



# Productivity Improvements through Electrotechnology application in Industrial Process Heating

## **EPRI**

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# Agenda

- Introduction
- Process Heating - Infrared Technology
- Industry Applications
- Case Study: Utility – Industry Partnership Aids Productivity
- Summary

# About EPRI

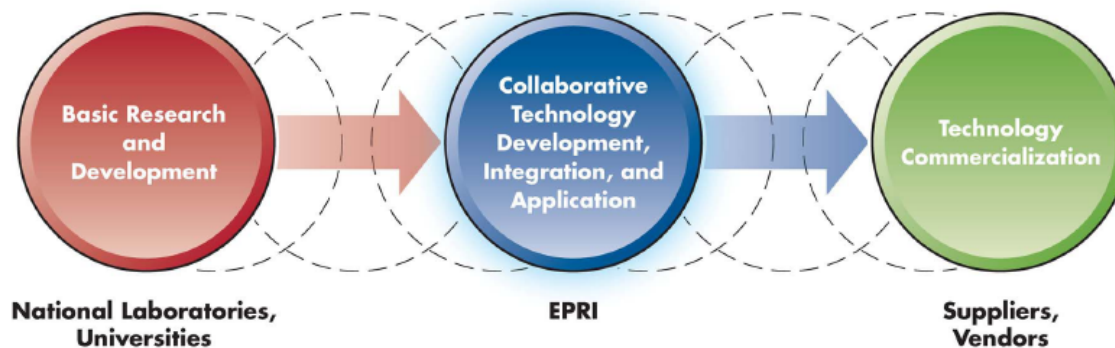
- **Electric Power Research Institute** - Founded in 1973
- **450+** members in more than 40 countries
- **Independent, nonprofit center** for public interest energy and environmental research
- **Collaborative** resource for the electricity sector



***Collaborative  
Value***



***Thought  
Leadership***



***Technology Accelerator!***

# Portfolio Spans the Entire Electricity Sector

			
Generation	Nuclear Power	Power Delivery & Utilization	Environment
<ul style="list-style-type: none"><li>▪ Advanced Coal Plants, Carbon Capture and Storage</li><li>▪ Combustion Turbines</li><li>▪ Environmental Controls</li><li>▪ Generation Planning</li><li>▪ Major Component Reliability</li><li>▪ Operations and Maintenance</li><li>▪ Renewables</li></ul>	<ul style="list-style-type: none"><li>▪ Advanced Nuclear Technology</li><li>▪ Chemistry, Low-Level Waste and Radiation Management</li><li>▪ Equipment Reliability</li><li>▪ Fuel Reliability</li><li>▪ Instrumentation and Control</li><li>▪ Material Degradation/Aging</li><li>▪ Nondestructive Evaluation and Material Characterization</li><li>▪ Risk and Safety Management</li><li>▪ Used Fuel and High-Level Waste Management</li></ul>	<ul style="list-style-type: none"><li>▪ Transmission Lines and Substations</li><li>▪ Grid Operations and Planning</li><li>▪ Distribution</li><li>▪ <b>Energy Utilization</b><ul style="list-style-type: none"><li>▪ <b>Energy Efficiency</b></li></ul></li><li>▪ Cross Cutting Technologies</li></ul>	<ul style="list-style-type: none"><li>▪ Air Quality</li><li>▪ Global Climate Change</li><li>▪ Land and Groundwater</li><li>▪ Occupational Health and Safety</li><li>▪ T&amp;D Environmental Issues</li><li>▪ Water and Ecosystems</li></ul>

# EPRI Industrial Center of Excellence

## Practical Resources for Industrial Productivity



- **Collaborative projects:** Focused Collaborative Project (one per funder) - Industrial EE Facility Audits
- **Industry Application Guides and Tech Briefs:** 2 to 4 per year, topics prioritized by funders
- **Electrotechnology Resource Guide:** Annual update with Topics/Emphasis prioritized by funders
- **Case Studies and Training:** A case study, training, or presentation derived from each collaborative project
- **Coordination:** Federal Government and Industrial Energy Efficiency Programs
- **Website / Hotline / Other Resources:** Maintaining web presence, member inquiry service, and supporting resources.

# About Southern Company (NYSE:SO)

- Super-regional energy company

- Operating revenues: \$17.45 billion
- Nearly 43,000 MW of electric generating capacity; 304 generating units
- **Alabama Power, Georgia Power, Gulf Power, and Mississippi Power**



- Core service area

- 120,000 square miles in 4 Southeastern states (GA, AL, MS, FL)
- 4.4 million customers

- Member of Electric Power Research Institute (EPRI) supporting various research activities

**One of the largest producers of electricity in the U.S.**



# Technology Applications Center (TAC)

TAC works with Resource Partners to:

- Understand new technologies that could potentially help our customers
- Equipment donation
- Provide facility for vendor – extended sales office
- Assist them in finding new market opportunities



# Advantages of Using the Regional Testing Facility

## ■ Industrial Customer Advantages:

- Less travel
  - More personnel from a particular facility can see the testing and results at the same time.
- Neutral facility – no sales pressure from vendors
- Fuel and Vendor neutral

## ■ Vendor Advantages:

- Customer exposure
  - Leads to customer contacts & decision makers
- Produce quality unbiased test results – Validate Claims
- Quoting opportunities & Equipment testing

