Brazil – US DER Tech Forum
Advanced Monitoring and Diagnostics

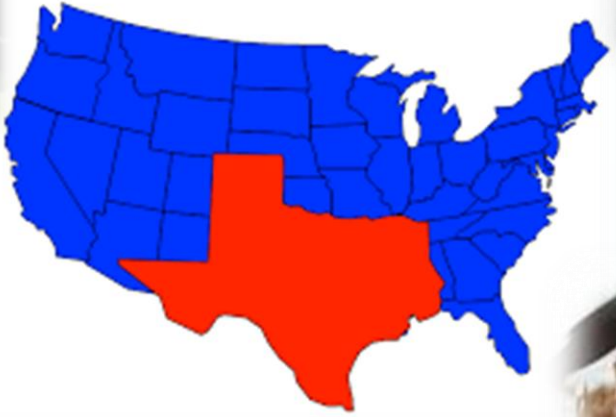
Applying the Industrial Internet of Things to Cost Optimize Distributed Energy Resources

Clinton E. Carter
Dale Higginbotham
Josh McSpadden

Luminant

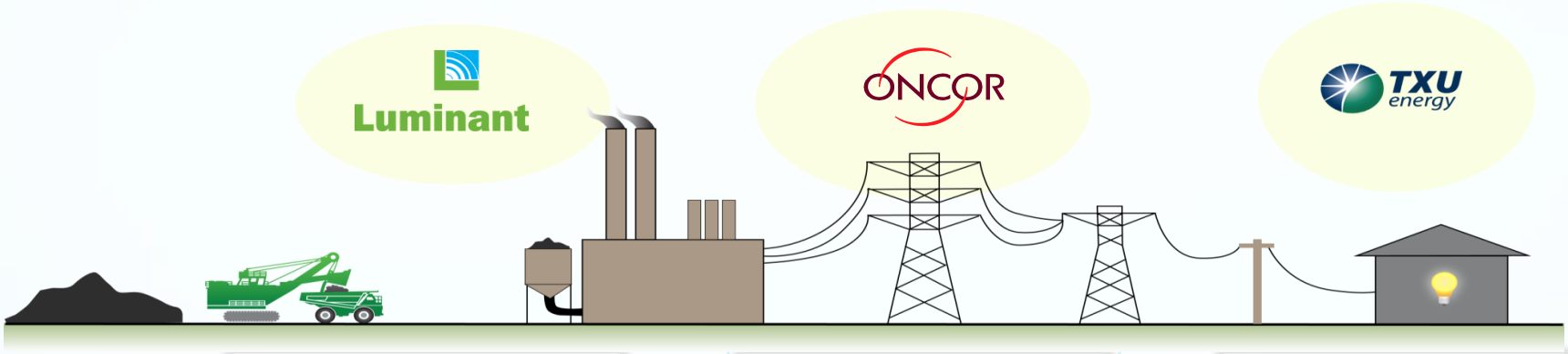
Sao Paulo
May 11-12, 2015

Howdy Y’all..! We are from Texas!



Luminant Business Profile

Energy Future Holdings



Luminant

- Largest generator in Texas
- Largest coal and nuclear fleet in Texas
- Low-cost lignite

ONCOR

- Largest T&D utility in Texas
- Leader in smart-grid development
- Constructive regulatory regime

TXU energy

- Largest retail electricity provider in Texas
- Strong customer value proposition

*While Oncor is owned by a limited number of investors (including majority owner Energy Future Holdings), Oncor is managed by its Board of Directors, which is comprised of a majority of independent directors.

