



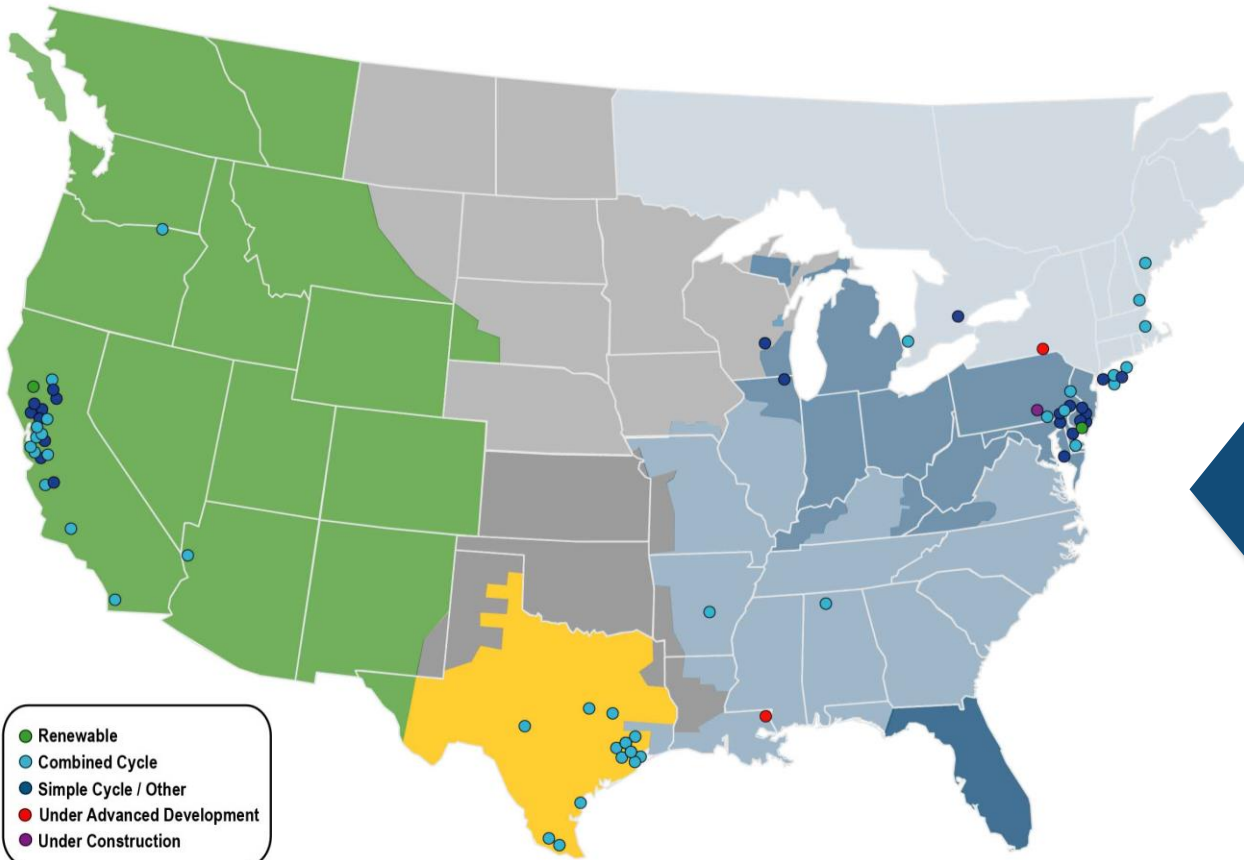
America's Premier Competitive Power Company  
... Creating Power for a Sustainable Future



## Implementing anomaly detection framework in KNIME

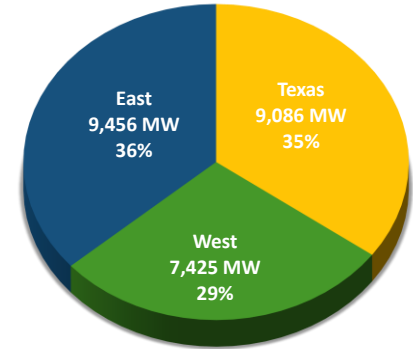
11/9/2018

# CALPINE: National Portfolio of Approximately 26,000 MW

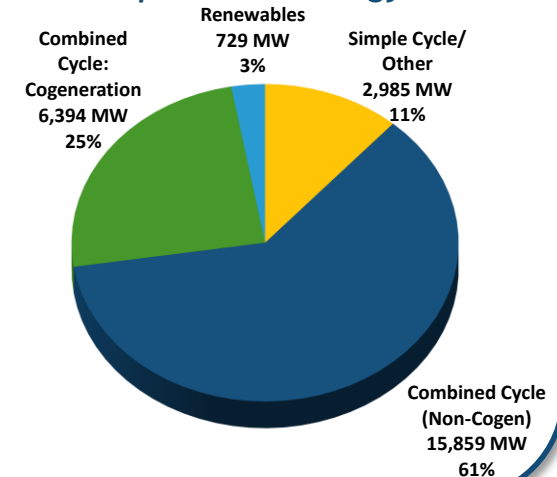


As of 06/30/2018

## Geographic Diversity



## Dispatch Technology



- Geographically diversified portfolio: Scale in America's most competitive power markets
- Featuring one of smallest environmental footprints in America's power generation sector
- Largest operator of combined heat and power (cogeneration) technology in America
- Largest geothermal power producer in America