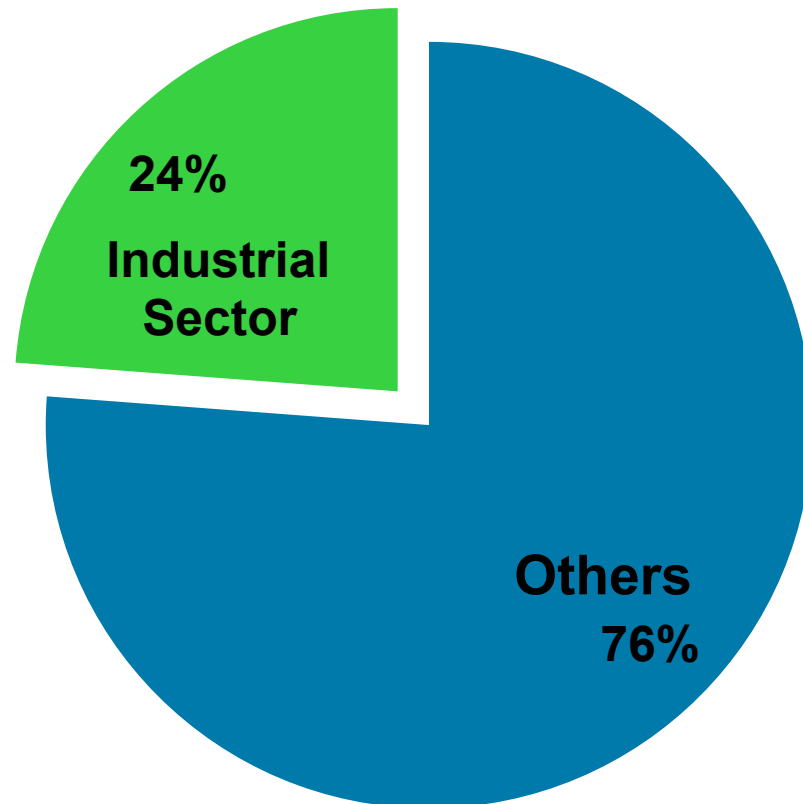


# Overview of Industrial Sector in USA



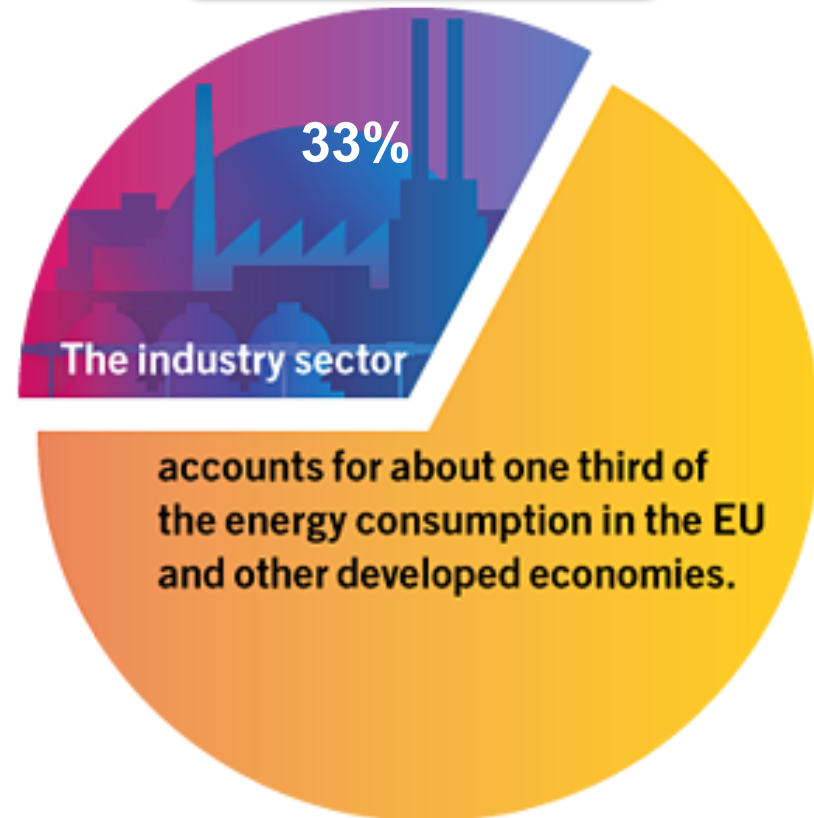
# Total Annual Primary Energy Usage in Various Sectors

