

Mission Critical Electric Heat Tracing Solutions to Support the Energy Transition



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November 8, 2023



Agenda

- nVent Overview
- Industry and the Energy Transition
- High Power Retention (HPR) Technology Supporting the Energy Transition
- Heat Management System (HMS) Applications/Challenges in the Energy Transition
- Q&A



MISSION CRITICAL ROLE IN ENERGY TRANSITION



Energy Transition

We connect and protect

Our Mission



At nVent, we believe that safer systems ensure a more secure world. We connect and protect our customers with inventive electrical solutions.



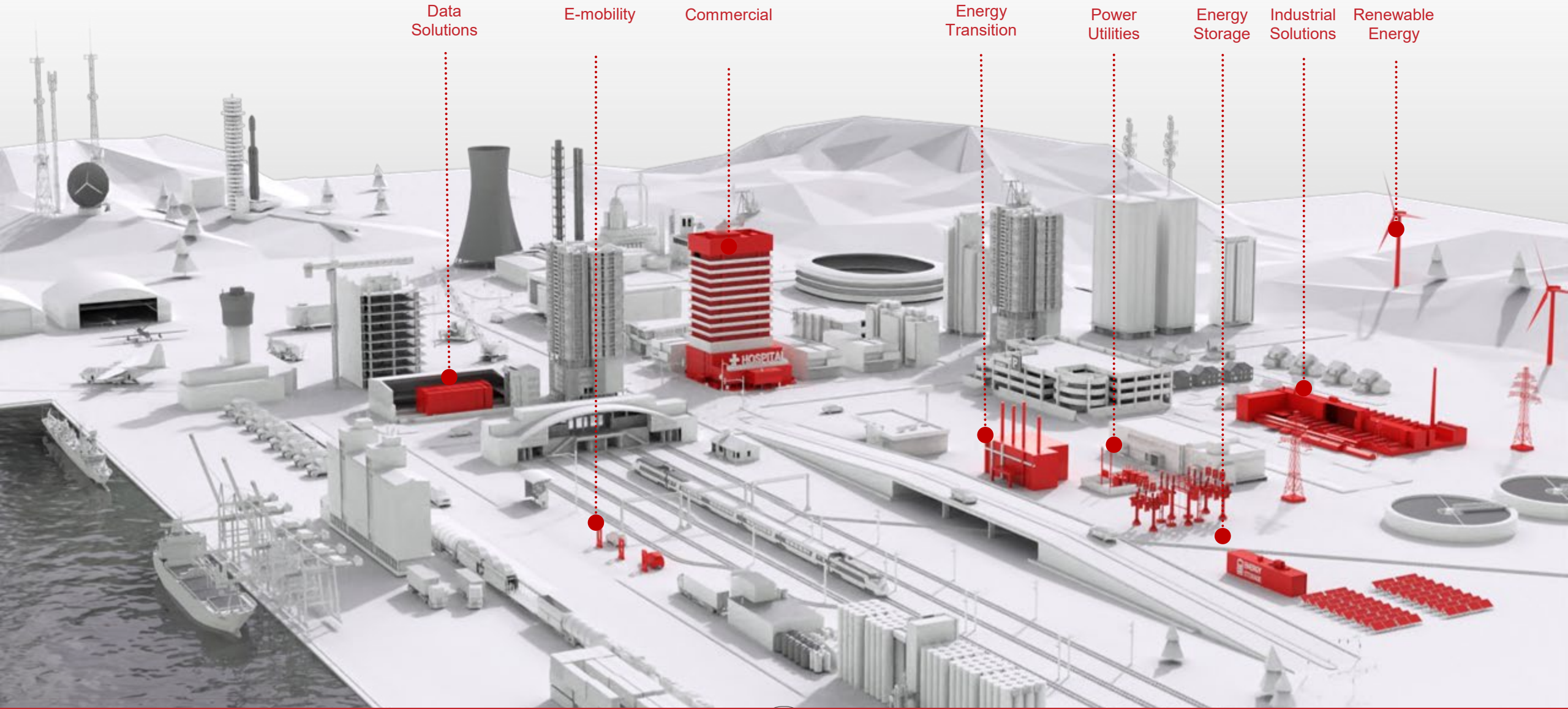
nVent Business Segments

Enclosures

Electrical & Fastening Solutions

Thermal Management

Connecting and Protecting The Electrification of Everything



Explore our virtual world tool on nVent.com

Building a more **SUSTAINABLE & ELECTRIFIED** world



Thermal Management:

Save on Total Installed Cost

with advanced engineering and ease-of-use products and tools.



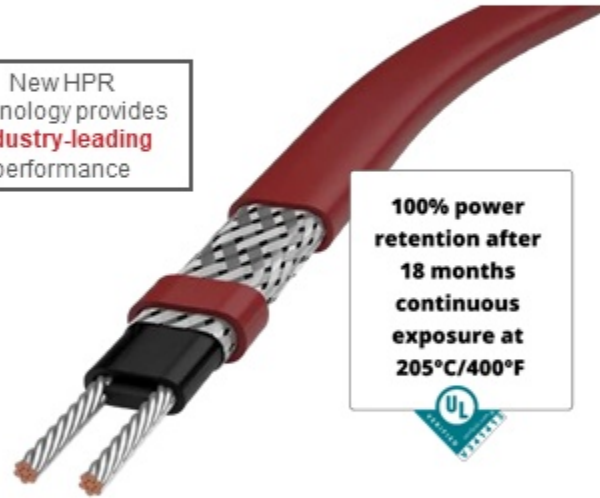
nVent RAYCHEM
TRACERLYNX
Software

nVent TracerLynx software supports >\$200M sales and delivers **cost and energy savings**.

Prevent Downtime

with reliable solutions and services.

New HPR technology provides **industry-leading** performance



100% power retention after 18 months continuous exposure at 205°C/400°F

Restricted pipe flow can shut down a facility, and **downtime costs millions of dollars** per day.

Save on Operating Cost

with smart controls.



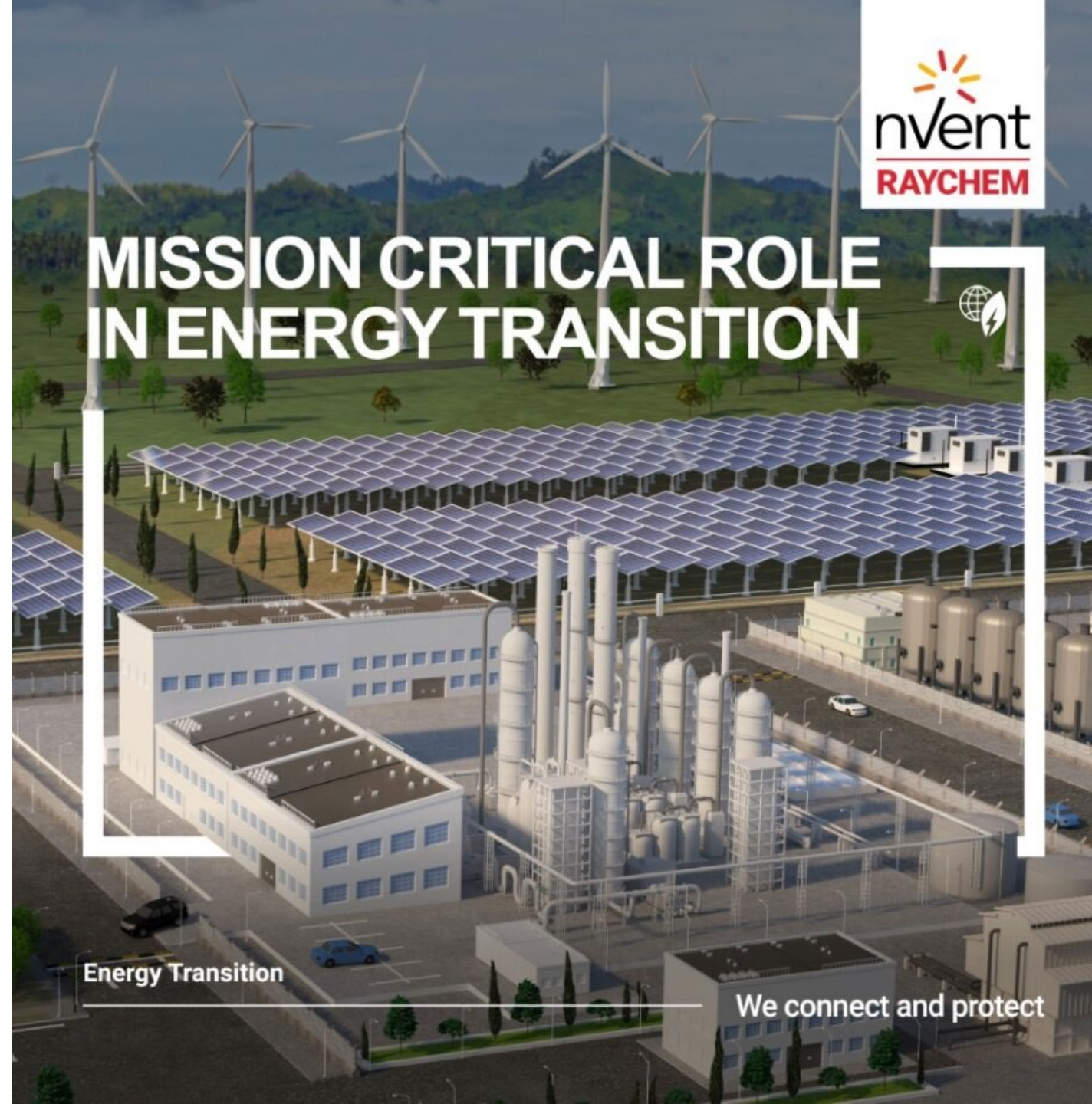
nVent RAYCHEM
Elexant Controls

70% energy savings for freeze protection systems with our controls versus uncontrolled systems.*