Luminant: Business Profile

- **Luminant Generation**
  - **Largest generator in Texas**
    - Nearly 17,000 MW of capacity
    - Coal, nuclear, natural gas
- **4,000 employees**
  - 2,000+ plant
  - 1,500+ mine
  - 300+ support
  - 100+ Luminant Energy
- **Business has grown**

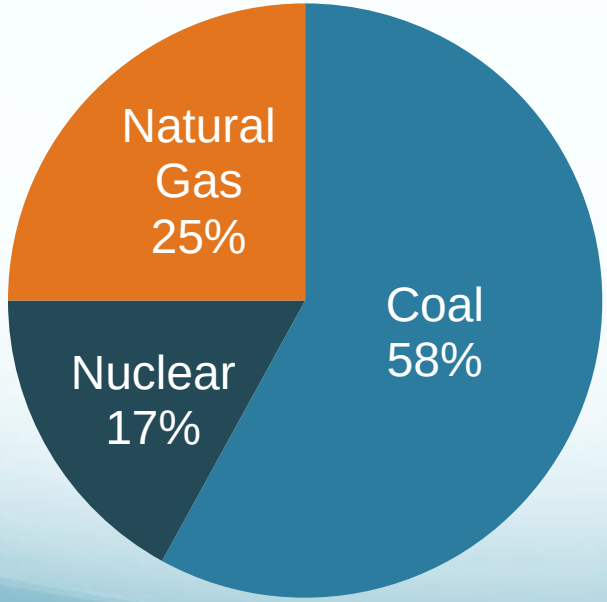
  Since 2007, we've added:
  - 3 new units
  - 4 new mines
  - 2 new CCGT plants *(purchased)*

***Blue area depicts lignite coal belts**

Luminant Generation

2015 Generating Capacity

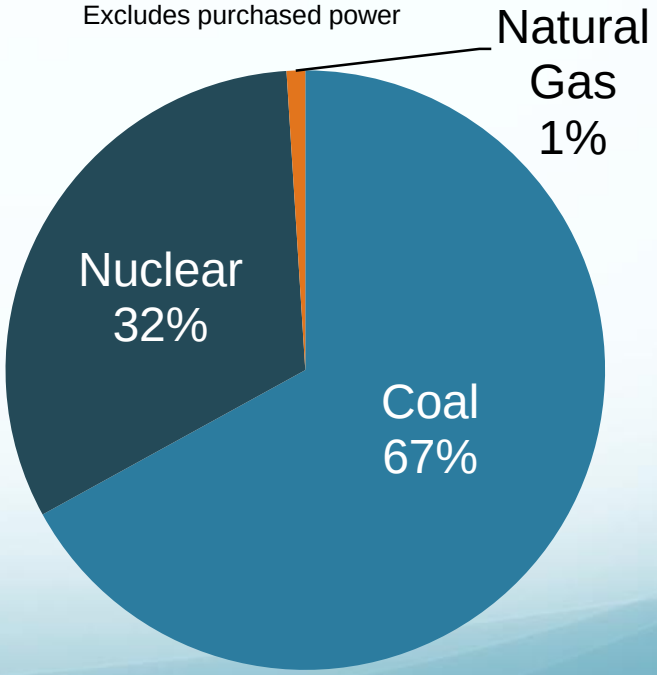
Total: 13,772 MW



2015 Energy Production

Total: 62,480 GWh

Excludes purchased power



Above graphs illustrate 2015 only. Generation capacity for 2016 is 16,760 MW due to the April 2016 purchase of Forney and Lamar power plants.

Luminant has also provided industry leadership in optimizing fleet operations through advanced technologies

The Power Optimization Center enables Real-Time 24x7 Operations Support

The Technological Revolution

“We stand on the brink of a technological revolution that will fundamentally alter the way we live, work and relate to one another.

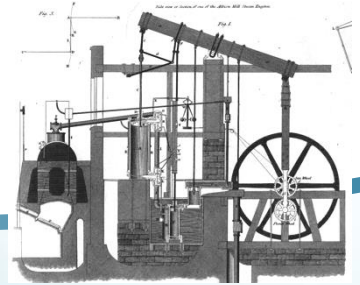
In its scale, scope and complexity, the transformation will be unlike anything humankind has experienced before…”

“The 4th Industrial Revolution”