**USA**



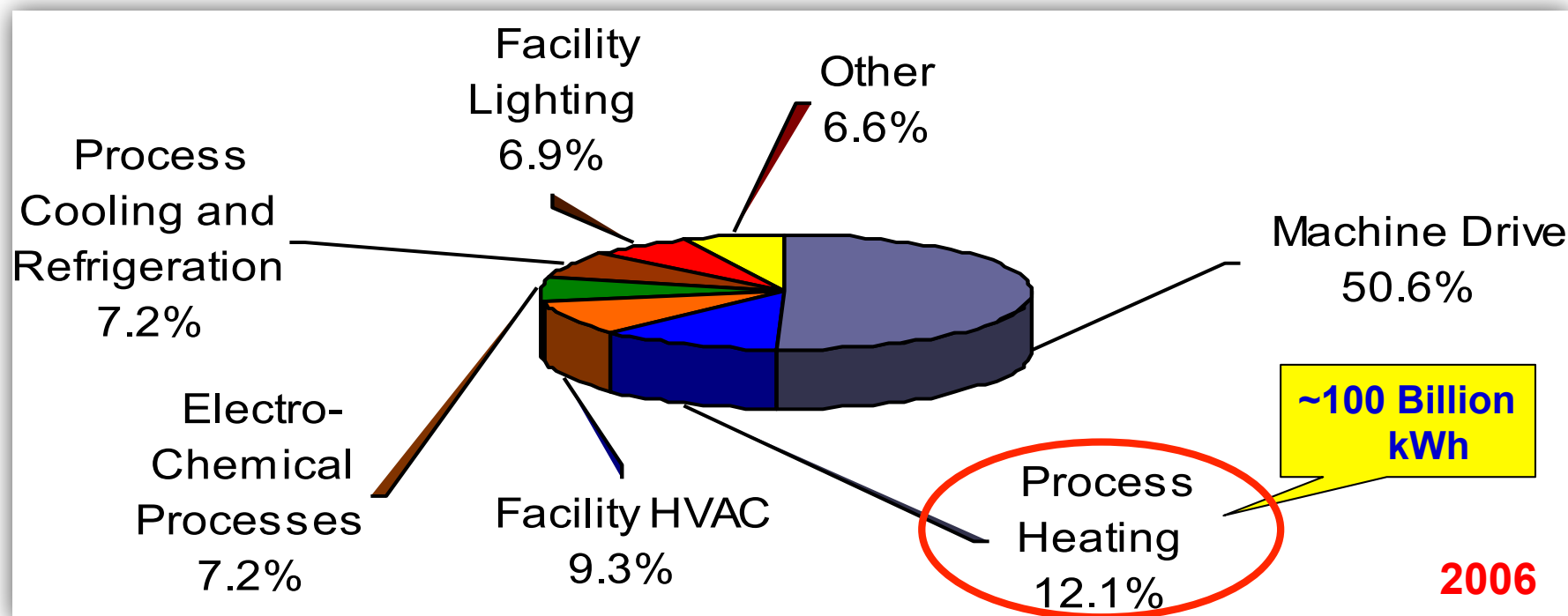
Source: DOE Annual energy Outlook 2010

**EUROPE**



Source: ECEEE 2012 ([www.eceee.org/industry](http://www.eceee.org/industry))

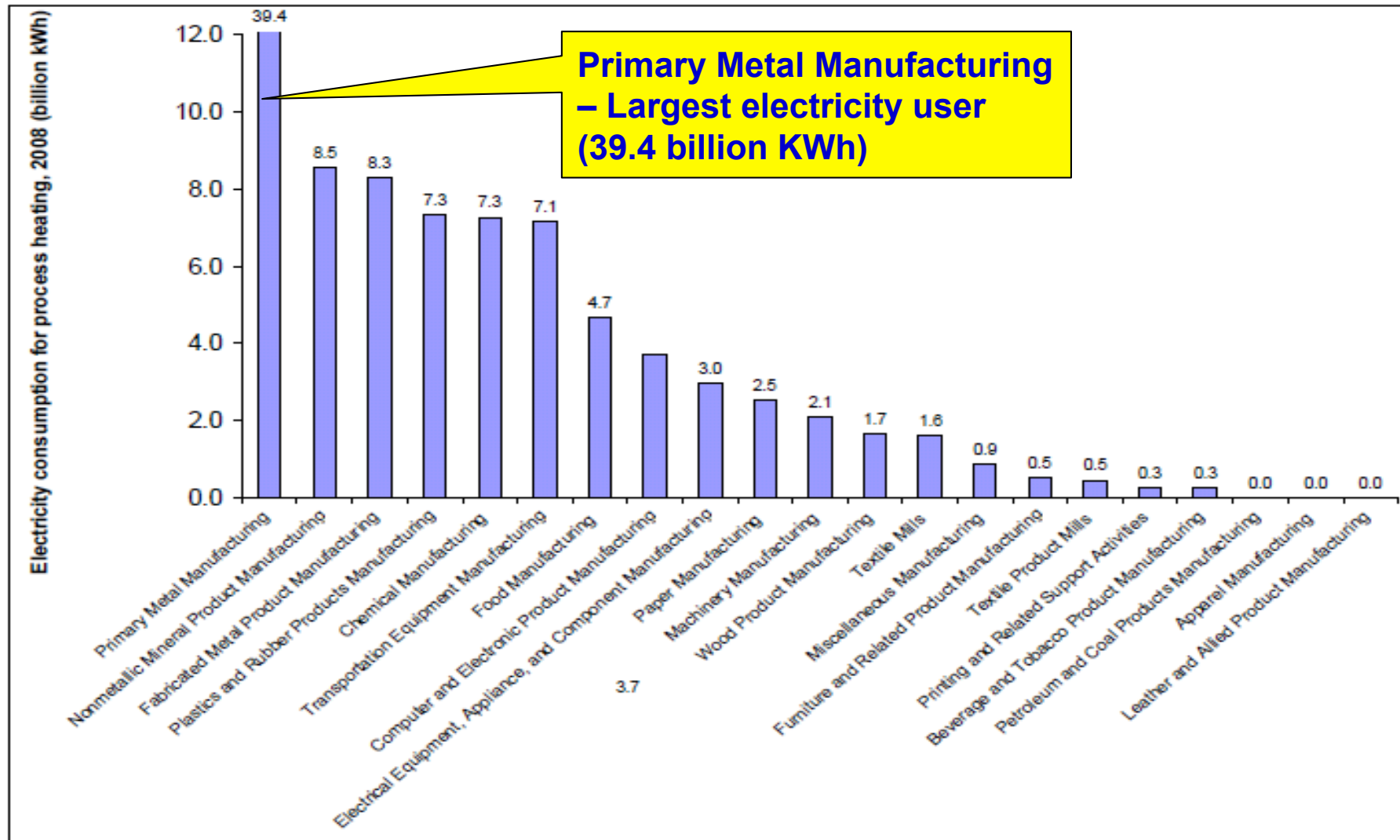
# Industrial Net Electricity Consumption (End Use)