Driving growth through strong value propositions

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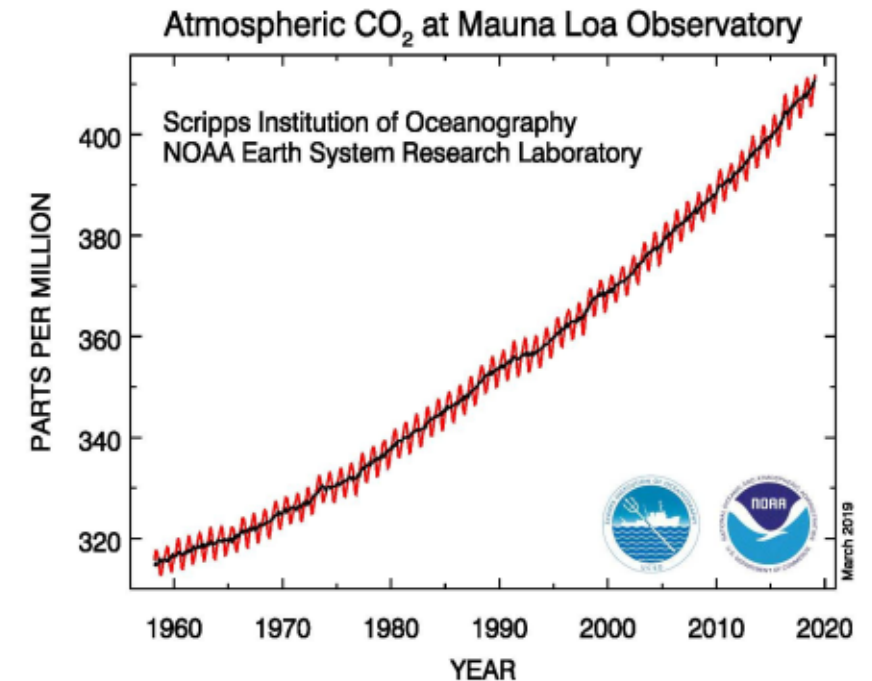


Energy Transition

We connect and protect

Why the Energy Transition?

- CO₂ levels have increased over 20% in the last 40 years
- Greenhouse gas effect
- Flue Gas and process vents from power and industry
As an example:
 - Flue gas composition in the power industry:
 - Heavy oil 14.5% CO₂
 - Coal 13.6% CO₂
 - Nat Gas 9.1% CO₂
- Industry includes steam methane reforming i.e., H₂ and NH₃
- Cement industry contributes CO₂ released through the clinker process
- Ethanol through fermentation



Air we breathe is 0.04% CO₂ today

Why Energy Transition Now?

- **Global warming**

- CO2 levels increasing
- Green-House Gas (GHG) effect on climate

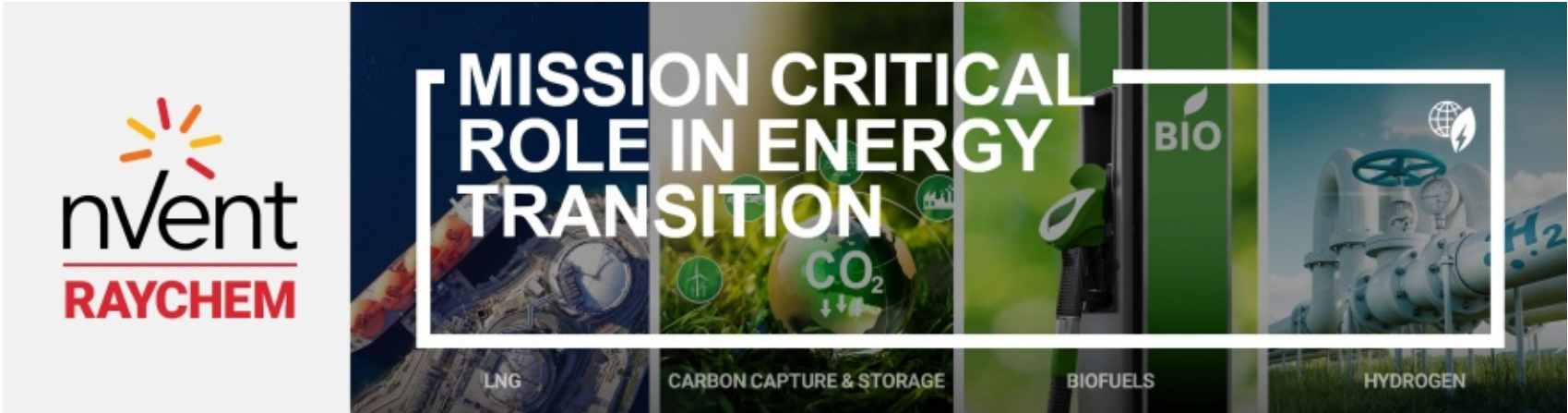
- **UN global framework “Paris Agreement” (2016) :**

- Legally binding goal to keep the global average T(°C) rise below 2°C above pre-industrial levels
- Committed to net-zero emissions by 2050

- **Governmental Incentives**

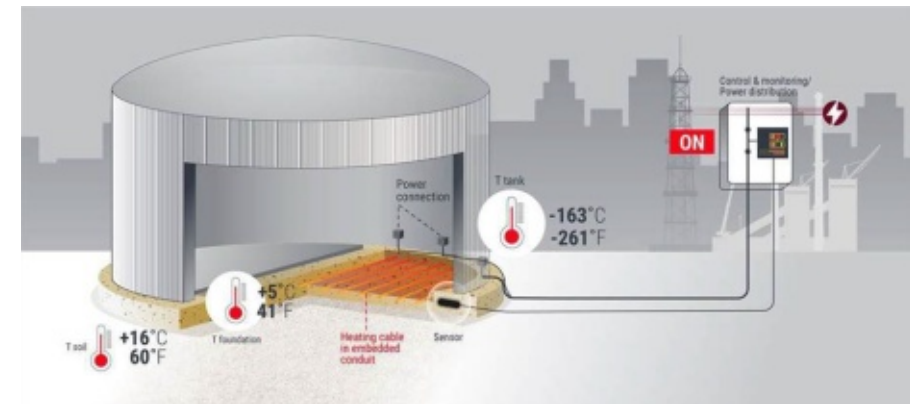
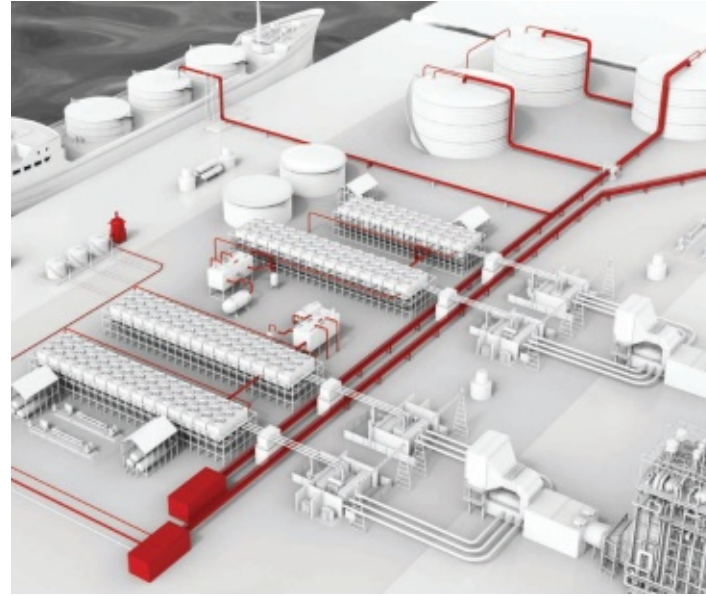
- US Infrastructure Act (IIJA) and Inflation Reduction Act (IRA) include \$20 billion for CCUS incentives/tax credits
- Canadian government set aside C\$3.8 billion for CCUS programs (e.g., Shell Quest received C\$873 million from CAN and Alberta government)
- Europe Green Deal & Net Zero Industry Act foresee incentives over next 10 years in CCUS technologies
- Many other national/regional incentives ...