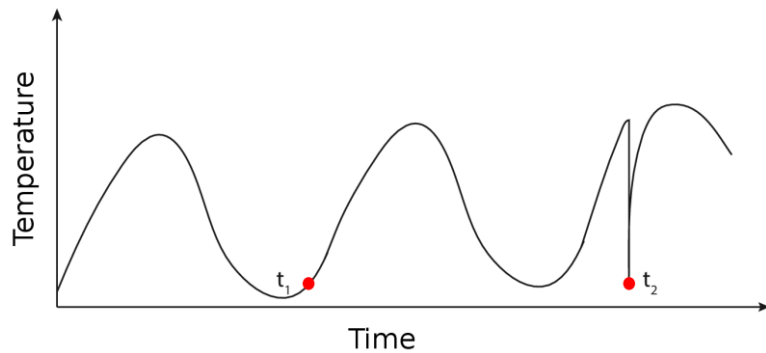
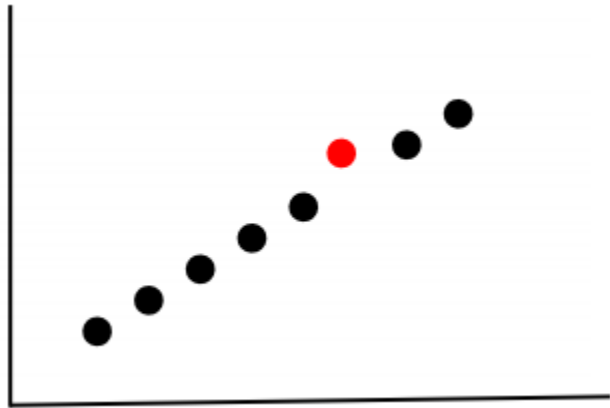
# How important is equipment prognostics

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- 80+ Plants, several thousand rotating equipment, translating to several thousand potential failures
  - Better monitor thy equipment
- Since 2013 Calpine has been using a 3<sup>rd</sup> party Anomaly Detection framework based on NASA's ORCA algorithm
  - Blind spots
  - No Fault Detection or Remaining Useful to speak of
- Improving on existing methods through a combination of DL and classical ML algorithms