- Process Heating uses **12.1%** of total net electricity in manufacturing
- Total Industrial Net Electricity Consumption  
**= 2,850 Trillion Btu (= 835 Billion kWh)**

• Source: Energy Information Administration, 2006 Manufacturing Energy Consumption Survey

# Process Heating - Electricity Use by Industry Sector

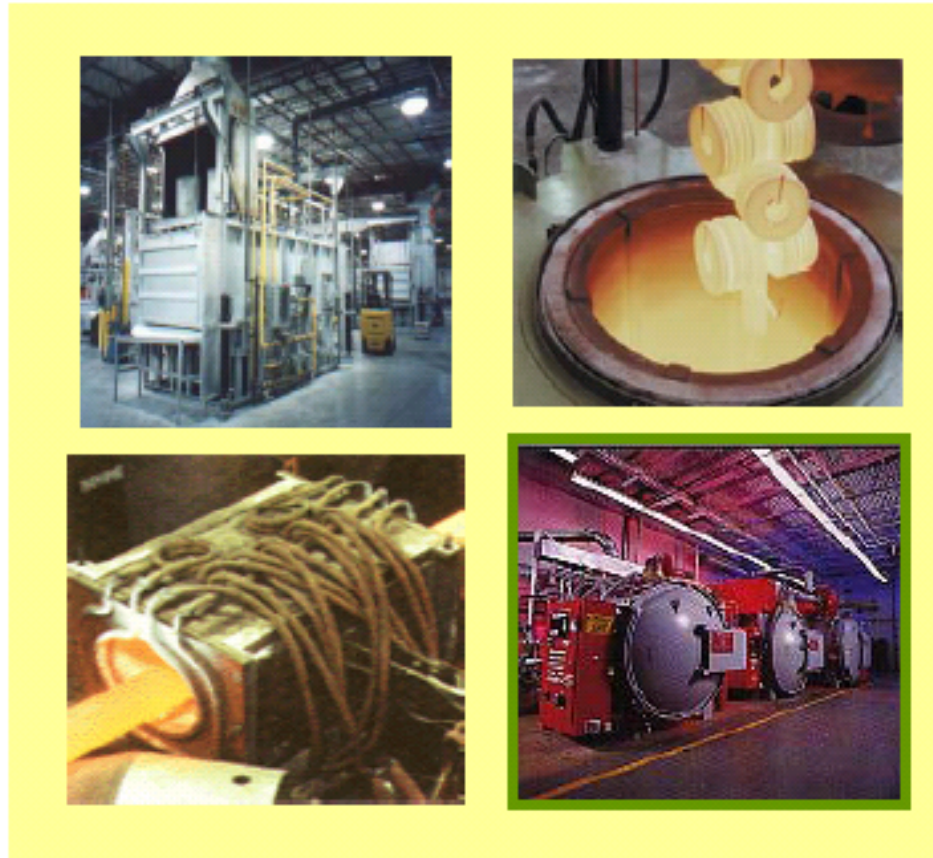


Source: *Electrotechnology Reference Guide*. EPRI, Palo Alto, CA: 1022334.

# Process Heating Basics & Infrared Technology Applications



# What is Process Heating?



## Supplying heat to materials in

- ❑ Furnaces
- ❑ Ovens
- ❑ Heaters
- ❑ Thermal oxidizers
- ❑ Dryers
- ❑ Boilers
- ❑ Other heating equipment

Source: U. S. Department of Energy -Energy Savings Assessment (ESA) Process Heating Assessment and Survey Tool (PHAST) Introduction, Arvind Thekdi, 2007



# Process Heating System Components

- **Heating devices:** generate and supply heat
- **Heat transfer devices:** move heat from source to product
- **Heat containment devices:** e.g. furnaces, heaters, ovens
- **Heat recovery devices**
- **Support Systems:** e.g. sensors and controls, materials handling, emission control, safety, other auxiliary systems