LNG

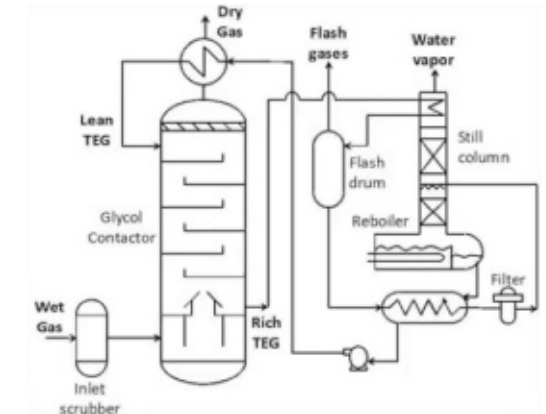
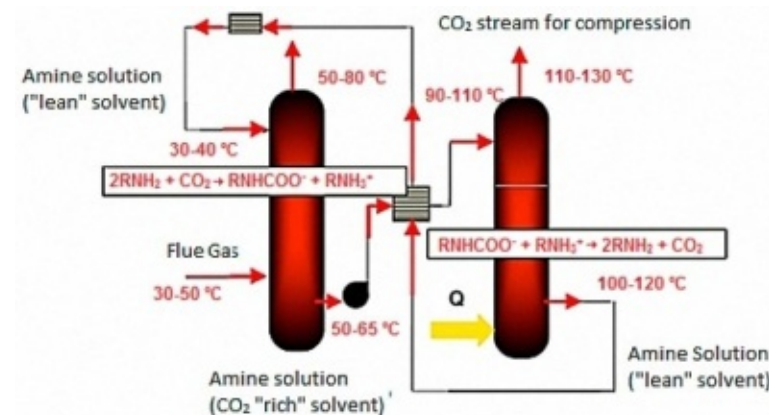
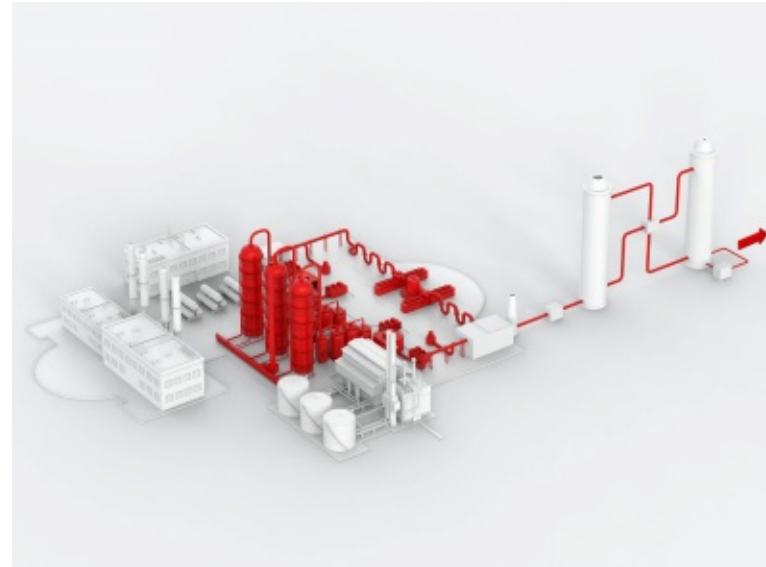
- Liquified Natural Gas
- Methane cooled to -162°C (-260°F) ($1/600^{\text{th}}$ original volume)
- Liquefaction and Regasification
- HMS Applications
 - Power Plant
 - Compressor trains
 - OSBL
 - LNG Storage tanks



Supply natural gas to the world

Carbon Capture and Storage (CCS)

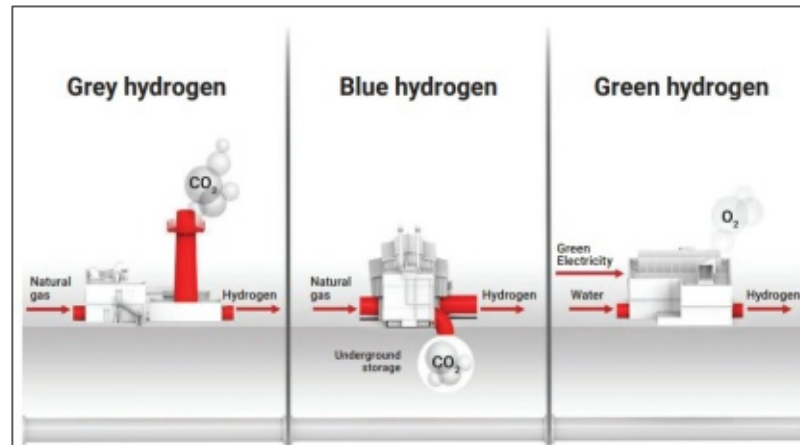
- Industries pursuing CCS
 - Hydrogen -Power
 - Ammonia -Cement
 - Steel -Petrochemical
 - Refining -Ethanol
- Pre and post combustion technologies
- Absorption, Adsorption and Membrane processes
- Geological formation storage
- HMS Applications
 - Utilities
 - Gas Treating Amine system
 - Dehydration system



Lower carbon footprint of industry

Hydrogen

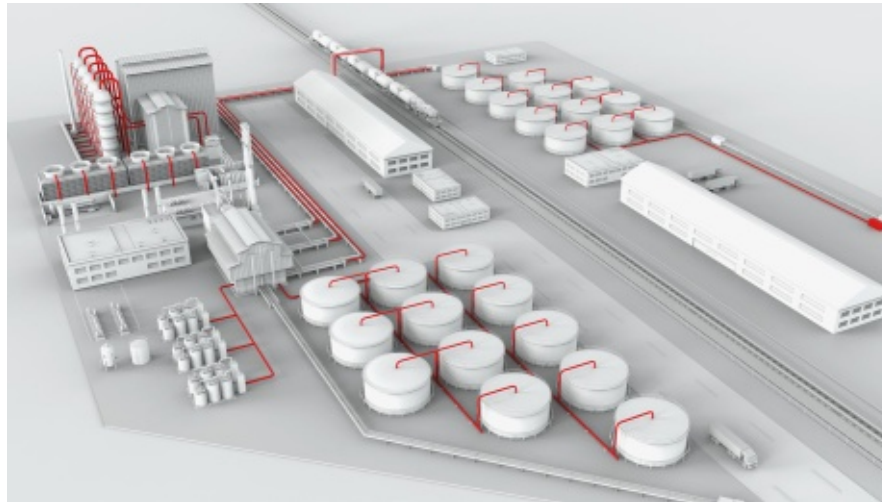
- Lightest element and most abundant in the universe
- Only exists in compounds on earth
 - Water H₂O, methane CH₄, Coal, petroleum, biomass
- SMR Process - >95% of hydrogen today
- Demand
 - Refining, fertilizer, petrochemical, biofuels, clean fuel
 - Energy carrier – e-methanol, e-ammonia
- HMS applications
 - Utilities



Ongoing industry support and clean fuels

Biofuels

- Ethanol
 - fermentation of corn, wheat or barley
- Biodiesel
 - transesterification of plant oils and animal fats
- *Renewable diesel
 - Hydrotreating of plant oils, animal fats and used cooking oil
- *Sustainable Aviation Fuel (SAF)
 - Feedstocks like renewable diesel
- HMS Applications
 - Utilities
 - Feedstocks
 - Finished products

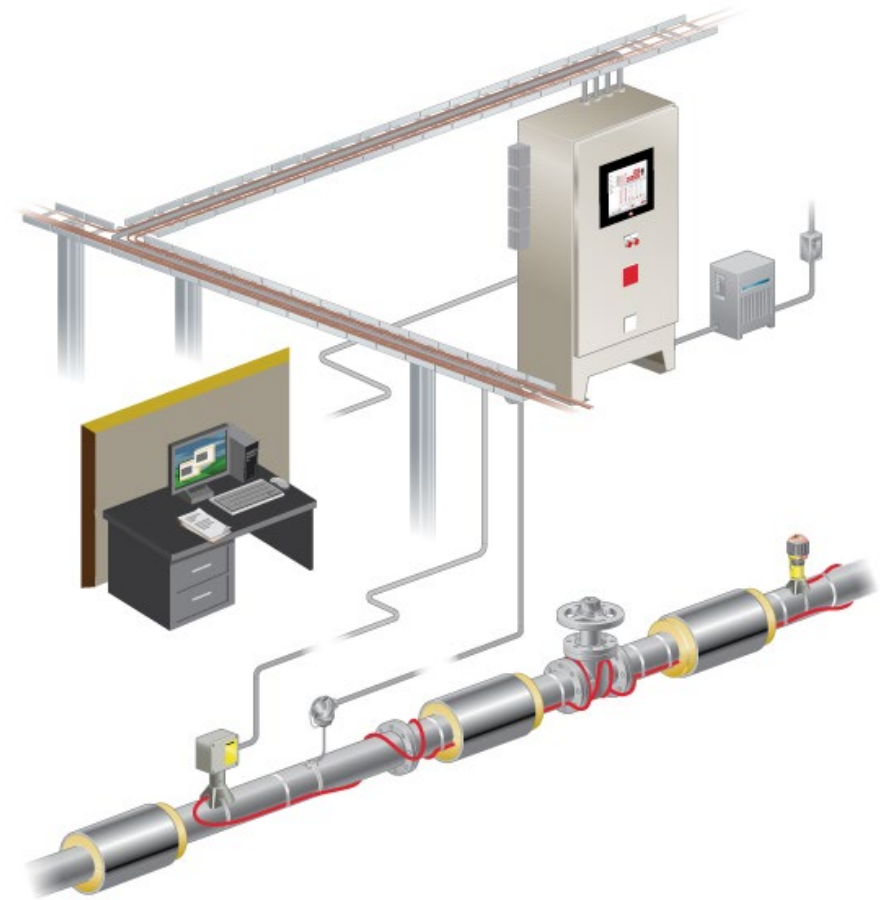
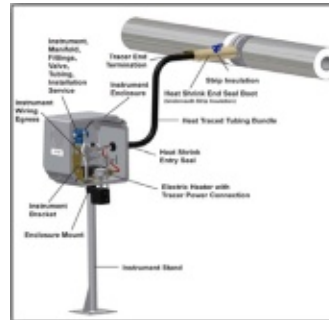


New refineries and refinery conversions

*require supplemental hydrogen

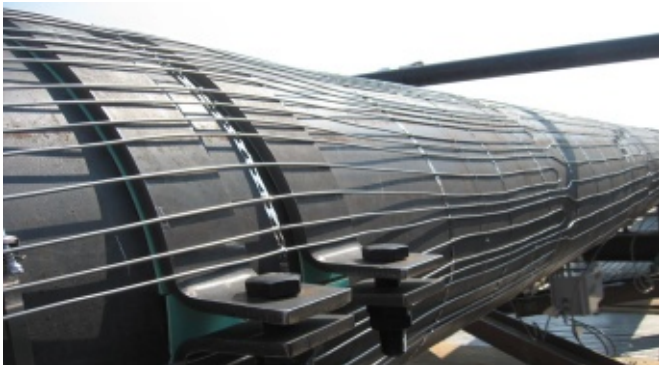
Energy Transition Heat Management Is A Complete System

- Industrial plants have processes that require heat tracing for freeze protection and process temperature maintenance to keep the plant running efficiently
- An electric heat tracing system consists of:
 - Engineering
 - Heating Cables
 - Connection kits and accessories
 - Power Distribution / Control and Monitoring
 - Supervisory Software
 - Connect and Communicate
 - Thermal Insulation
 - Instrument Winterization



Reliability is essential

Industrial Electric Heat Tracing



Freeze Protection and Process Maintenance

What can go wrong!



