What's Your Thermal IQ?

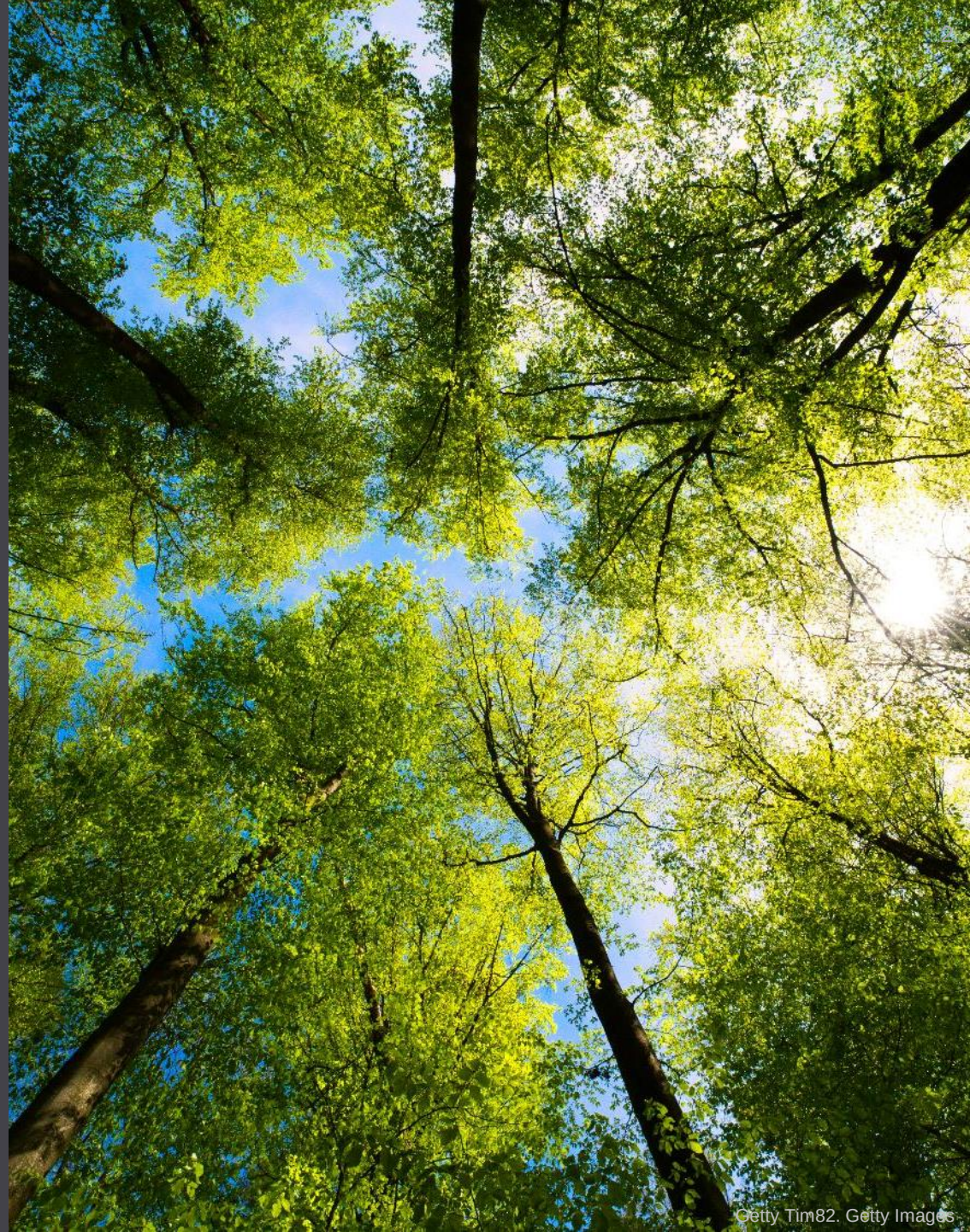
Engaging Industrials in Sustainability Management and Emissions Reduction