# Categories of Process Heating

- Combustion-based

Boilers and steam generators

Atmosphere generators

Blast furnaces

Crucible furnaces

Dryers

Indirect process heaters

Kilns

Muffle furnaces

Ovens

Radiant tube heat treat furnaces

Reverberatory furnaces

Salt bath furnaces

Solid waste incineration

Thermal oxidizers

- Heat recovery and heat exchange

- **Electric Processes**

Resistance

Induction

Plasma Arc

Electromagnetic Waves

- **Infrared (IR)**

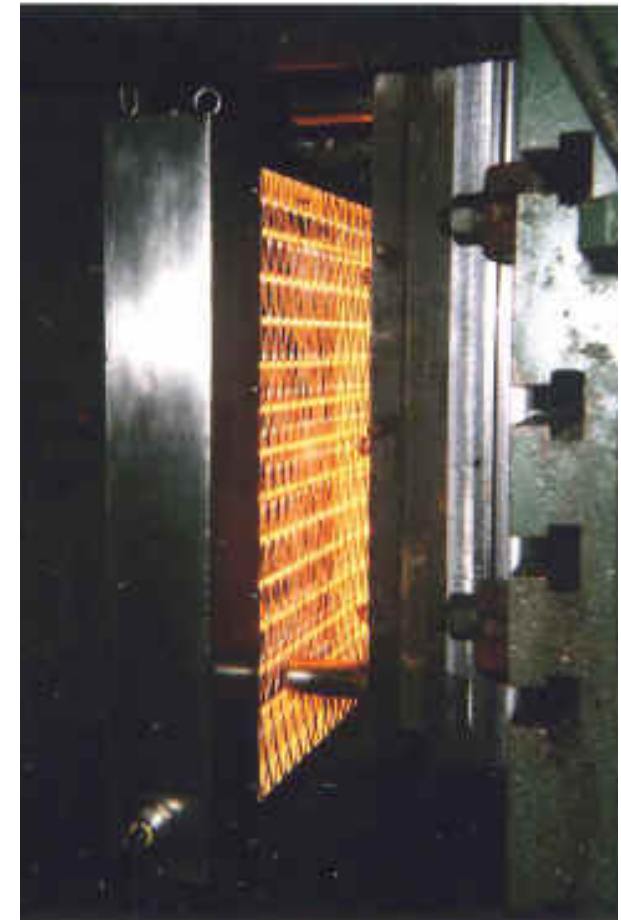
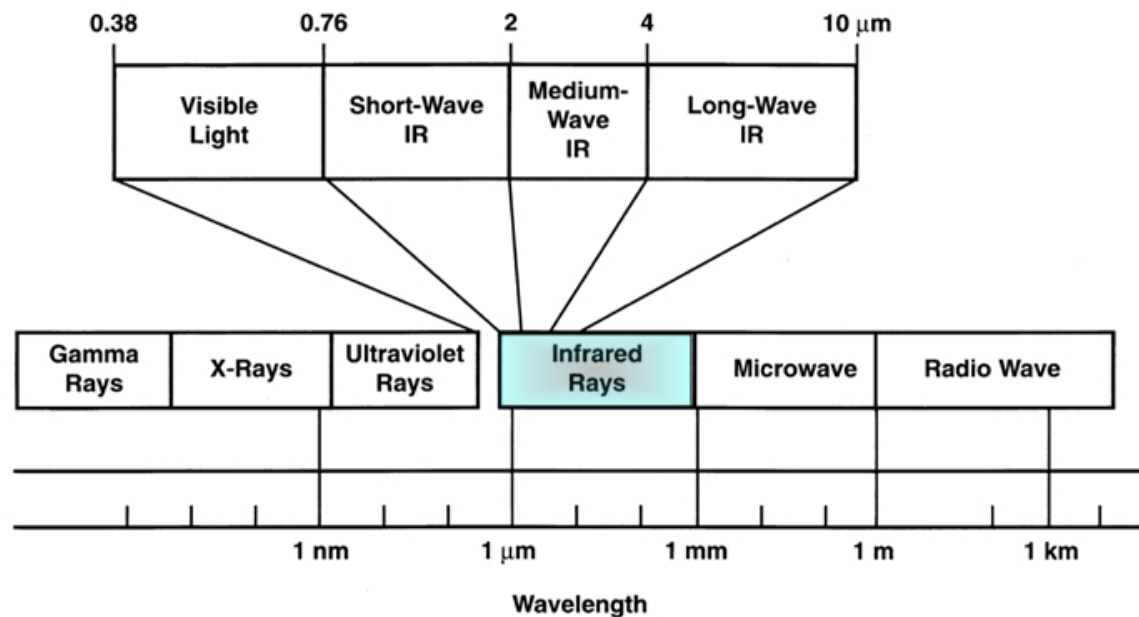
- Microwave (MW)

- Radio Frequency (RF)