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MISSION CRITICAL ROLE IN ENERGY TRANSITION



Energy Transition

We connect and protect

Agenda

1. Self-regulating cables
2. High temperature and High Power Retention (HPR) self-regulating cables
3. High Temperature Self Regulating and the Energy Transition
4. Summary



MISSION CRITICAL ROLE IN ENERGY TRANSITION



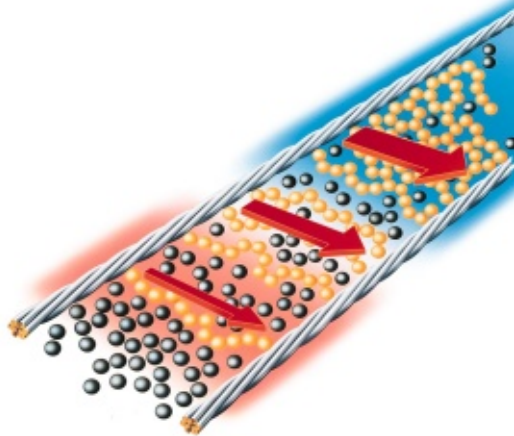
Energy Transition

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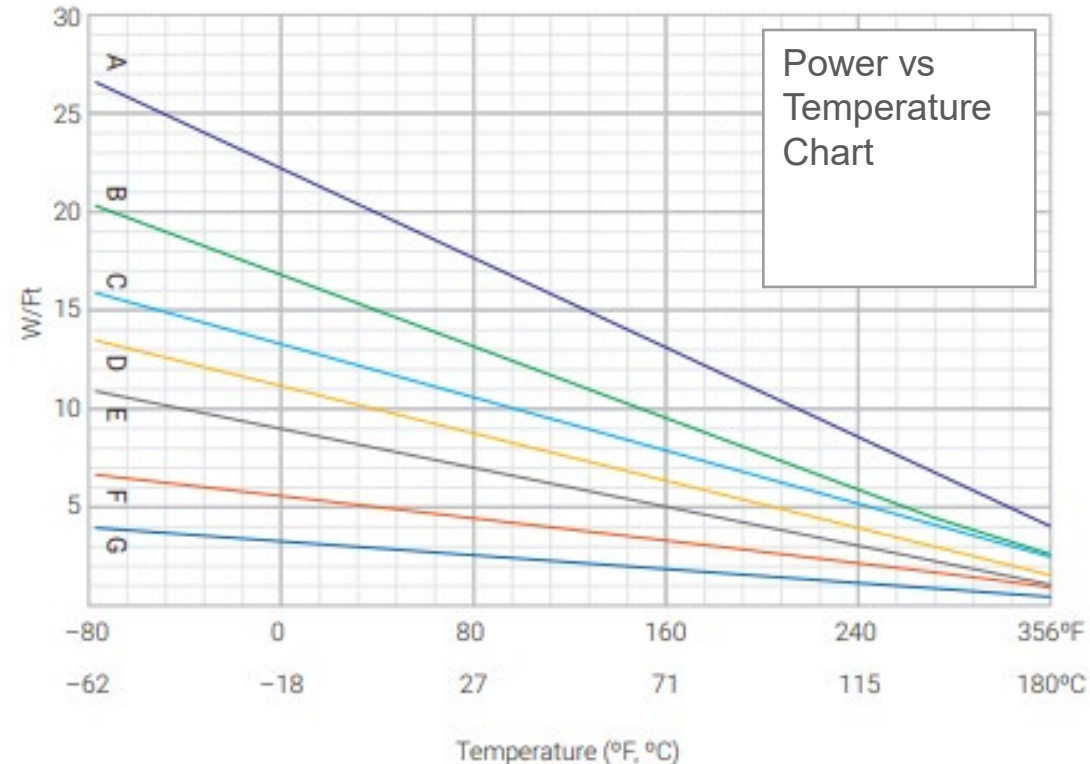
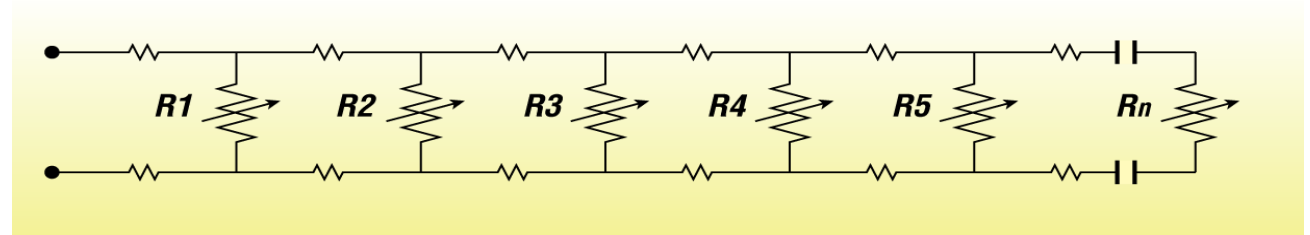
Most Applicable Heat Tracing Cable Technology for the Energy Transition

▪ Self-regulating technology

- 50+ years old and still evolving
- Parallel electric circuits
- Conductive polymer core that generates heat
- Manages cold and hot spots of process
- Inversely vary power output in response to temperature of pipe or equipment



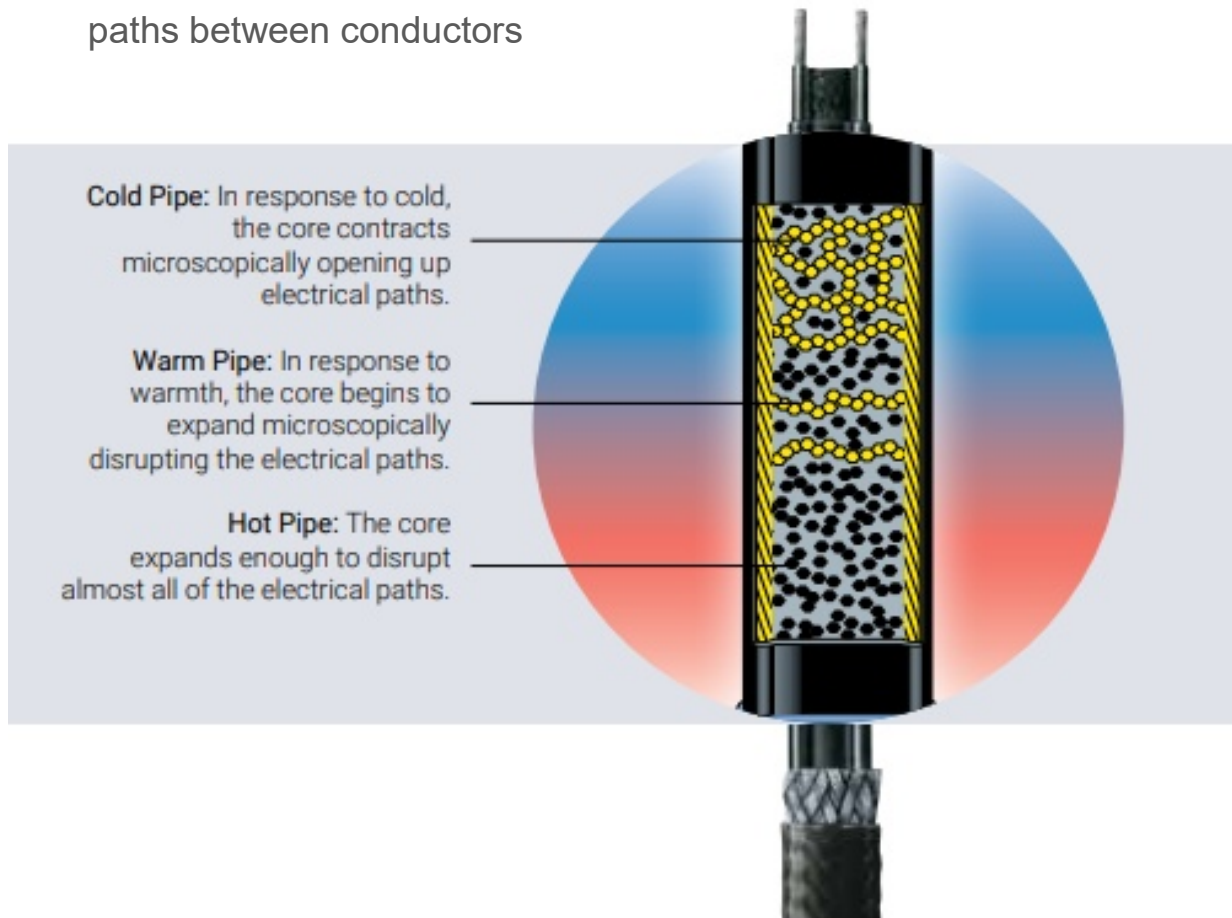
- But how does it work?