# Anomaly detection vs Fault Classification

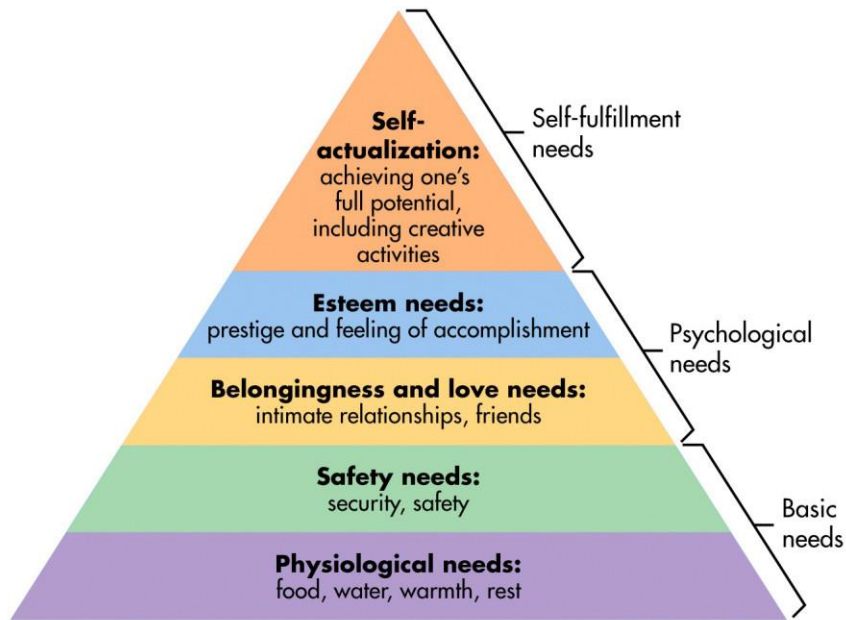
Unknown unknowns



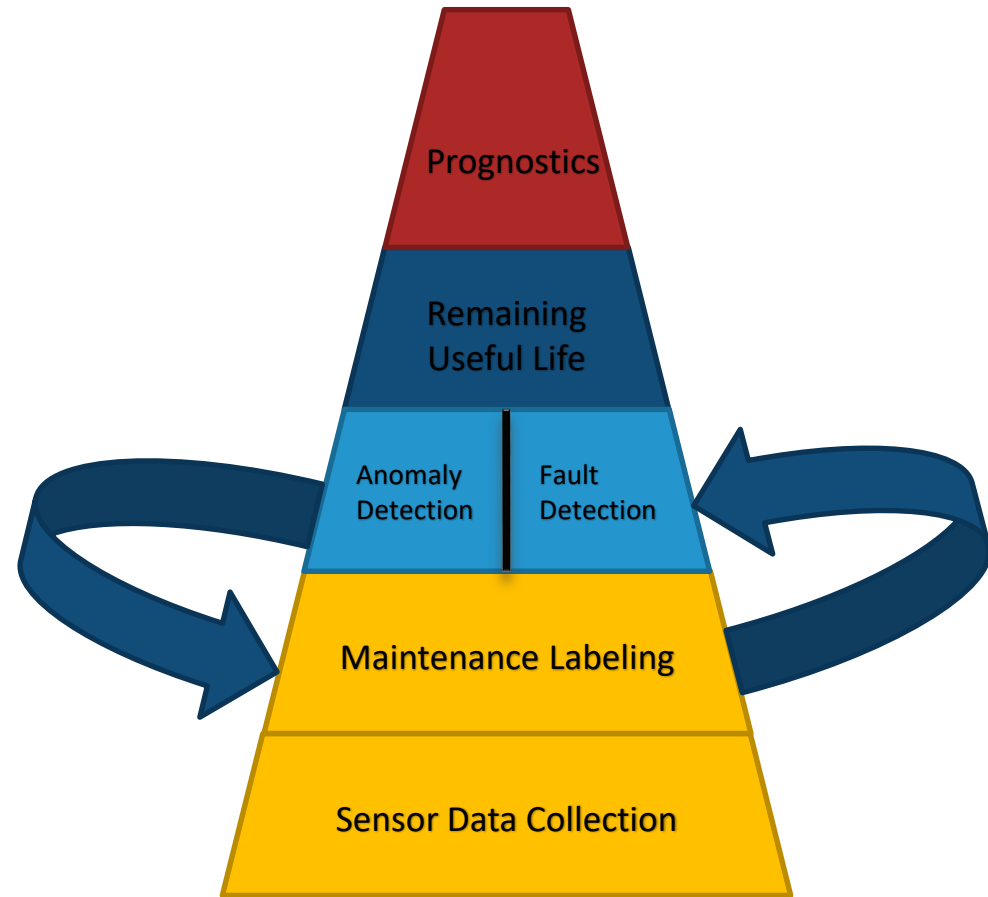
Unknown knowns



# Anomaly detection in context

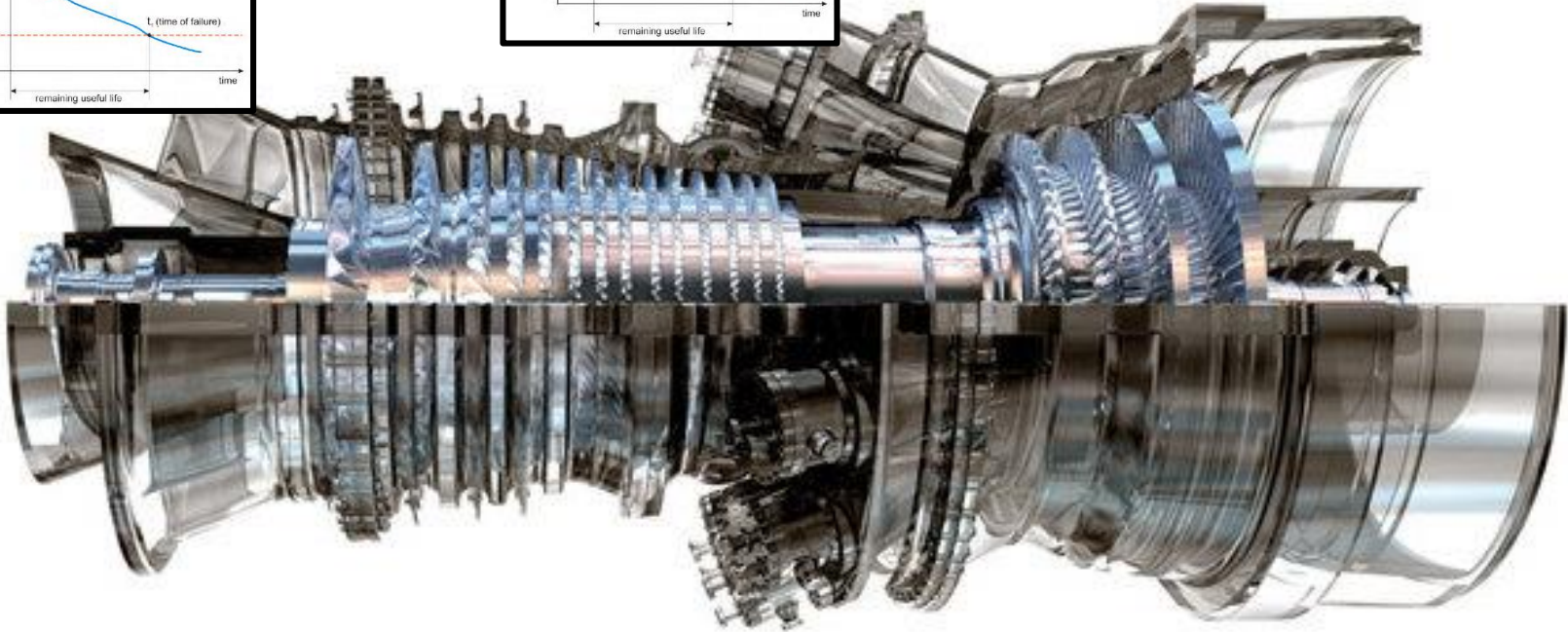
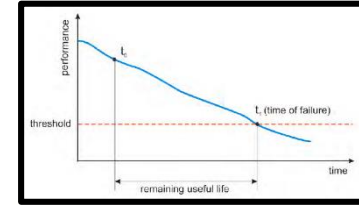
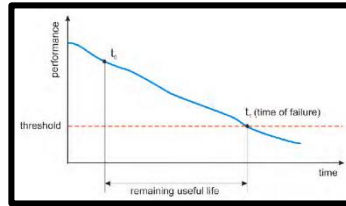
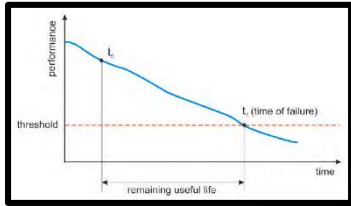