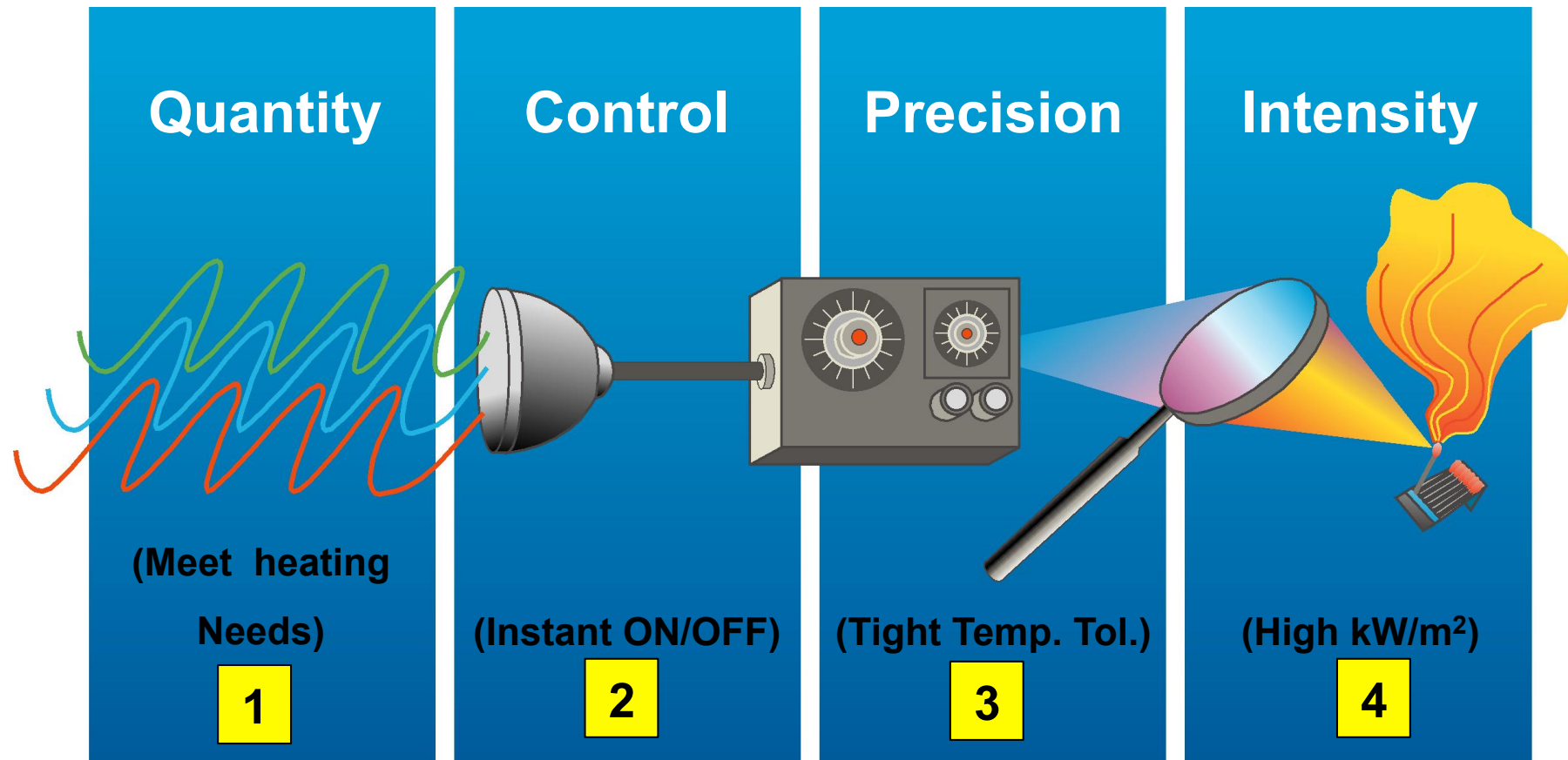
- Ultraviolet (UV)

# Infrared Heating

- Wavelength range 0.76 – 10 microns
- Line-of-sight technology
- Suited for surface heating applications



# Electric IR – Characteristics



# Infrared Efficiency and Response Time

Type	Wavelength (mm)	Max. Heat Flux (kW/m <sup>2</sup> )	Max. Radiant Efficiency (%)	Response Time * (sec.)
Electric Short Wavelength	1.0-1.5	400	75-85	1-3
Electric Medium Wavelength	2.0-3.0	100	50-80	30-120
Electric Long Wavelength	3.0-6.0	50	30-70	60-240
Gas Flame Impingement	2.0-3.0	400	30-40	30-60
Gas Ported Ceramic Tile / Ceramic Fiber	2.0-3.0	250	40-50	20-80
Gas Ceramic Foam / Metal Fiber	2.0-3.0	400	35-45	10-30
Gas Catalytic	3.0-6.0	50	35-40	30-60 (20 min. start-up)
<p>Response times indicate time required to move between 20% and 100% of maximum rated radiant output.</p> <ul style="list-style-type: none"> <li>• For electric units, this would be close to the start-up time.</li> <li>• For gas units, start-up will be somewhat longer due to time required for the flame safety sequence (typically 2-15 sec.).</li> <li>• For gas catalytic, the start-up is significantly longer since the catalyst needs to be electrically heated prior to ignition</li> </ul>				

# Infrared Benefits

- Immediate turn on/off
- Full output obtained within seconds to few minutes
- Reduced environmental concerns (no point emissions)
- Energy efficiency 50-80%