Self-Regulating Heat Tracing Technology

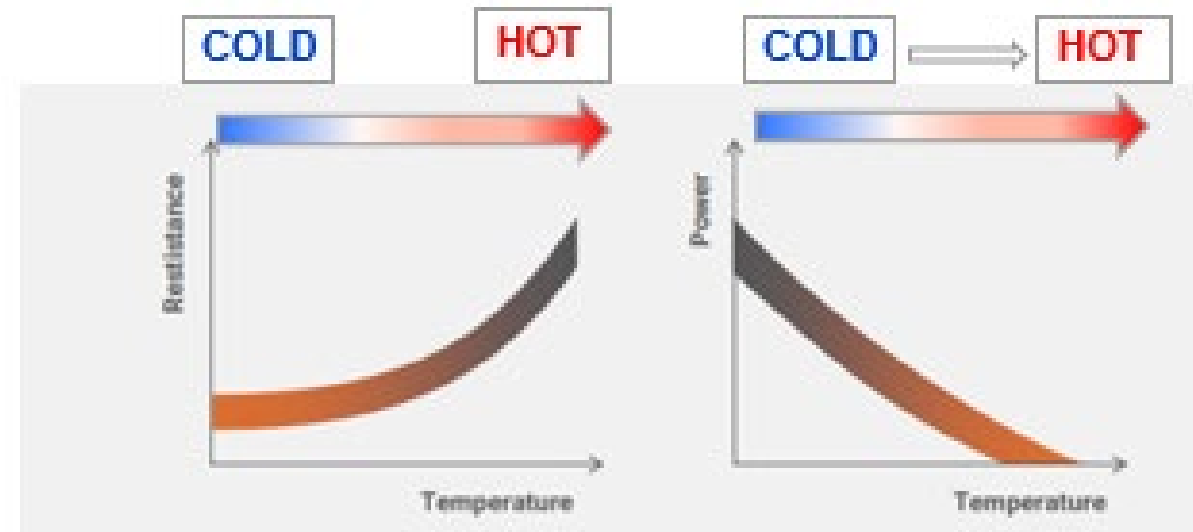
The Core = Mixture between insulating polymer & conductive carbon black

- Carbon black creates conductive paths between conductors



As pipe temperature increases, resistance increases and power output decrease

- Cold pipe sections get more heat input
- Warm pipe sections get less heat input



Self-Regulating Design, Installation and Operation

▪ Design

- Easy to design, unconditional T ratings
- Self-regulating technology compensates for local heat loss and voltage variations making pipe temperature as uniform as possible (ideal for temperature sensitive fluids)
- Parallel construction means cable can be cut to length (power output per ft (m) not affected)
- Heat tracing always in later stages of project when schedules are compressed

▪ Installation

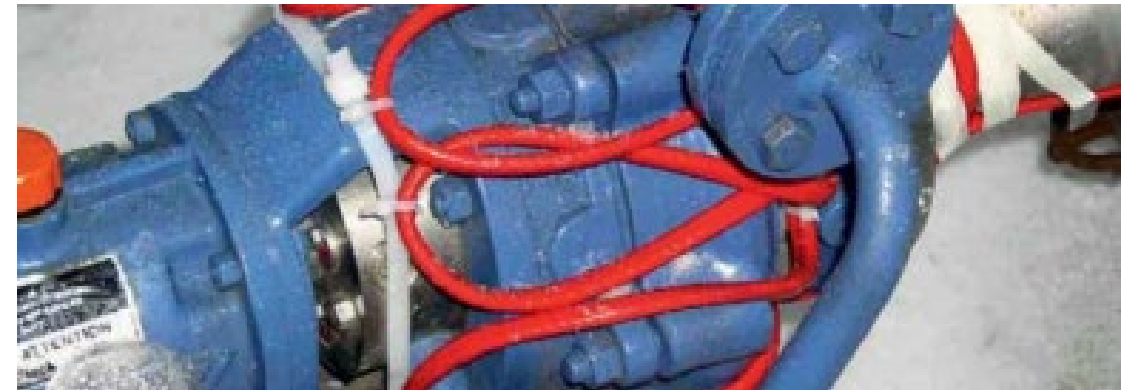
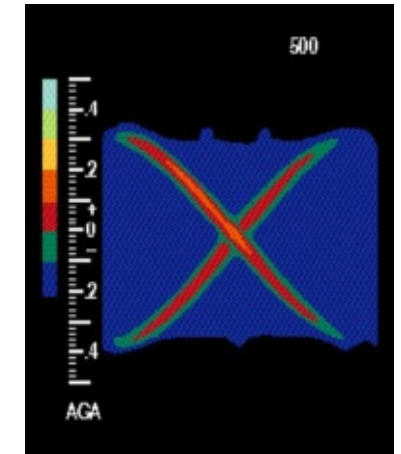
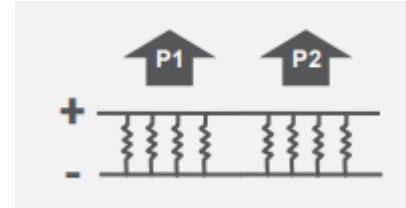
- Can be inventoried at site with standard components
- Ease of installation – can be cut to length, overlapped

▪ Operation

- Reliable and time tested
- Self-regulating principle means the system runs efficiently, saving energy and thereby operational costs

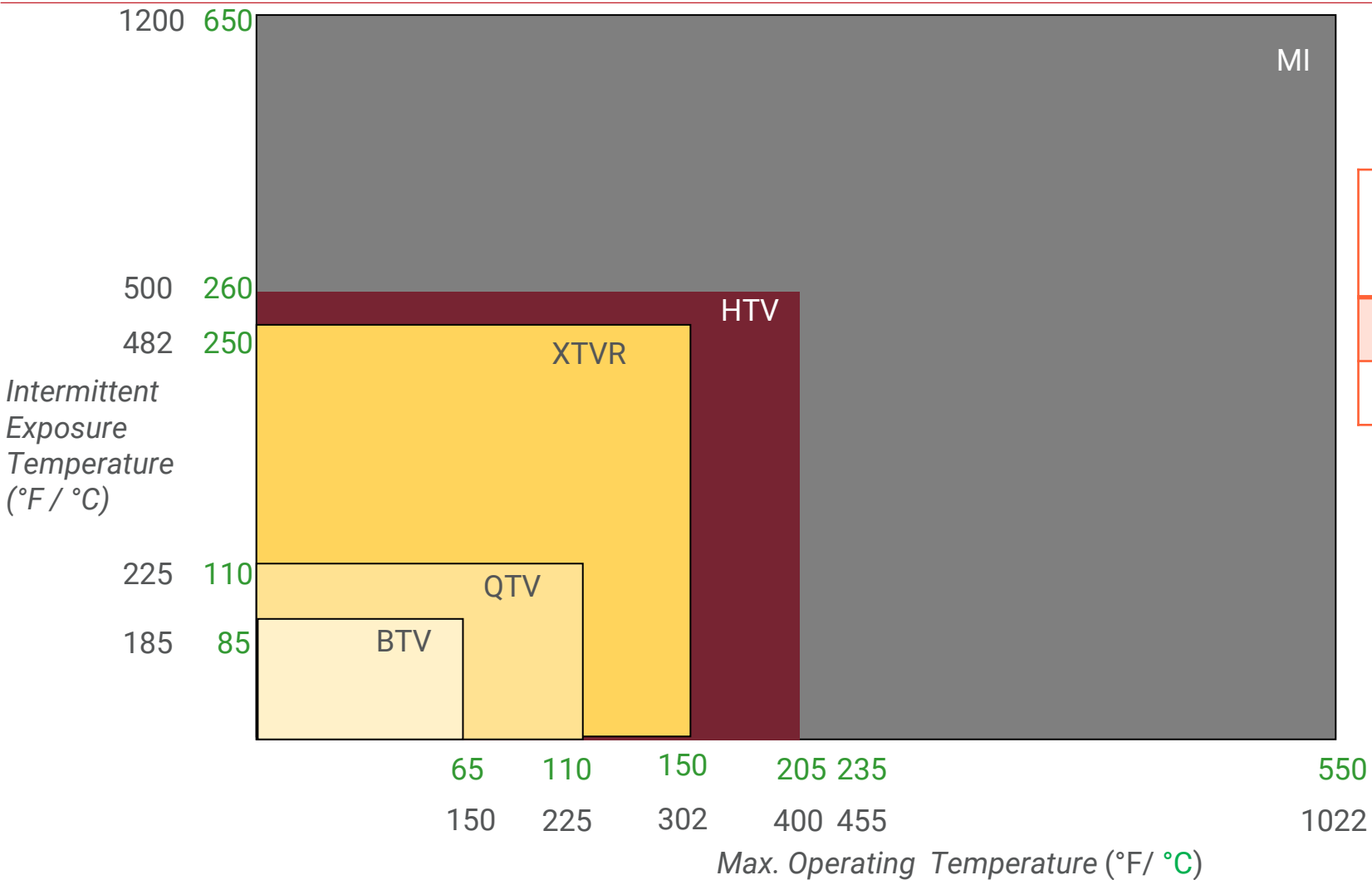
COLD

HOT



Products cannot burn themselves out, can be overlapped, easiest technology to install on complex shapes like valves