Klaus Schwab
Founder and Executive Chairman, World Economic Forum

4th Industrial Revolution –

Linear to Exponential Evolution



1st Industrial Revolution

> Water <
> Steam <

2nd Industrial Revolution

> Electric Energy <
> Division of Labor <

3nd Industrial Revolution

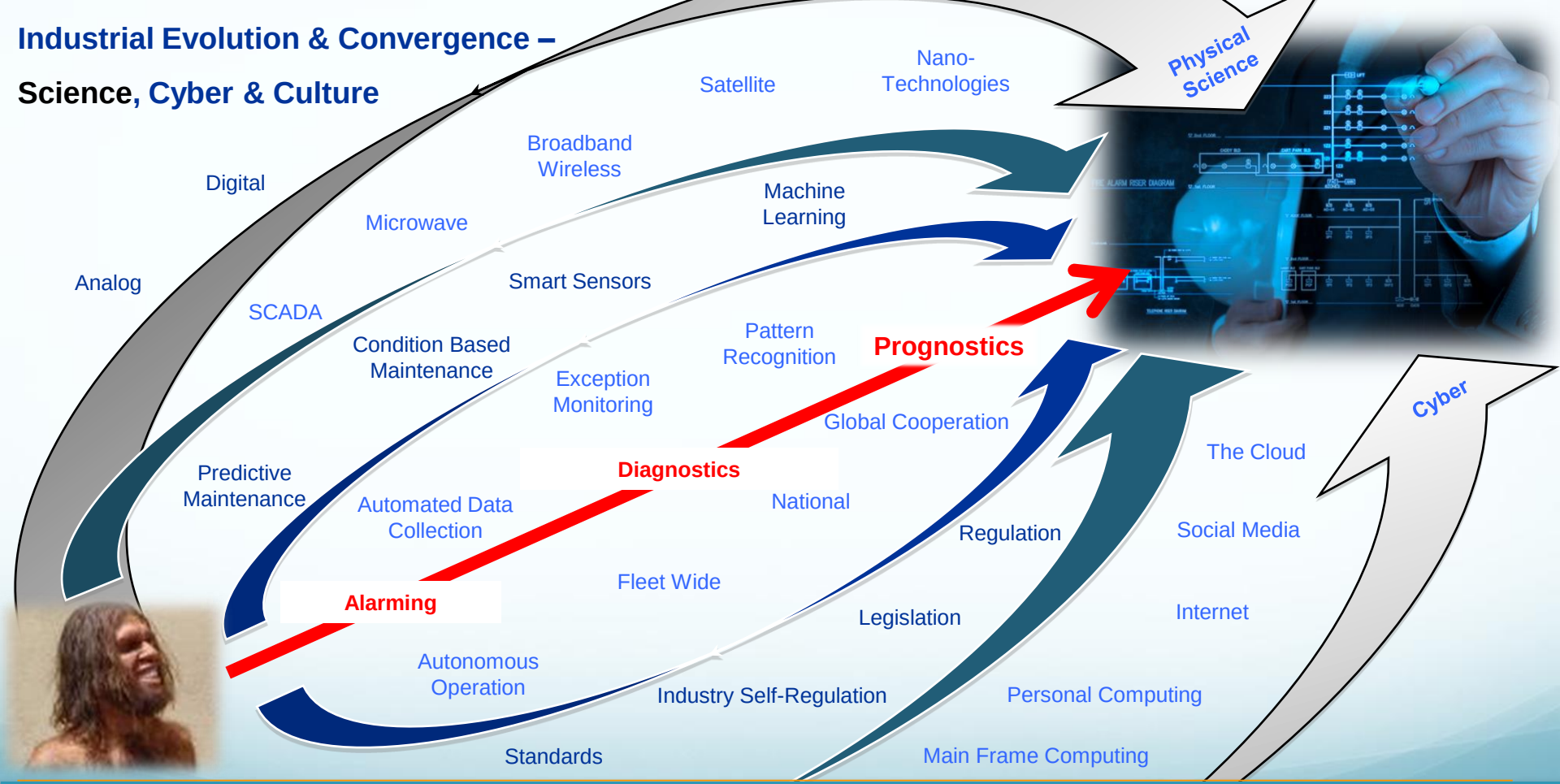
> Electronics <
> Information Technology <

4th Industrial Revolution

> Cyber Systems <
> Physical Production Systems <

1800 1900 1970 2000 2016

Industrial Evolution & Convergence – Science, Cyber & Culture



The "Industrial Internet of Things" – is enabling a new age of Operational Excellence across the electric utility industry

Power Optimization Center

“Transforming Big Data into Actionable Intelligence”

POC
Video

POC Mission

We partner with our customers to optimize power plant operations.