Dale P. Smith
Global Growth Leader
Digitalization & Energy Transition

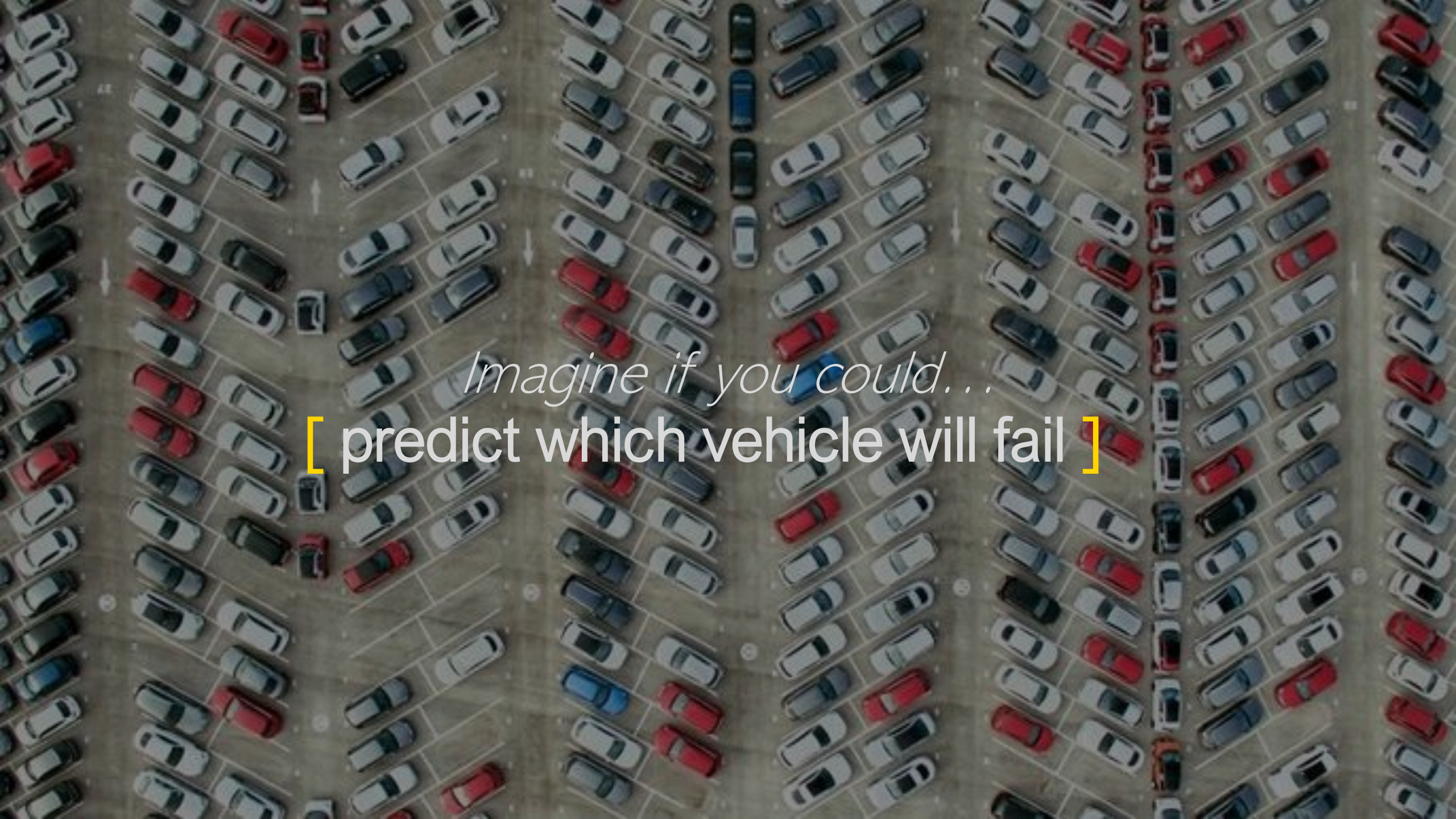
Honeywell

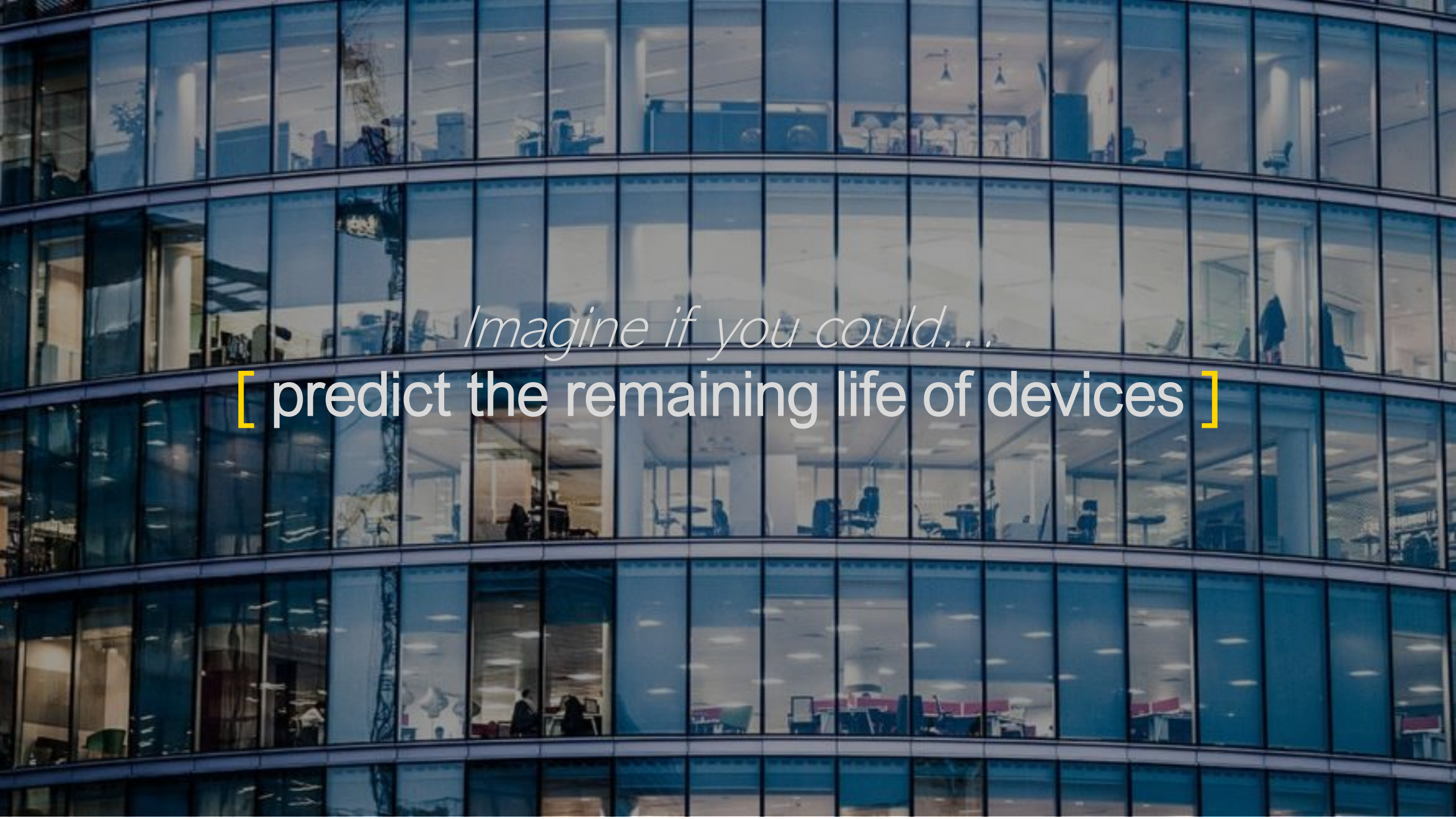