Maslow Pyramid of needs





# Remaining Useful Life as an odometer



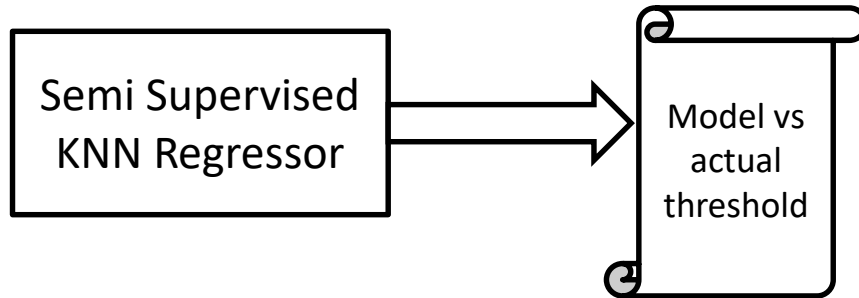
# Framework for equipment monitoring

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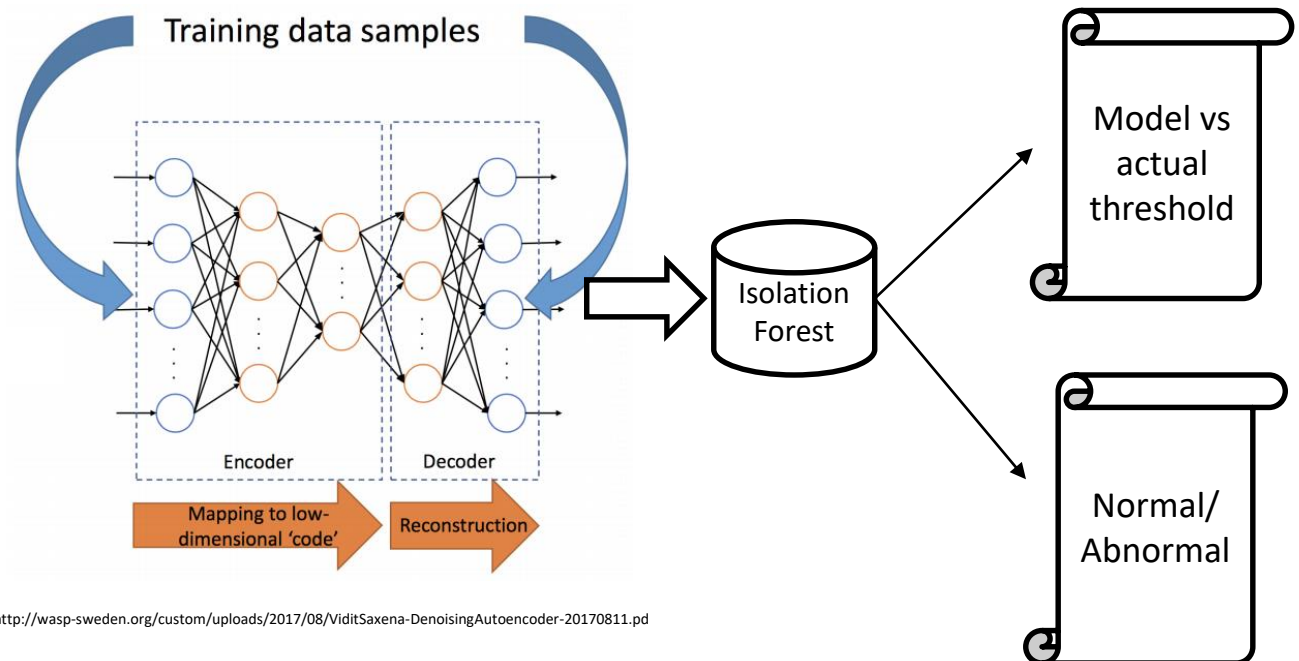