We apply our industry proven expertise to:

- ✓ increase equipment reliability,
- ✓ reduce operating cost,
- ✓ lower greenhouse gas emissions.

We are the "Smart Grid" of Power Generation…

Power Optimization Center

Nuclear

Coal

Natural Gas

Increase Generation

Optimize Performance

Reduce Cost

Operations

Maintenance

Engineering

Big Data → ***Advanced Monitoring & Diagnostics*** → ***Actionable Intelligence***

The Power Optimization Center delivers improvements in plant generation, performance and operating costs…

Advanced Monitoring & Diagnostic Services

- ✓ **24x7 Real-Time Operations Support**
- ✓ **Critical Equipment Diagnostics**
- ✓ **Plant Performance Optimization**

Plants We Serve:

Type	Units	MW
Coal	20	11,000
Gas	26	3,400
Nuclear	2	2,340
		16,740

www.pocdiagnostics.net

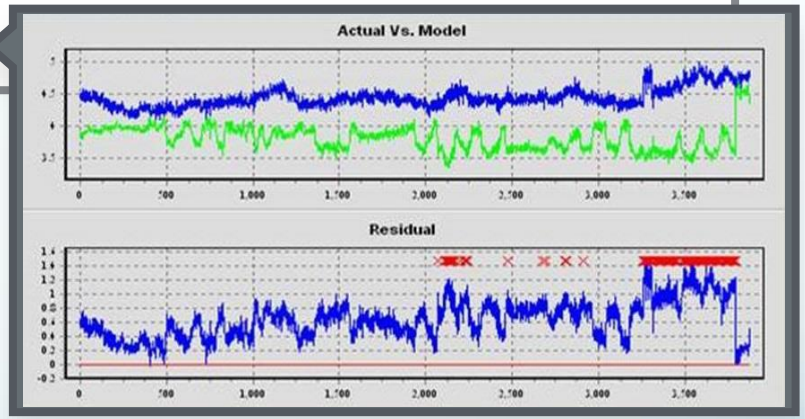
POC Success Stories

POWER OPTIMIZATION CENTER: SUCCESS STORIES

Component	**Primary Air Fan**

POWER OPTIMIZATION CENTER: SUCCESS STORIES

Component	**Primary Air Fan**
POC Indication	**High Vibration**



POWER OPTIMIZATION CENTER: SUCCESS STORIES

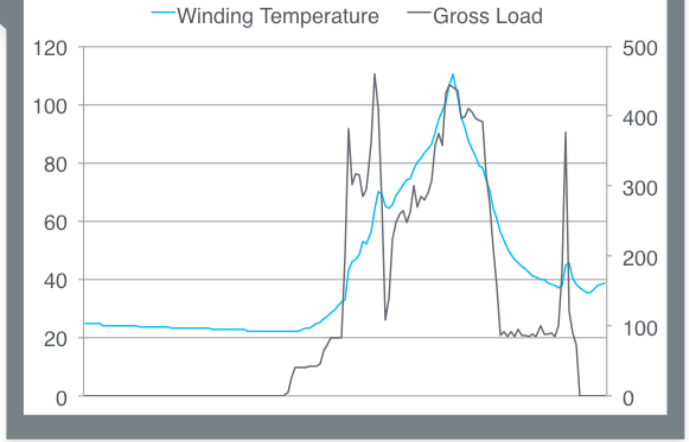
Component	**Primary Air Fan**
POC Indication	**High Vibration**
Action Taken	**Plant notification and subsequent investigation**
Corrective Action	**Added oil, replaced bearing during planned outage**
Consequence Avoided	**Plant Derate: 50% load, 48 hours**
Total Value	**$589,187**

POWER OPTIMIZATION CENTER: SUCCESS STORIES

Component **Main Power Transformer**

POWER OPTIMIZATION CENTER: SUCCESS STORIES

Component	**Main Power Transformer**
POC Indication	**High Winding Temperatures**