AGENDA

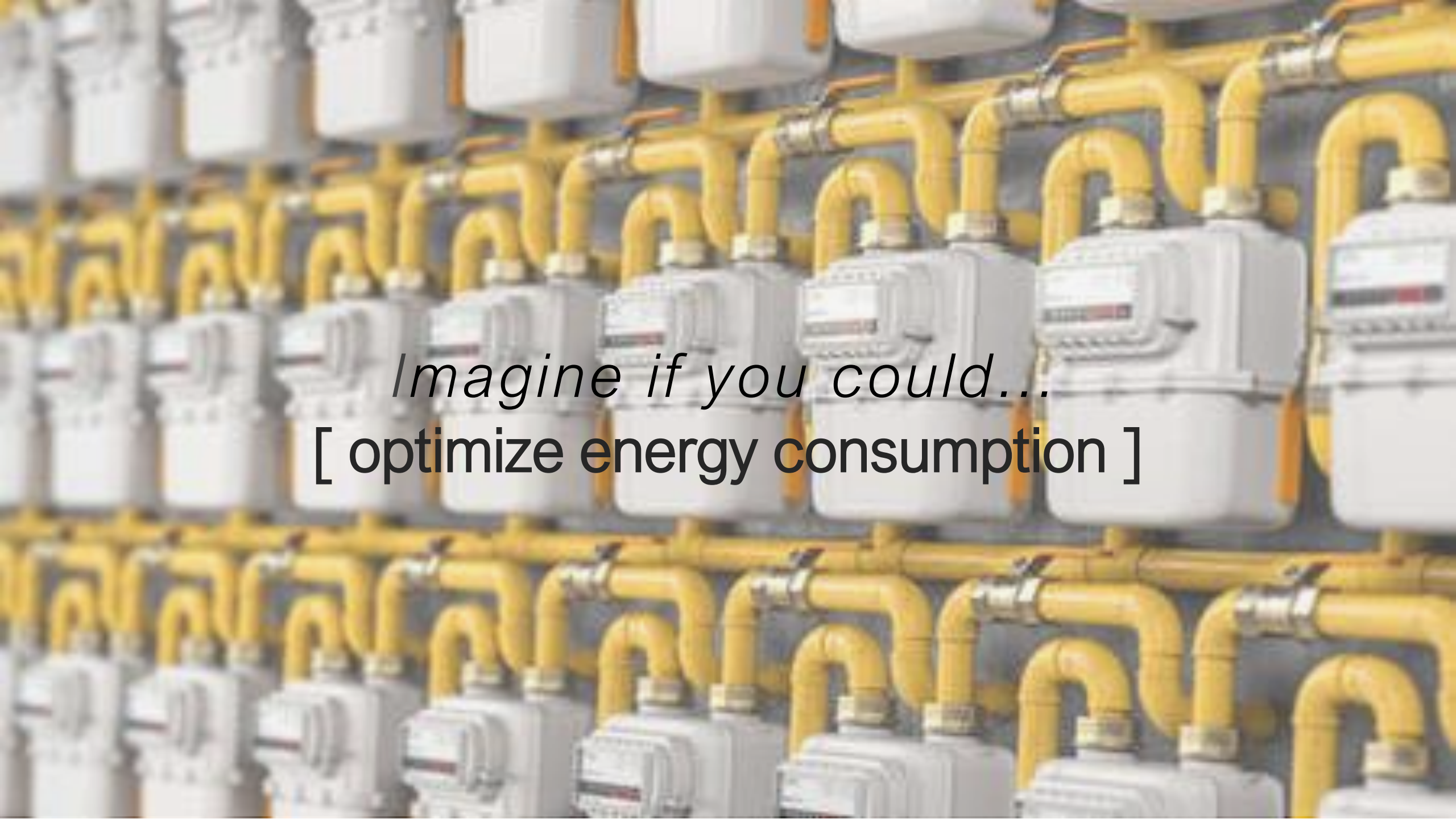
- Imagine If You Could
- Emissions Hype
- Digitalization Calming
- Practical Solutions During Energy Transition