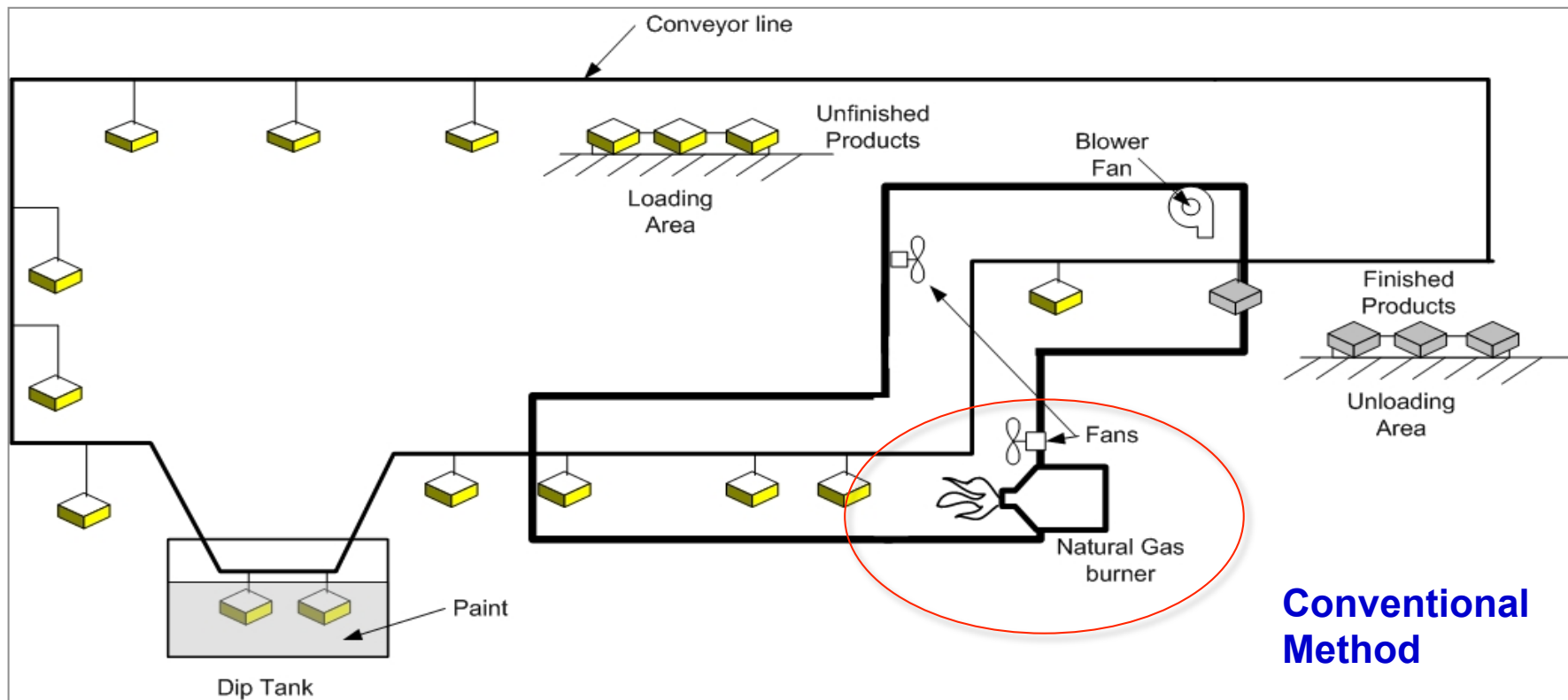
# Infrared: Applications

- Textile and Paper industry for drying
- Latex and adhesive drying
- Annealing and curing of rubber
- Powder coating of metal (automobile industry)
- Preheating cast aluminum wheels
- Heating aluminum strips prior to bending
- Ink curing
- Drying of parts
- Fine soldering
- Silk screening
- Molding plastics by blowing, vacuuming, squeezing the plastic between calendar rolls

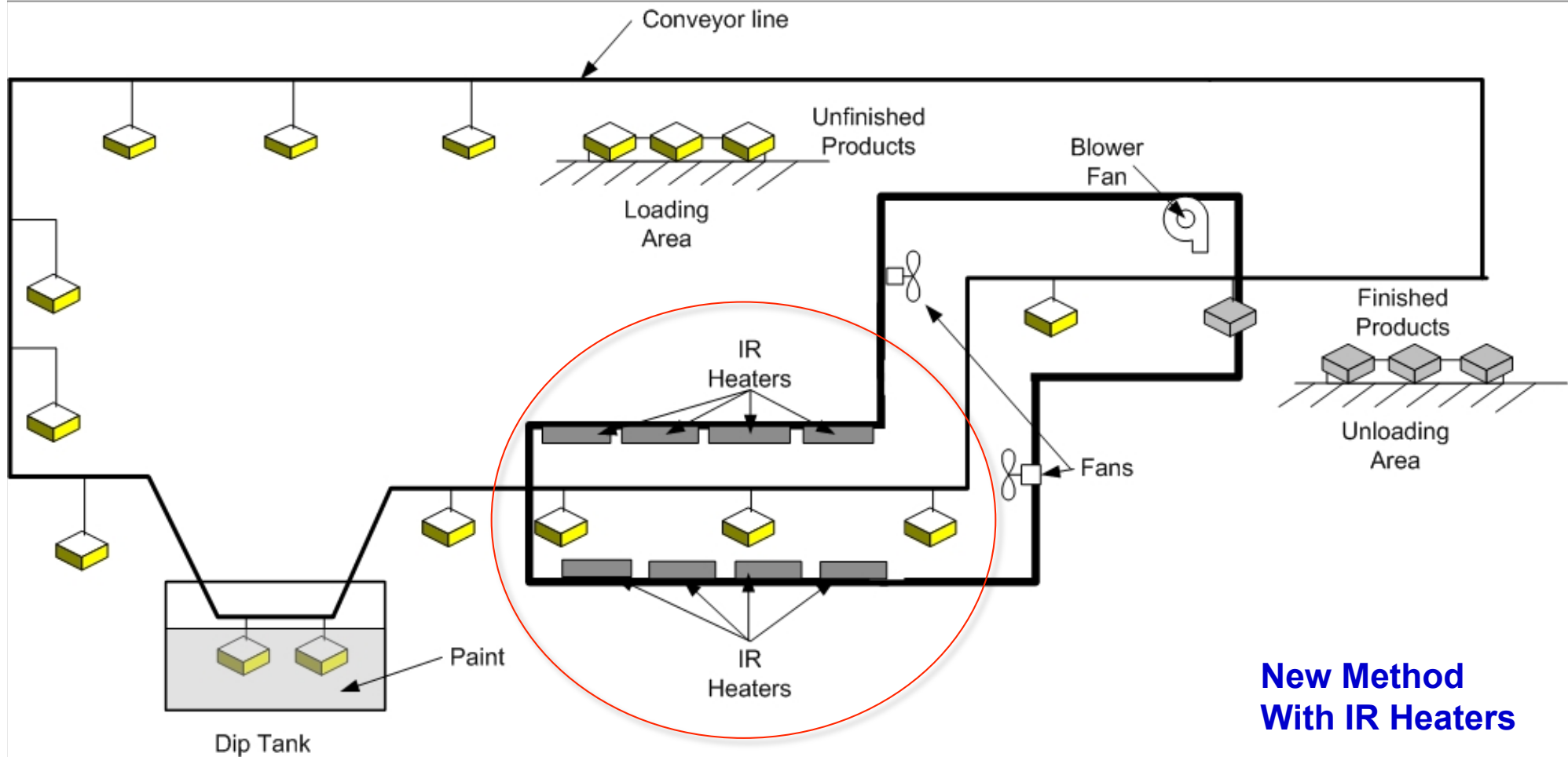
# Case Study: Improved Productivity through Utility-Industry Partnership