# Improving Calpine Anomaly Detection Framework

Existing Algorithm



New supplemental Algorithm based on Autoencoders



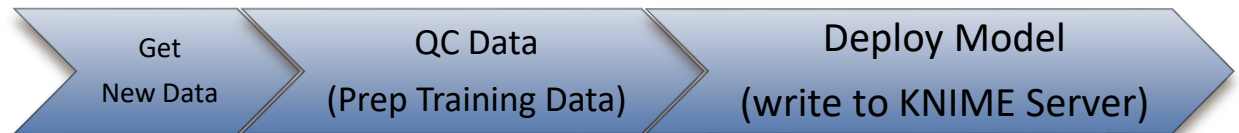
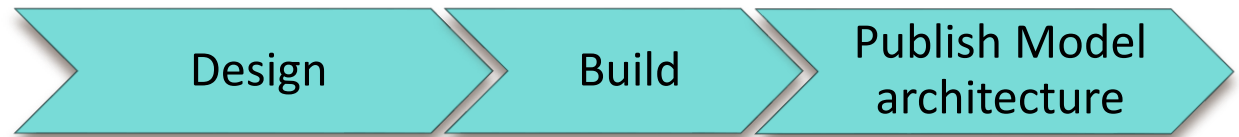
<http://wasp-sweden.org/custom/uploads/2017/08/ViditSaxena-DenoisingAutoencoder-20170811.pdf>