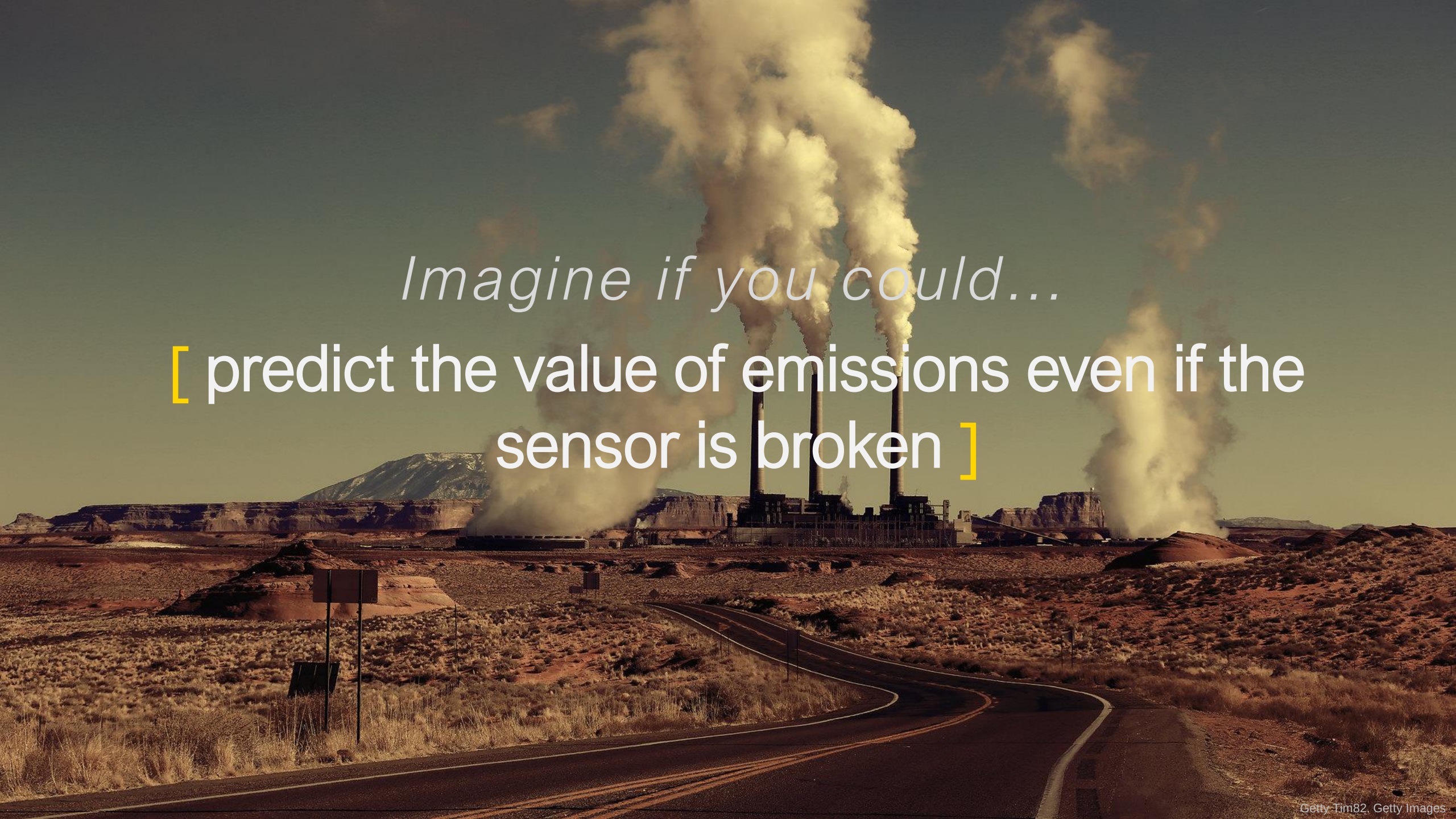


Imagine if you could…

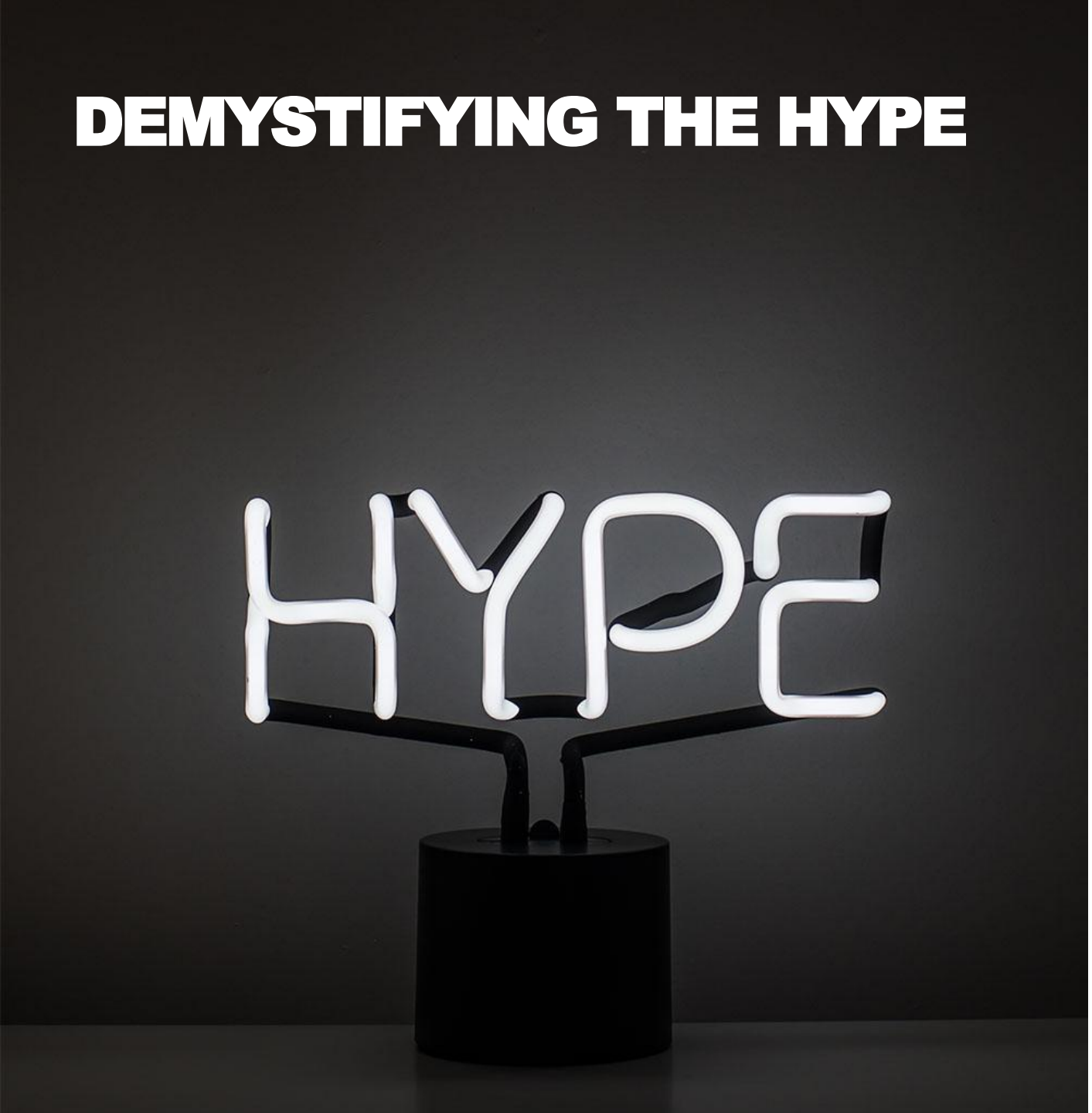

Imagine if you could. . .
[predict which vehicle will fail]


Imagine if you could...
[predict the remaining life of devices]


Imagine if you could...
[optimize energy consumption]


Imagine if you could...
[predict the value of emissions even if the sensor is broken]
Getty Tim82, Getty Images

DEMYSTIFYING THE HYPE



Find Your Trusted Advisor

All Industries driving to reduce energy and achieve publicly reported carbon reduction / Net Zero targets - Many must do something now!

Lack of thermal application expertise and resources to baseline, roadmap, fund, and deploy multiyear energy/emission projects

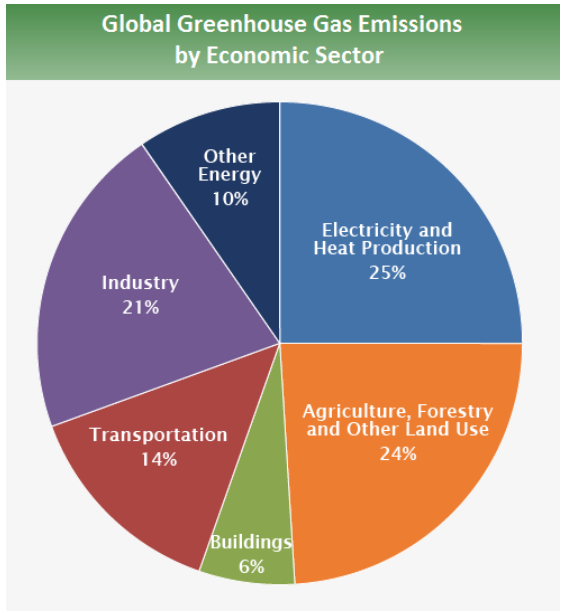
Great uncertainty about future of technologies, fuel costs, and green energy sources

Need trusted advisor to balance existing business needs, future proof operations, and financially succeed while achieving publicly announced targets

Look for
Free Tools Links

ENERGY FUD is Challenging the Industrial Energy Transition

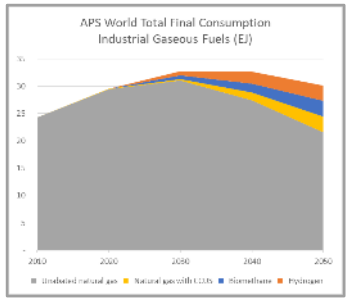
Industrial Process Heat >20% of Global Emissions



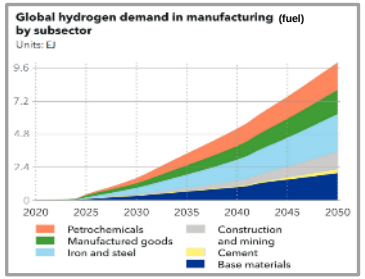
Source: IPCC Climate Change 2014: Mitigation of Climate Change