## Curing of Paint in a Pipe Fitting Plant (Foundry Operation)

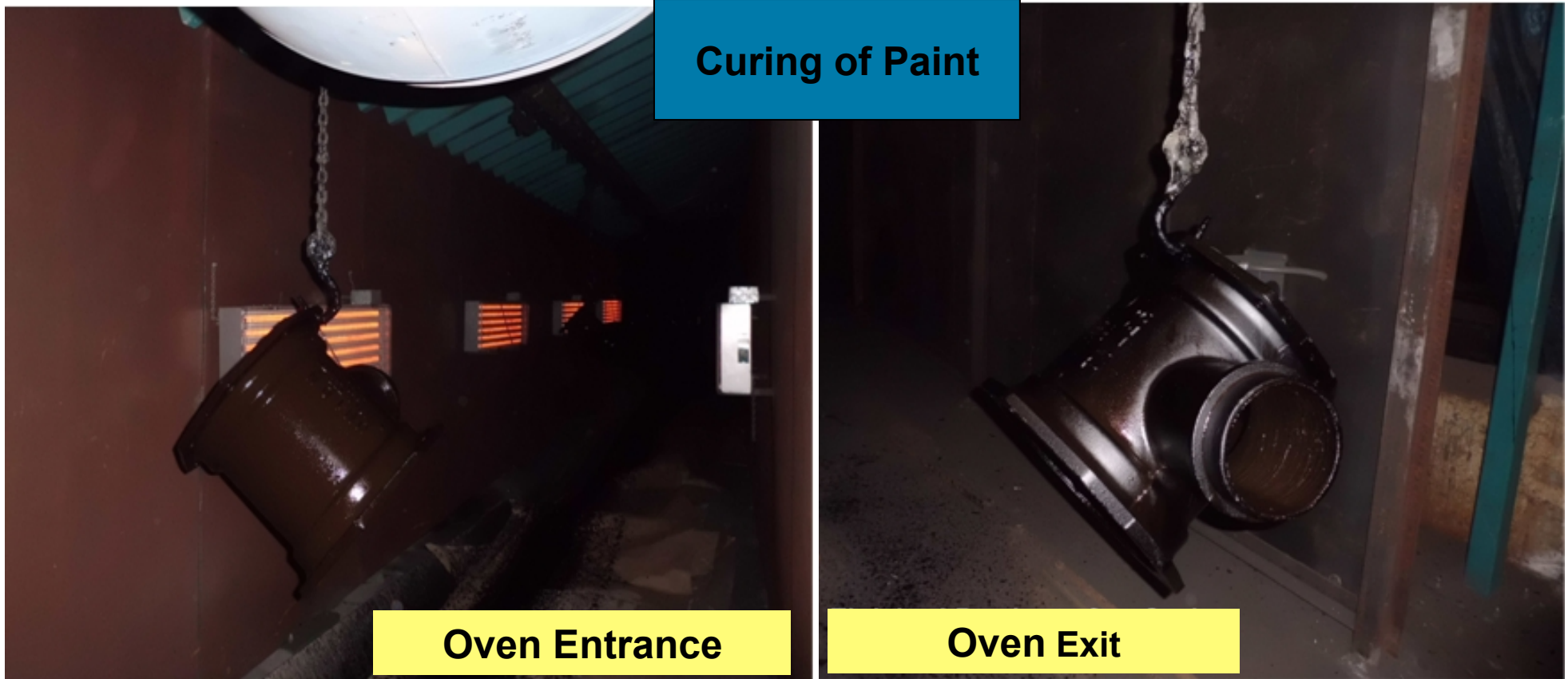
- **Challenge:** Natural gas (NG) burner/ blower system was having problems leading to production line shutdown.
- **Solution:** Replaced NG system with electric IR Heaters



# Case Study: Modified Process Flow Diagram



## Case Study: Results (1/2)



## Case Study: Results (2/2)

- Production line back in operation
- Cost of IR heater = \$1000 (€ 760)
- Total cost of all heaters including installation = \$10,000 (€7600)
- **Payback time less than 1 year**
- **Avoided expenses:**
  - Maintenance cost
  - Burner replacement cost
  - Loss of production cost
  - 100's of man-hours used by maintenance crew per year
- Set Temp. reached in < 1 min (new) rather than 20 min (old)
- **Increased Productivity**
- **Reduced on-site emissions**

# Summary

- Create awareness about various applications to customers
- Share documented benefits with customers
- Proof of Concept Demonstrations:
  - Decrease fear & Increase Belief of Industrial Customers
- Educate customers about operating cost Vs. first cost
- Utility – industry partnership help increase productivity as well as increase the process efficiencies





# Thank You!



# Together...Shaping the Future of Electricity

# Alabama Power – Examples of Industrial Customers

- Nexel: spinneret burn-off
- Rheem Mfg.: cure coating on water heaters
- Talladega Castings: IR mold drying
- Steel Scape: cure primer on coil steel



**Example of an Alabama Power's Customer**