# Framework overview



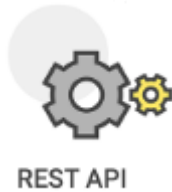
KNIME Analytics Platform



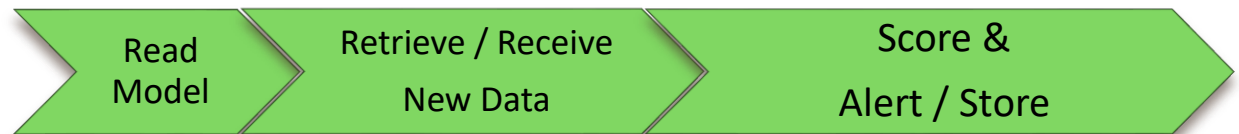
WebPortal



KNIME Server



REST API

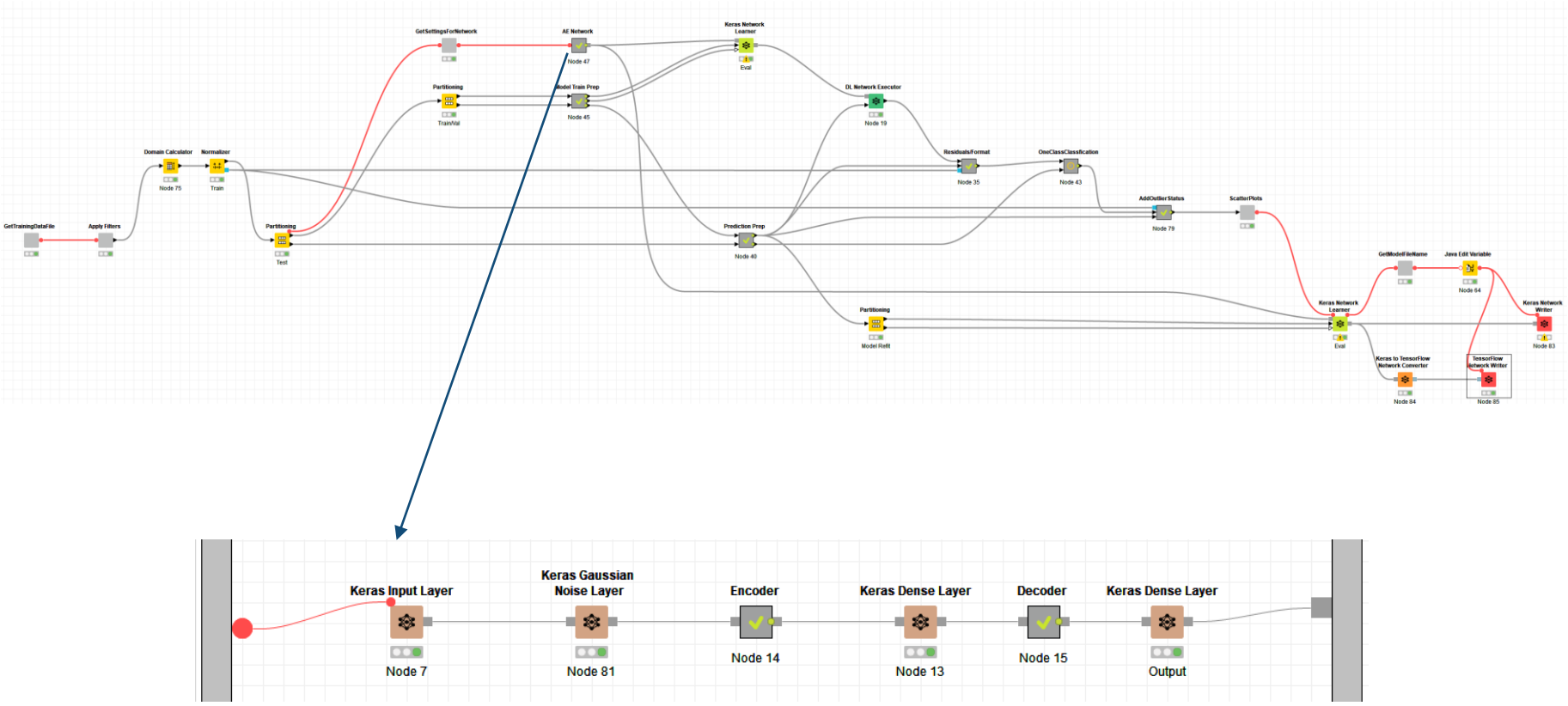


Schedule

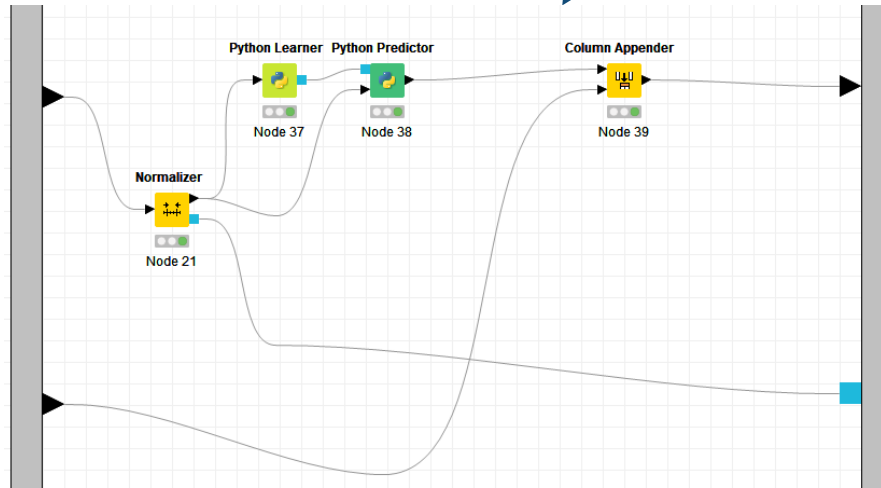
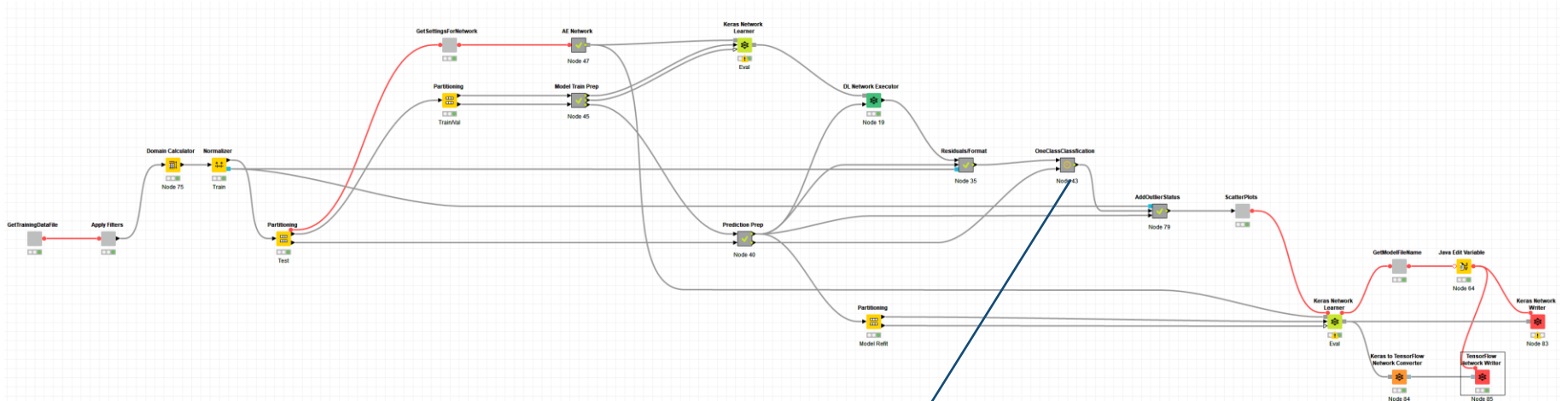
# Appendix

