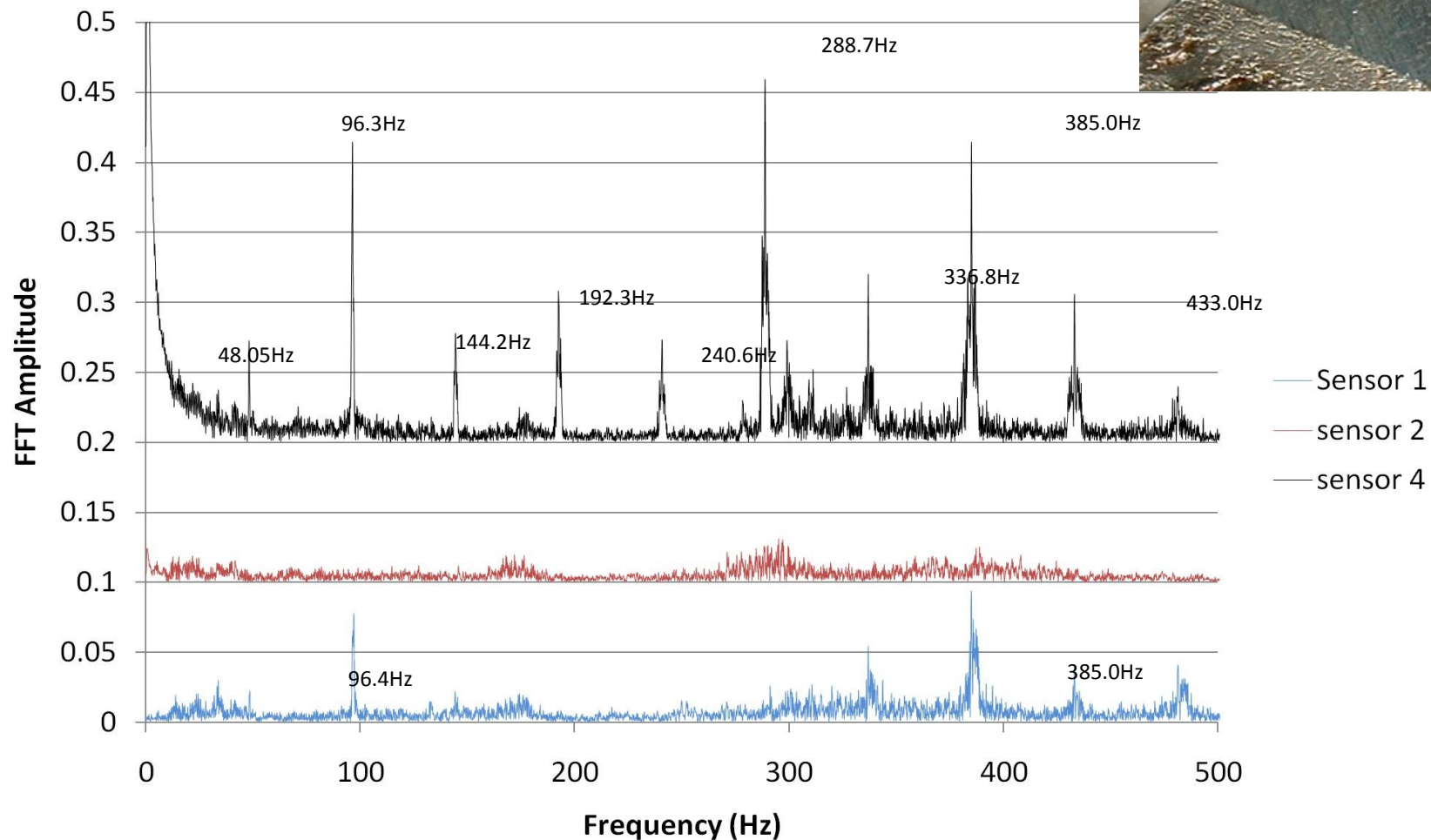


# Real Harvester Output on Train.



# FFT Results @ 13.3 m/s

10-second FFT at 13.3 m/s.





# 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
- Other energy harvesting solutions exist but vibration – optimum when available
- Rail has great power potential
- Robust, reliable, “Fit and Forget” - Economic, fast installation
- Improve safety, reliability, maintenance and operating costs