Differing Views on Future Energy Scenarios to Achieve Net Zero

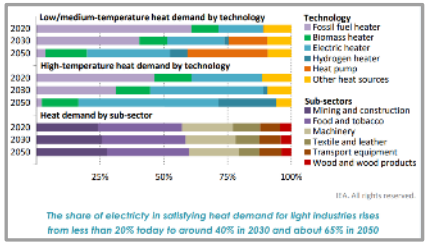
NatGas Still Leads (IEA)



Hydrogen Blossoms (DNV)

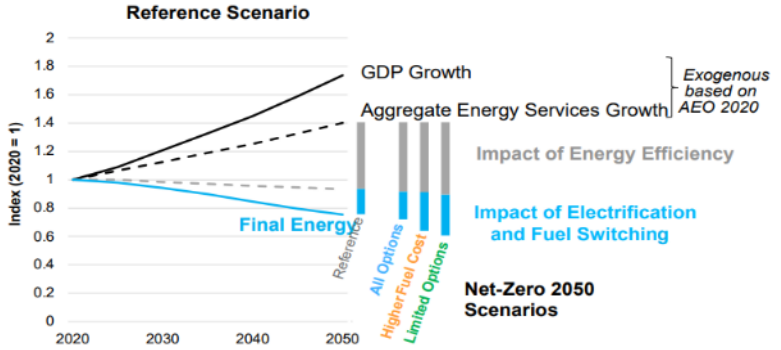


Electricity Dominates (IEA)



Source: IEA Global Energy and Climate (GEC) Model – Announced Pledges Scenario (APS); DNV Hydrogen Forecast 2022 to 2050; IEA Net Zero by 2050 Roadmap

Net Zero Requires Cleaner Energy + Increased Efficiency



Source: Low Carbon Resources Initiative (LCRI) Net-Zero 2050 version 1.1.0

Fear, Uncertainty, and Doubt (FUD)

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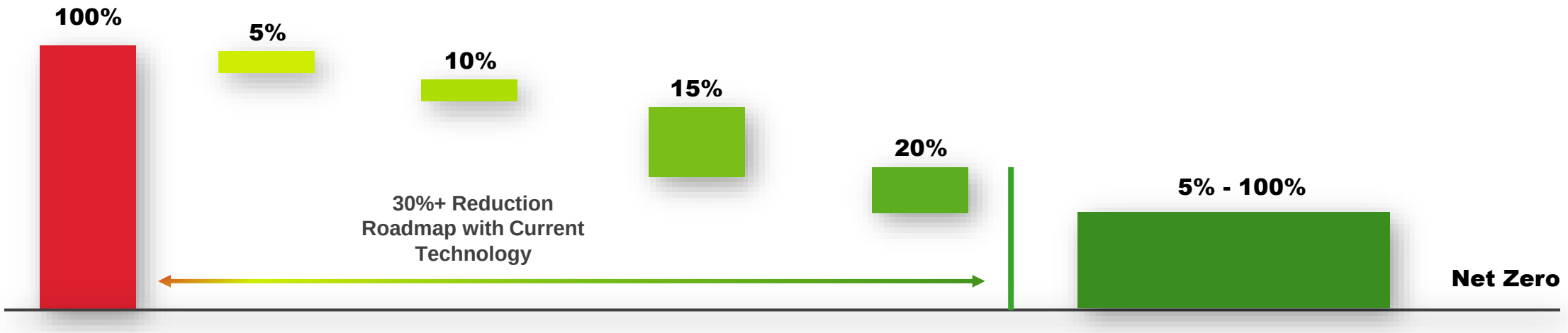
DECARBONIZATION TRANSFORMATION ROADMAP

MEASURE & MONITOR | **REDUCE & REPLACE & RECAPTURE**



LEVERS

Baseline Footprint	Digital Thermal Twin	Energy Efficiency	Better Control	Better Combustion	Low Carbon Fuels	Alternate Solutions
						
Carbon audit to establish baseline and multi-year budget / specification	Increase sensors and real-time performance / emissions monitoring and alerting	Tuning / PM contracts, fugitive emissions IR scans, compliance checks	Upgraded controls and actuators drive better F/A ratio	High efficiency burners, low NOx burners, Heat Recovery	H2 / NG blending, Biofuels, Hybrid NG / H2 / Elec	Electrification, Carbon Capture, etc.

Outcome-based Strategies & Technology to Accelerate Customer Journey

THERMAL IQ | OVERVIEW

INSIGHT ABOVE. PERFORMANCE BEYOND.

MONITOR

See real-time performance data and get alerts when key parameters are outside normal limits.

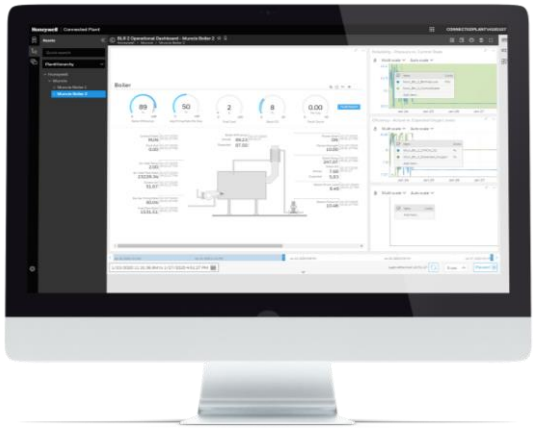
MANAGE

Connect everyone from management to maintenance with insights to drive smarter decisions.