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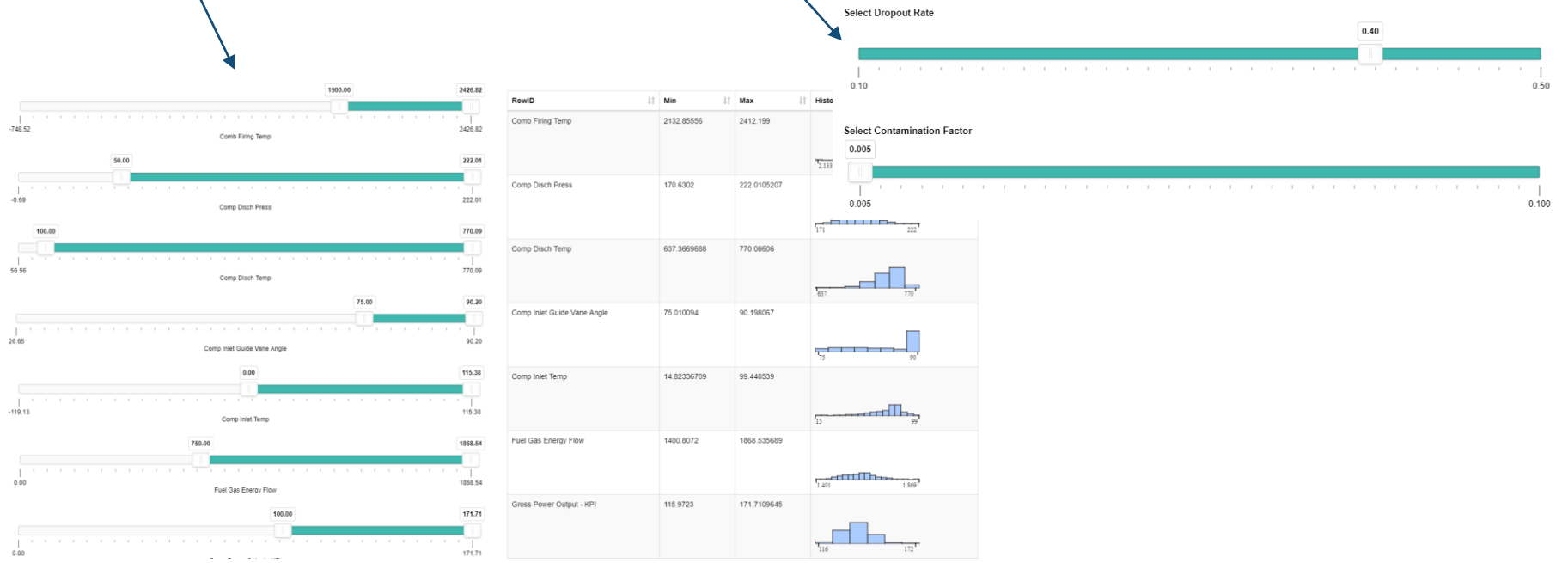
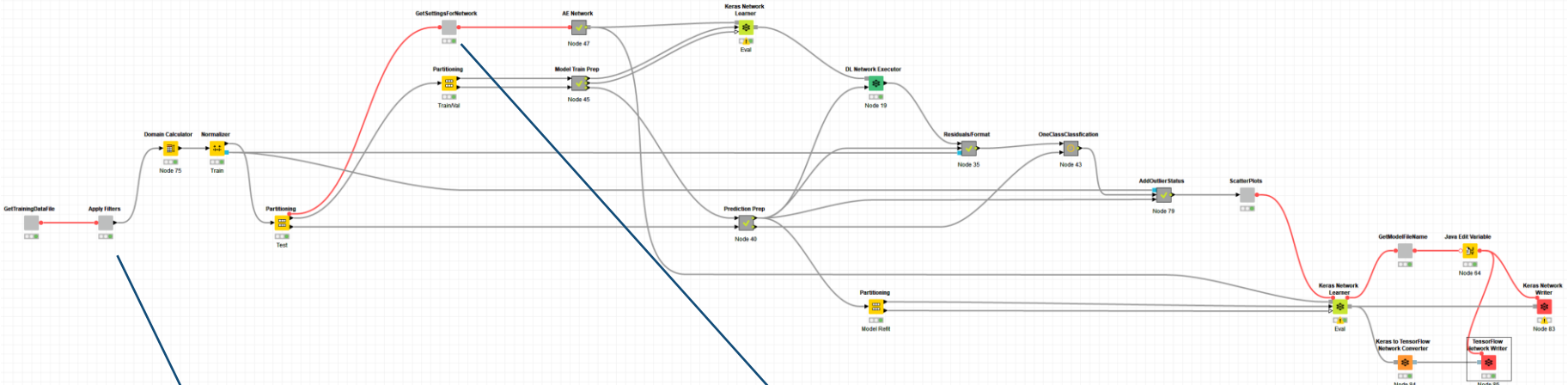
# Workflow - Training (Keras Network)