POWER OPTIMIZATION CENTER: SUCCESS STORIES

Component	**Main Power Transformer**
POC Indication	**High Winding Temperatures**
Action Taken	**Plant notification and subsequent investigation**
Corrective Action	**Cooling pumps and fans returned to service**
Consequence Avoided	**Catastrophic Failure / Major Internal Inspection**
Total Value	**$4,562,520**

ASSETS AND SYSTEMS MONITORED BY THE POC:

Mechanical Systems

Electrical Systems

Performance Models

- Pumps
- Steam Turbines
- Fans
- Chillers
- Air Preheaters
- Pulverizers
- Absorbers
- Scrubbers
- Precipitators
- SCRs
- Combustion Turbines
- HRSGs

ASSETS AND SYSTEMS MONITORED BY THE POC:

Mechanical Systems

Electrical Systems

- **Power Transformers**
- **Generators**
- **Motors**

Performance Models

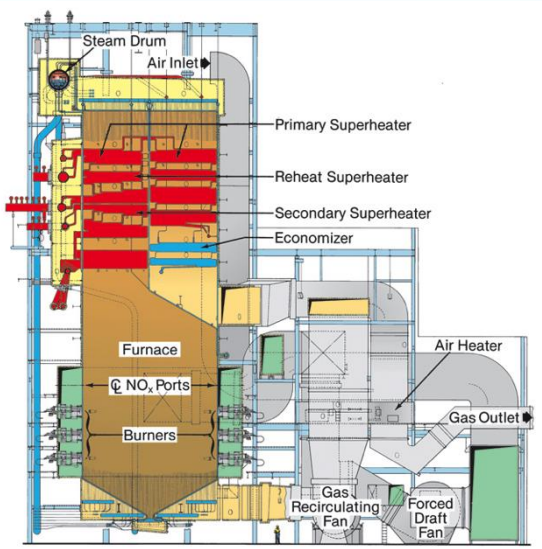
ASSETS AND SYSTEMS MONITORED BY THE POC:

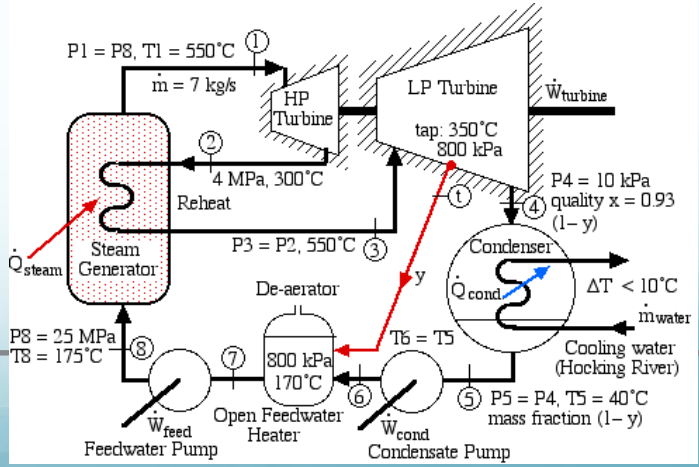
Mechanical Systems

Electrical Systems

Performance Models

- **Plant Thermal Efficiencies**
- **Feed Water Heaters**
- **Condensers**
- **Boilers**
- **Compressors**
- **Heat Exchangers**
- **Steam Generators**





Our Results

- **$178MM** Total Cost Avoidance over 10 years
- **$257MM** Total Fuel Savings
- **1.5MM** Tons of Green House Gas Reductions Annually

> The Future <

Optimizing
Distributed Energy Resources
for
Brazil

Optimizing Utility Value

Smart Grid

Optimizing Supply & Demand

Optimized Utility Operation = **Distributed Energy Resources** + **Transmission & Distribution** + **Demand**

Optimizing Equipment Reliability & Performance

Smart Generation

Advanced Monitoring & Diagnostics enables Smart Generation of Distributed Energy Resources

Next Steps

Next Steps - Explore Benefits of Advanced Monitoring & Diagnostics

Select	Conduct	Initiate	Deploy
Host Utility	Feasibility Assessment	Demonstration Project	Full-Scale Services for Distributed Energy Resources

Luminant

Obrigado..!