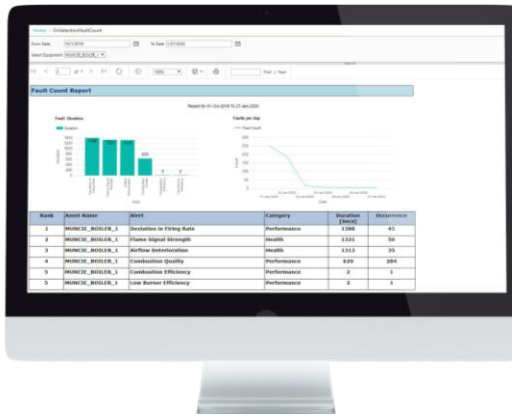
MAXIMIZE

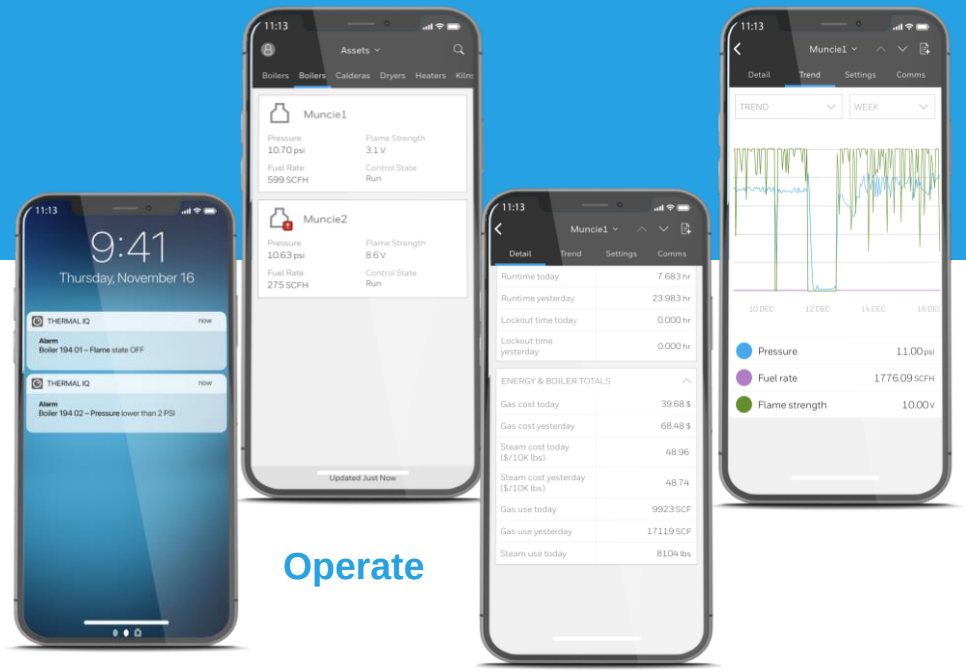
Stop waiting for faults and failures that can lead to shutdowns – get ahead of trouble and maximize uptime.