## Workflow - Training (One Class Classification)



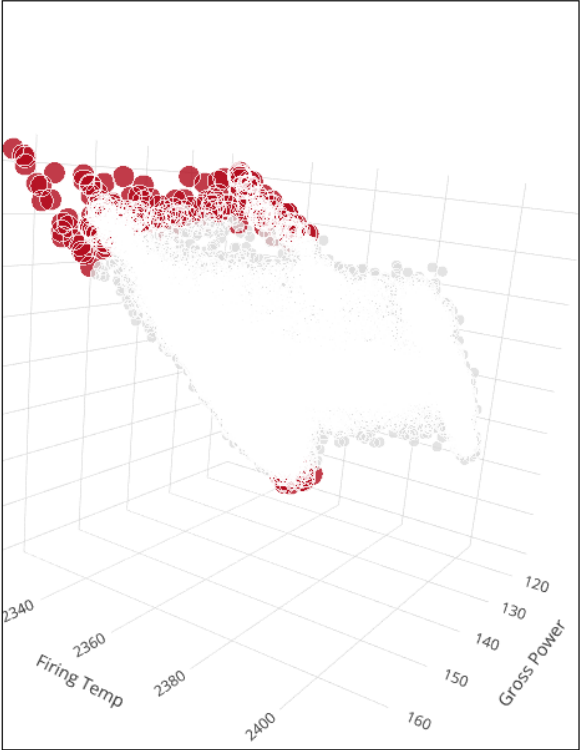
# Workflow - Training (User Input)





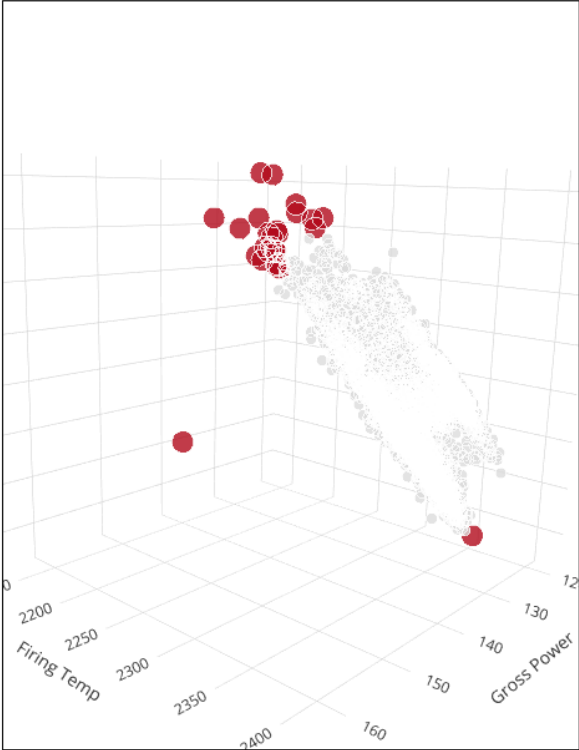
# Workflow - Training (Visualize Model Performance)

Training Dataset



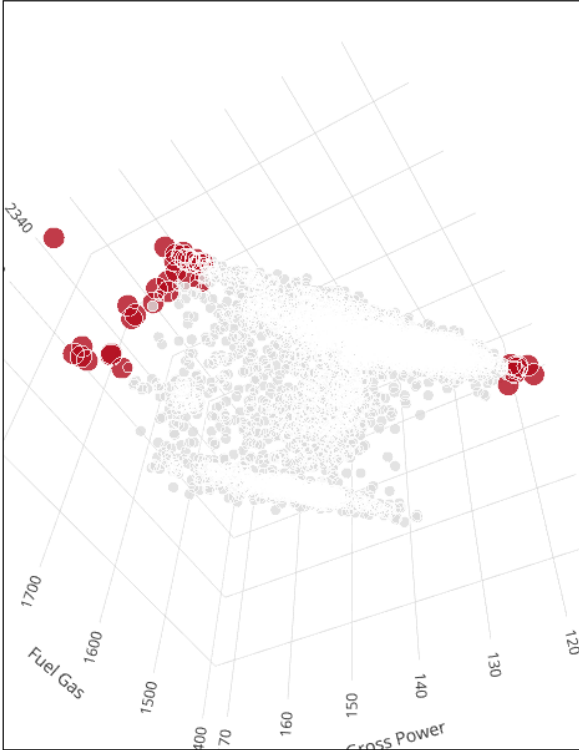
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Validation Dataset



🗑 Discard

Test Dataset



Next ▶

# Workflow - Prediction (Rest API)