Typical Heat Tracing Technology



°C (°F)	Max continuous operating T (on)	Max continuous exposure T (off)	Max intermittent exposure T (on/off)
XTVR	150 (302)	150 (302)	250 (482) for 2000h
HTV	205 (400)	205 (400)	260 (500) for 2000h

High Temperature Self-Regulating extends the temperature range of Self-regulating cable applications

High Power Retention (HPR) Self-Regulating Cables

Fiber

XTVR

Nickel plated
copper Conductor

HPR heating core

Electrical insulation

Braid

Outer jacket



Solid

HTV

Nickel plated
copper Conductor

HPR heating core +
electrical insulation

Braid

Outer jacket



Conductors:
Carry electric current

Core:
Conductive polymer generates heat

Insulating jacket:
Electrical insulation between
conductive core and metallic braid

Metallic braid:
Acts as a ground path

Outer jacket:
protects the cable mechanically and
chemically

HPR cables require special polymers to enable reliable operation at high temperatures

Safety, Power Retention and Design Life

Key HTSR Considerations

- Polymers age faster at higher temperatures
- Ratings in published literature usually based on certification tests from standards
- Safety based standards are not concerned with long term performance
- Cables seen to be safer when they lose power

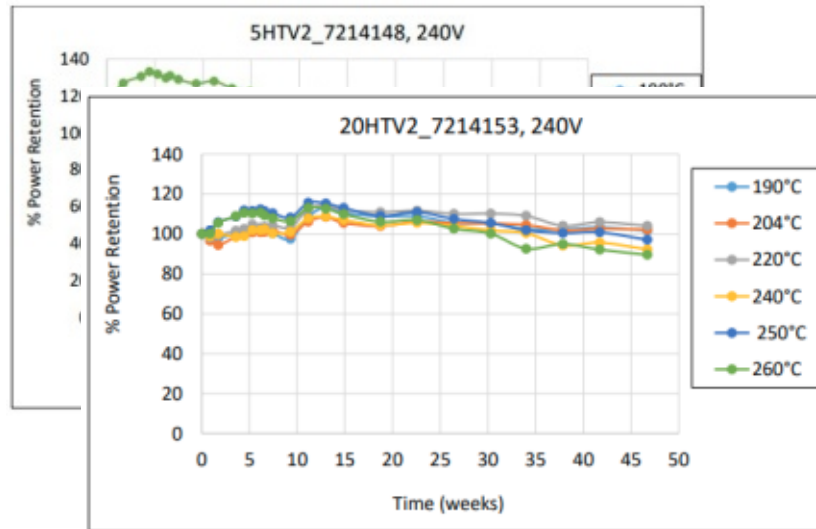


Figure 2 % Power retention for 20HTV2 cable

- Using accelerated aging tests at higher T's, and 3D Arrhenius modeling techniques
 - For HTV, to predict performance at 205°C
 - Many cable samples, wattage levels
 - At 190, 204, 220, 230, 240, 240, 260°C
 - Statistical modeling

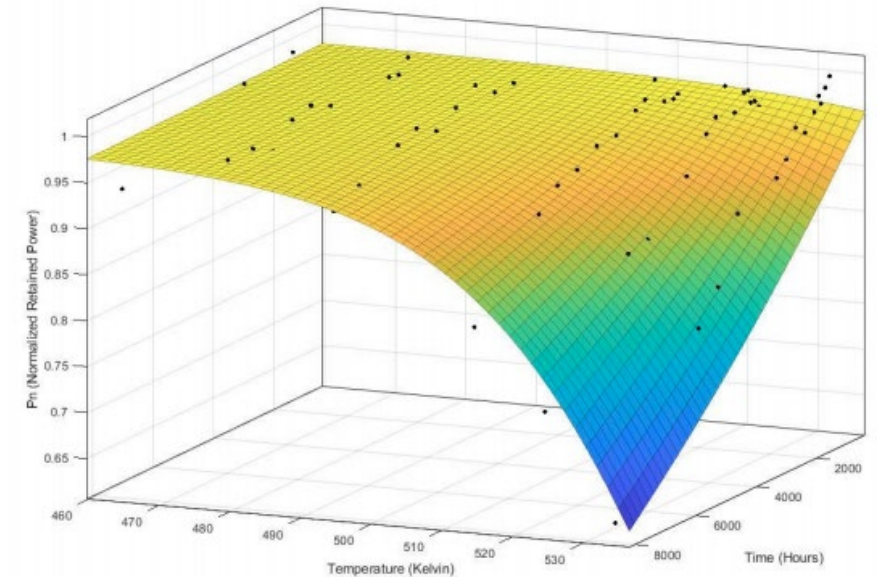


Figure 4 3D Arrhenius Plot for 5HTV2 using raw data from Figure 1

Critical to understand performance of HTSR at high temperatures.

Why High Temperature Self-Regulating?

- Market trends:
 - Industrial processes requiring **higher temperatures** (Bitumen, Chemicals, Clean Fuels, Carbon Capture ...)
 - Opportunities to **convert Steam tracing** to more efficient Electric tracing
- Higher temperature polymers required to handle continuous operating temperatures – maintain and / or exposure
- All benefits of SR technology desired for higher temperatures and remain
 - Easiest technology to design, install etc.
 - Energy efficient solution
- Note, for some applications, other technologies such as Mineral Insulated may still be required if polymer ratings are exceeded

Industry is Changing

Energy Transition Typical Line List Temperatures

System	Energy Transition Industry	Application	Operating Temp °C	Maintain Temp °C
Steam, BFW, Cond	All	Freeze Protection	90-225	10
Cooling Water	All	Freeze Protection	15-30	10
Utility	All	Freeze Protection	5-30	10
Instrument Air	All	Freeze Protection	25-57	10
Gas Condensation	LNG,H2,CCS	Freeze Protection	20-45	10-40
Regenerant Amine	CCS,LNG	Process Maintenance	40-200	10-40
Dehy	CCS	Process Maintenance	40-204	10-20
Lube oil	CCS,H2,LNG	Process Maintenance	100-120	20
Feedstock loading	Biofuels	Process Maintenance	30-50	30-50
Finished product	Biofuels (biodiesel)	Process Maintenance	40	45-50

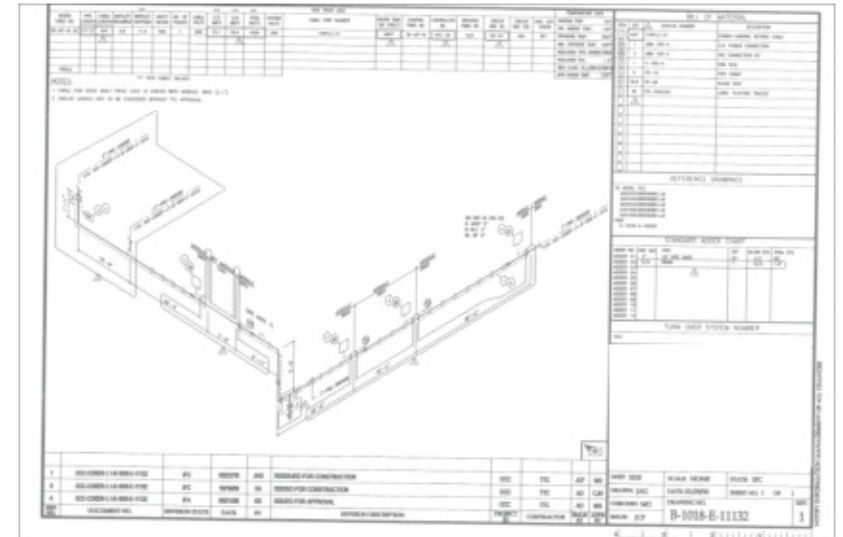


Strong fit for HPR self-regulating technology

HTV Design Flexibility Supports Energy Efficiency

8 Wattage Selections			
100 - 130Vac		200 - 277Vac	
3HTV1-CT	3 W/ft	3HTV2-CT	3 W/ft
5HTV1-CT	5 W/ft	5HTV2-CT	5 W/ft
8HTV1-CT	8 W/ft	8HTV2-CT	8 W/ft
10HTV1-CT	10 W/ft	10HTV2-CT	10 W/ft
12HTV1-CT	12 W/ft	12HTV2-CT	12 W/ft
15HTV1-CT	15 W/ft	15HTV2-CT	15 W/ft
20HTV1-CT	20 W/ft	20HTV2-CT	20 W/ft
		28HTV2-CT	28 W/ft

- Wattage choices allow a better match of heat input to heat loss
- Maximum circuit lengths can be achieved because of optimized power consumption



Maximized circuit lengths means lower TIC

High temperature HPR Self-Regulating Cables Support the Energy Transition

- Reliable, proven technology
- Energy efficient designs
- Long life expectancy
- High operating temperature applications
- Low temperature maintain
- Ease of installation
- Cut to length
- Project standardization opportunity
- Standard SR connection kits
- UL Verified

Company:
nVent Thermal LLC

Verify ID:
V461322

Expiration date:
September 01, 2023 - August 31, 2024



°C (°F)	Max continuous operating (on)	Max continuous exposure T (off)	Max intermittent exposure T (on/off)
HTV	205 (400)	205 (400)	260 (500) for 2000h
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Thanks