SEE EVERYTHING WITHOUT BEING EVERYWHERE

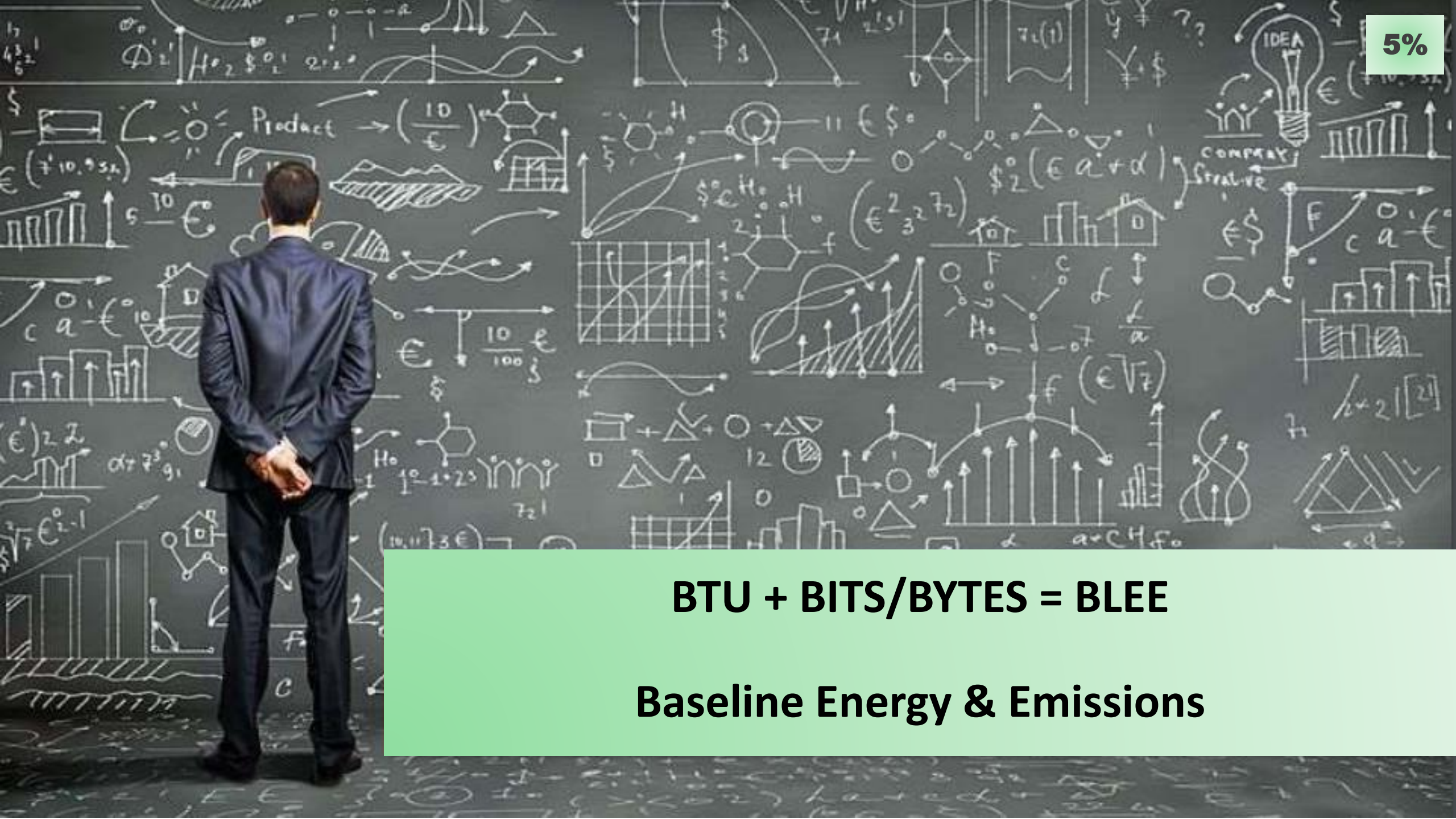


Optimize





Operate


5%
BTU + BITS/BYTES = BLEE
Baseline Energy & Emissions

BLEE | Keep it Super Simple

THERMAL IQ

EXISTING FLAME SAFEGUARDS + TEMP CONTROLS + FUEL SYSTEM DATA = BLEE

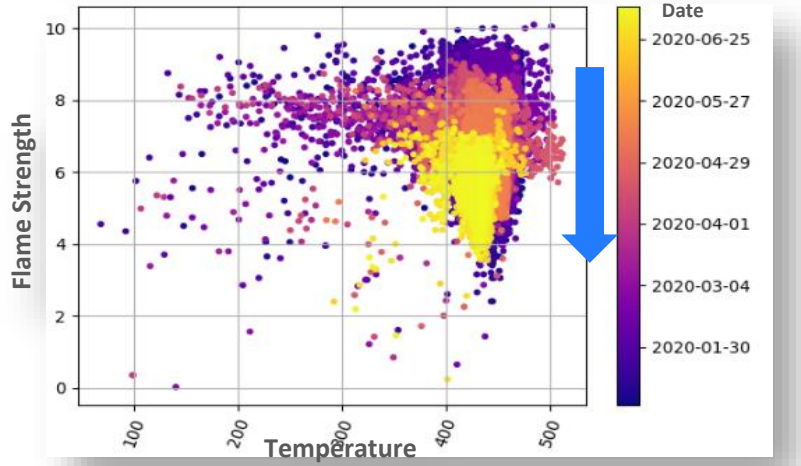
BCU5xx + FCU + Thermal IQ

7800 + UDC + Thermal IQ

Analytic Input	Source
Firing Rate	Temperature Controller
Hours of Operation	Burner Management
Burner Capacity	Name Plate
Burner Efficiency	Cut Sheet / Tuning
Fuel Type | HHV Btu	Customer | Utility
CO2e* Emission Factor	Environmental Agency

All Types of Controls

30+ Analytics



BLEE =

tCO2 / year

DIY BLEE | Calculating Carbon Reduction Potentials

BURNER CAPACITY KNOWN

Analytic Input	Value	Source
Firing Rate	70%	Temperature Controller
Hours of Operation	6000	Burner Management
Burner Capacity	50 MMBtu/hour	Name Plate
Burner Efficiency	80%	Cut Sheet / Tuning
Fuel Type | HHV Btu	Natural Gas | 1000	Customer | Utility
CO2e* Emission Factor	53.114	Environmental Agency

BLEE Calculations

1. (50,000,000 x 70%) / 1000 = 35,000 cf/hr
2. 35,000 Natural Gas Consumption
3. (35,000 x 6000) / 100 = 2,100,000 Therms / Year
4. (2,100,000 x 53.114) / 10,000 = **11.15K tCO2e / year**
5. BLEE vs. Your Carbon Reduction Goals

CO2e – Carbon equivalent that Includes CO2, CH4, N2, etc.

1 Therm = 100cf

Digital Nervous System

Add Sensors to Drive More Visibility and Accuracy

Burners & Ignition

- Variety of burners for different industrial applications.
- Pilot burners.
- Ignition components such as transformer & electrodes.

Flame Scanners, Flame Rod

- U2S IFM
- C70XX Flame Scanners,
- Flame rods

Water Level Control / Gas, Oil & Air Pressure Sensors

- Honeywell SmartLine Series for flow, temperature, level, pressure and multivariable.

O2 / Methane Sensors

Honeywell Industrial Gas Sensors

- CiTceL 4 Series.
- CiTceL 5 series, and others.

Burner Controls

- 7800 Series
- BCU Series
- SLATE™
- SOLA Hydronic Controls

Thermal Performance Monitoring

- Thermal IQ - Mobile / Desktop
- Real Time, Alerting, Predictive
- Enterprise Analytics / KPIs
- Sustainability, Efficiency, Safety, Reliability, Production Packages

Custom Solutions / Services

- Field Service Contracts, Upgrades, Remote Service Centers
- Engineered to order.
- Control panels, fuel skids, heat exchanges, etc..

Blowers/Boosters

- Packaged blowers
- SMJ blower, and many more.

Actuators, Servomotors

- SLATE Actuators
- SmartLink DuraStep
- SmartLink MRV

Other Accessories

Temperature / Process Controls

- UDC Temperature and High Limit Loop Controllers

Valves / Switches

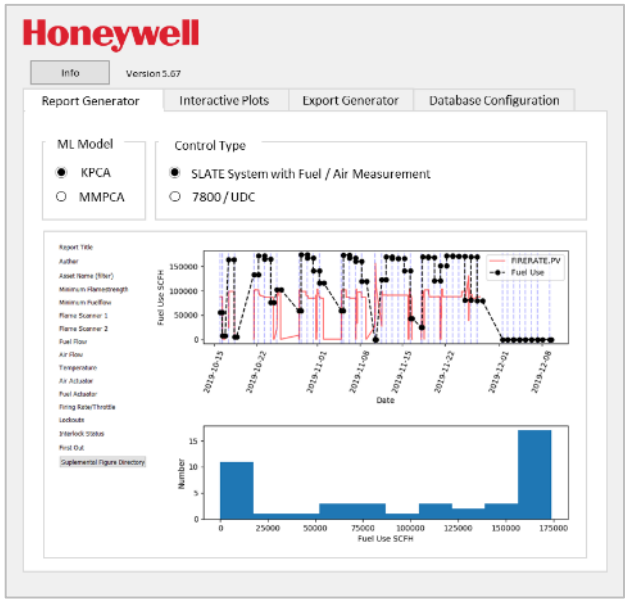
- Valvario™ series valves
- Maxon Safety shut off valves.
- SmartLink CV valves
- Gas regulators, pressure switch, gauges, flame relays, etc.
- Valves, fittings, etc.

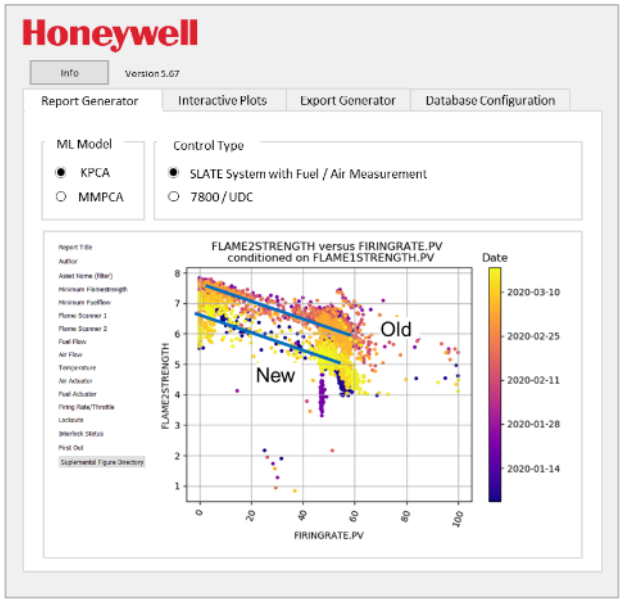
Hydrogen Ready !
Complete solutions for Hydrogen combustion