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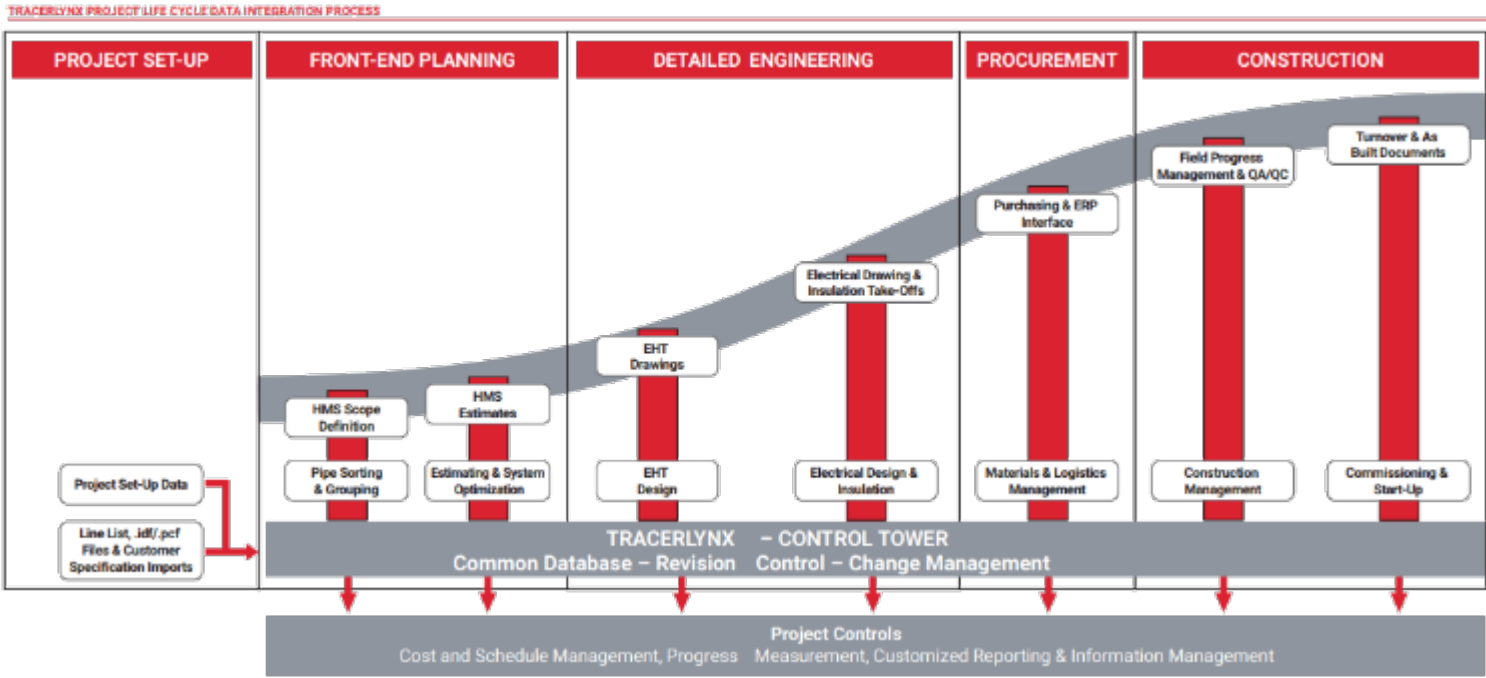
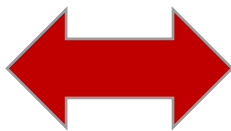


Energy Transition

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nVent RAYCHEM Mission Critical Offering

Turnkey Project Management



TracerLynx in numbers...





17+

Years of 3D Design Expertise







215+

TracerLynx EHT Designers







550,000+

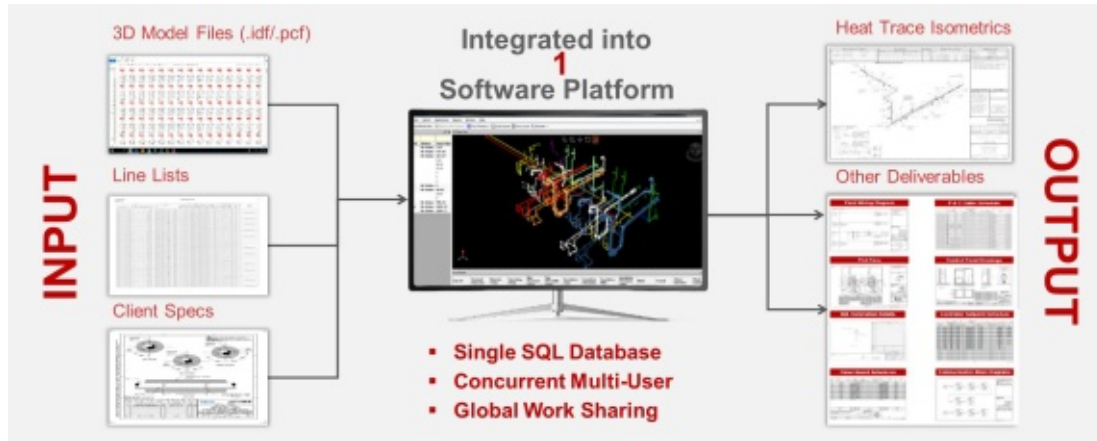
Optimized EHT Circuits



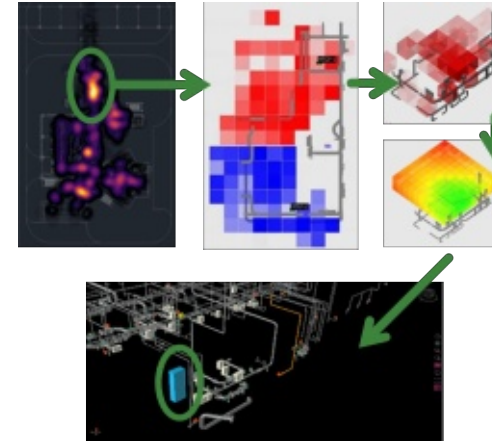
nVent RAYCHEM Mission Critical Offering

TracerLynx proprietary 3D integrated HMS software offers unique benefits

1. Singular Platform



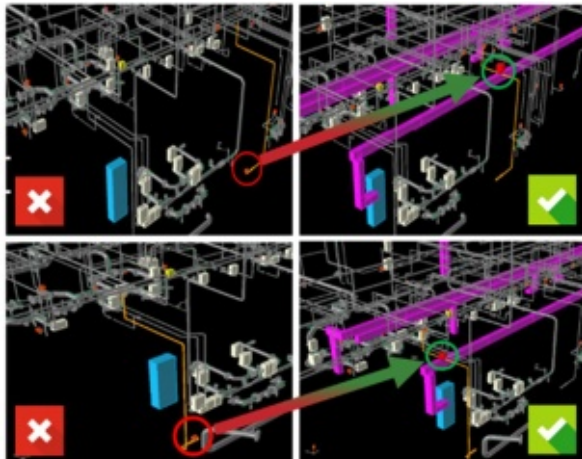
2. Heat Mapping Technology



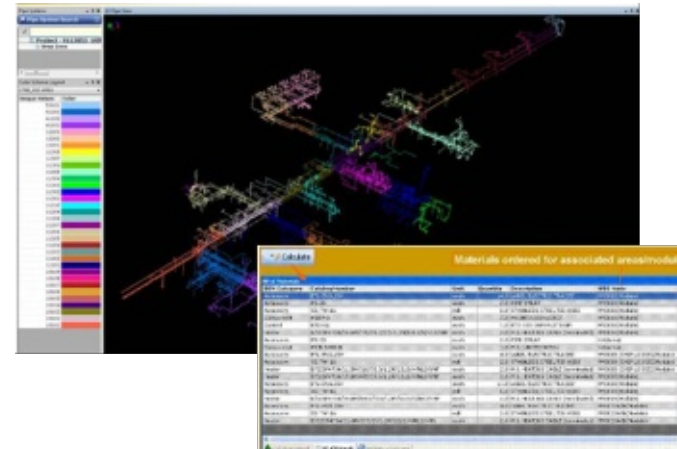
3. Change Management



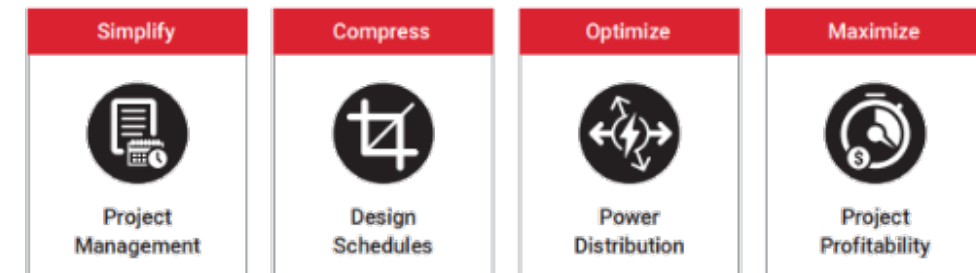
4. Power Distribution Optimization



5. Advanced Work Packaging



>> Resulting in 4 main client benefits



<https://go.nvent.com/tracerlynx>

Major Refinery CCS Opportunity

- Canada's first and second world class CCS facilities designed to capture 1.75 million tonnes per year of CO₂
- **Challenge**
 - Operation reliability
 - Northern climate freeze protection and process maintenance
 - Energy efficiency
- **Solution**
 - TracerLynx 3D design supporting freeze protect and process maintain applications
 - RAYCHEM high temperature SR cables with HPR technology
 - Control and monitoring skids including power distribution and Supervisory Software



Operational Reliability Essential

Fuels Terminal Operation

- Major retrofit to support biodiesel blending and storage
- Challenge
 - Dock loading, tank farm and interconnecting piping not heat traced or not adequately heat traced
 - Process maintain 43°C (110°F) to support biodiesel storage and blending
- Solution
 - TracerLynx design supporting power distribution optimization
 - HPR self-regulating EHT technology for interconnecting piping
 - Control and monitoring installed to support process maintain temperature of biodiesel products and save energy.

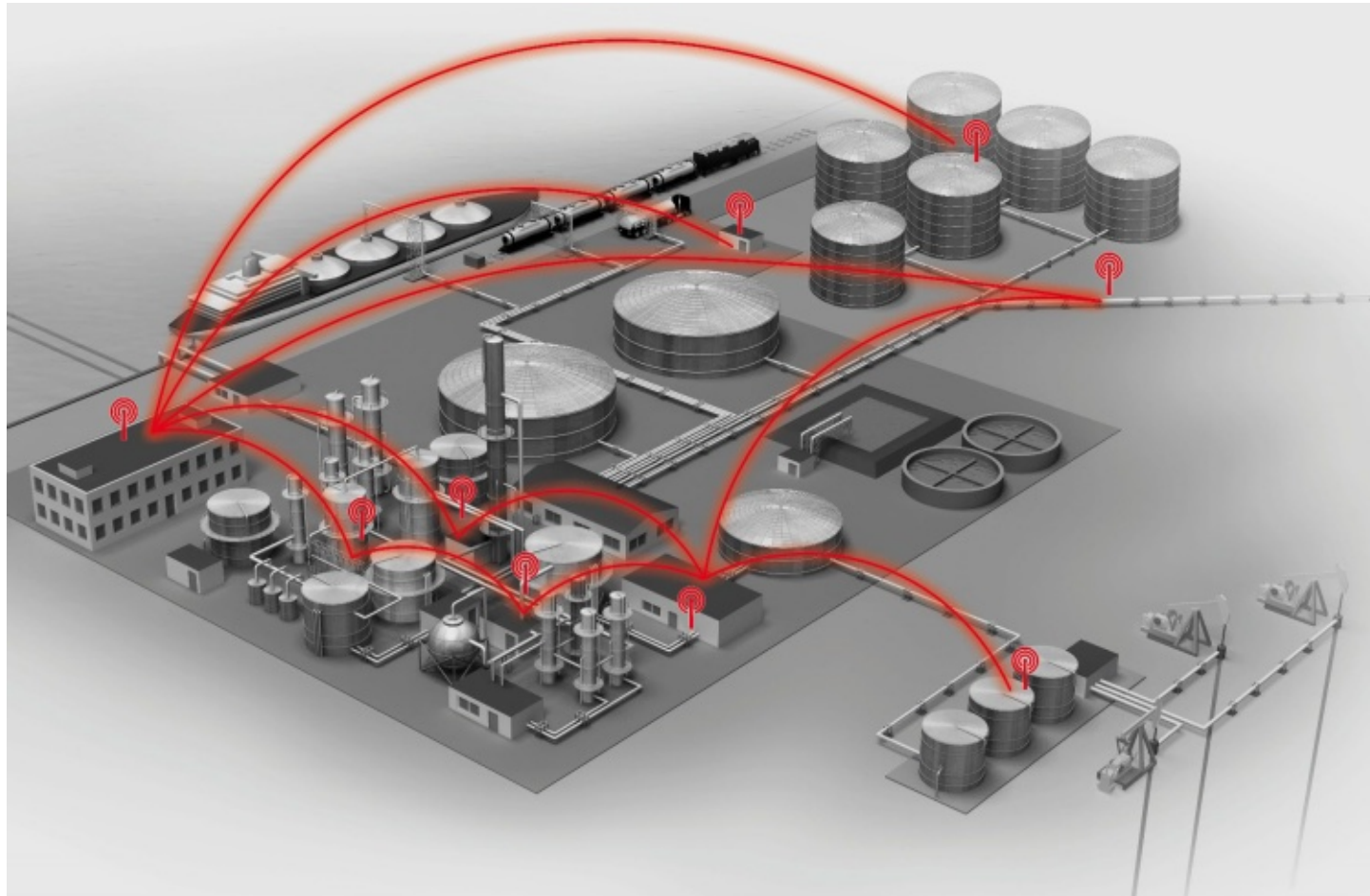


Significant change from gasoline and petroleum diesel

nVent RAYCHEM Mission Critical Offering

Smart EHT Control and Monitoring

Advanced Control & Monitoring For Industrial Heat Tracing Installations



New Steam methane reformer H2 Plant

- New standalone SMR hydrogen plant to support long term viability of local chemical industries
- **Challenge**
 - Critical high temp freeze protect, and process maintain heat tracing applications
 - Large bore pipe gas condensation prevention applications
 - Instrument winterization
- **Solution**
 - TracerLynx design supporting optimization
 - Power limiting and high temperature SR cables with HPR
 - Control and monitoring skids including power distribution
 - Tubing bundle designs and instrument enclosures

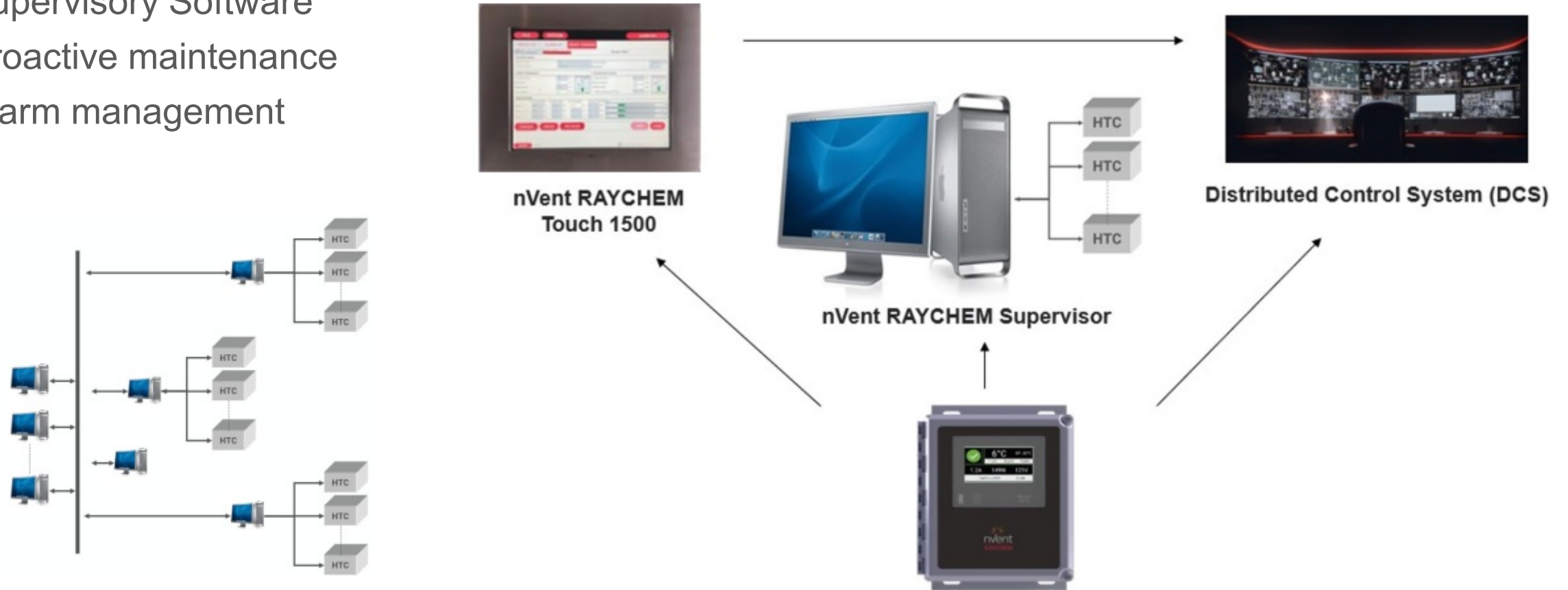


Regional Industry Support Demands Reliability

nVent RAYCHEM Mission Critical Offering

Connect and Communicate

- Supervisory Software
- Proactive maintenance
- Alarm management



Operations Expectation

Gulf Coast USA Refinery Renewable Diesel Expansion

- Expanding Renewable Diesel capacity by 400 MGPY
- **Challenge**
 - Feedstock includes recycled animal fats, used cooking oil and inedible corn oil
 - Rail car unloading of feedstocks located approx. 1 mile from refining facility
- **Solution**
 - STS design and installation for process maintain of 50°C (120°F)
Pre-insulated pipe with channel for ease of installation above and below grade
 - Fiber optics temperature sensing technology for accurate process temperature maintain feedback to controller
 - Longline supervisory software for HMS management of this critical process maintain line



STS-Skin Effect Tracing long line heating technology

In Summary ...

- nVent RAYCHEM Mission Critical Solutions increase plant reliability by
 - Keeping critical processes operational
 - Protecting pipes, tanks and equipment from freezing
 - Developing optimized power distribution designs with TracerLynx 3D modelling software
 - Meeting the high temperature demands of new biofuel feedstocks with high power retention (HPR) technology self-regulating cables



MISSION CRITICAL PROTECTION, CONNECTION, CONTROL AND OPTIMIZATION



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Thank you