Honeywell | Thermal Solutions

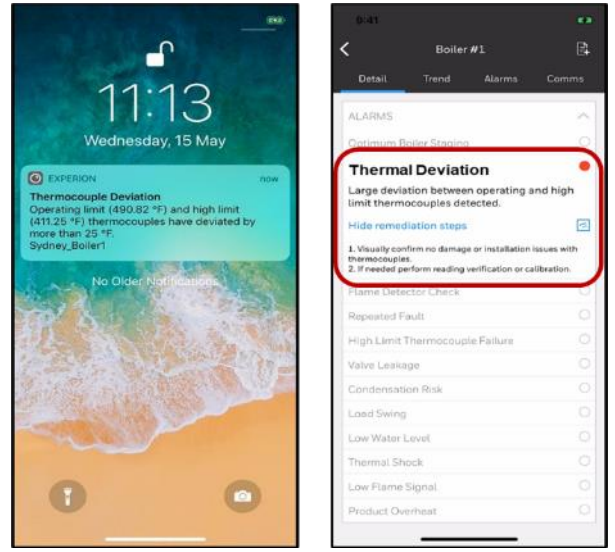

data scientists drive actionable intelligence.

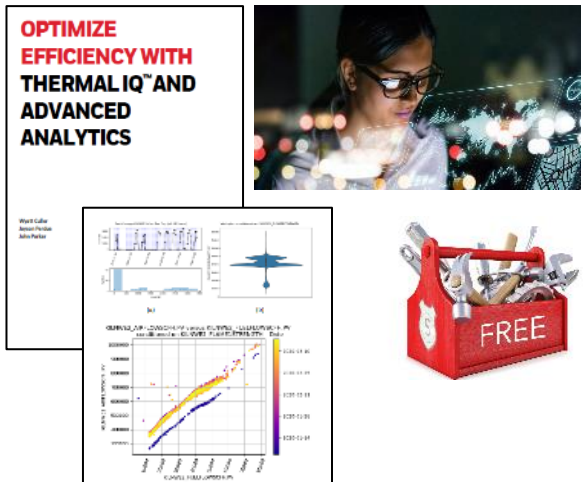
DATA SCIENCES | Drive Actionable Intelligence

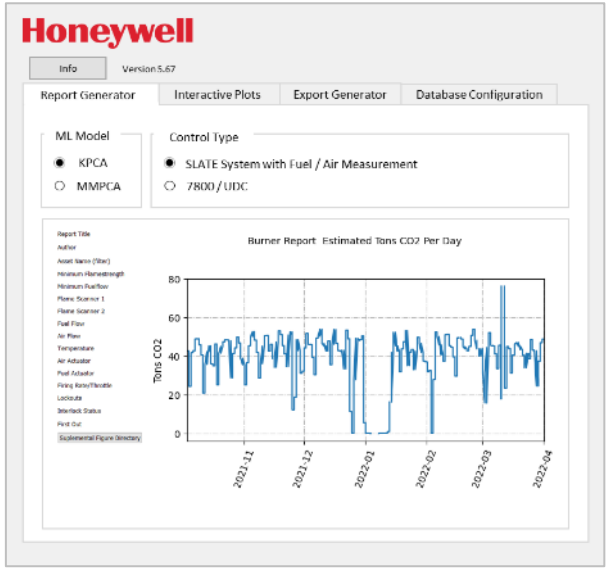




JUST TELL ME WHAT TO DO!







EMISSIONS COMPLIANCE REPORTING

WHAT IS YOUR "SAY / DO" RATIO?

Transparency and Accuracy Tied to Compliance and Funding Access or Preventing Taxes, Fines, Penalties without Data.

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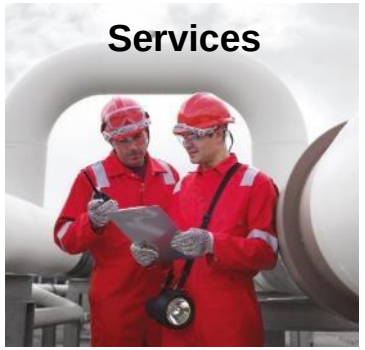
BURNER TUNING / OUTCOME BASED SOLUTIONS

10%



Must Balance

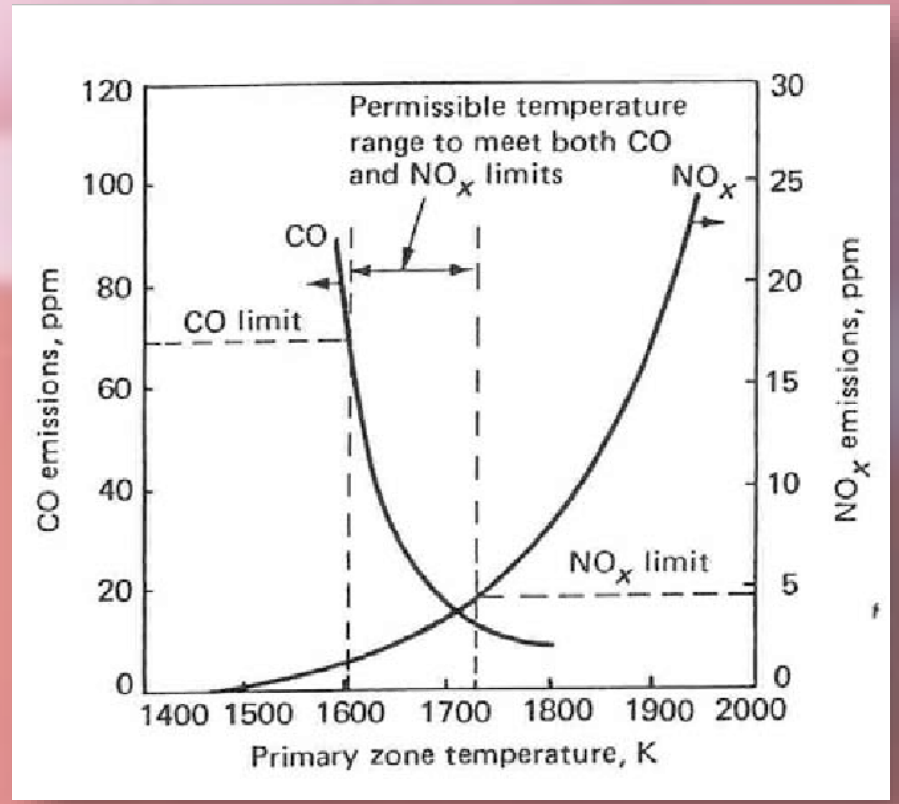
- NOx
- CO
- Efficiency
- Production

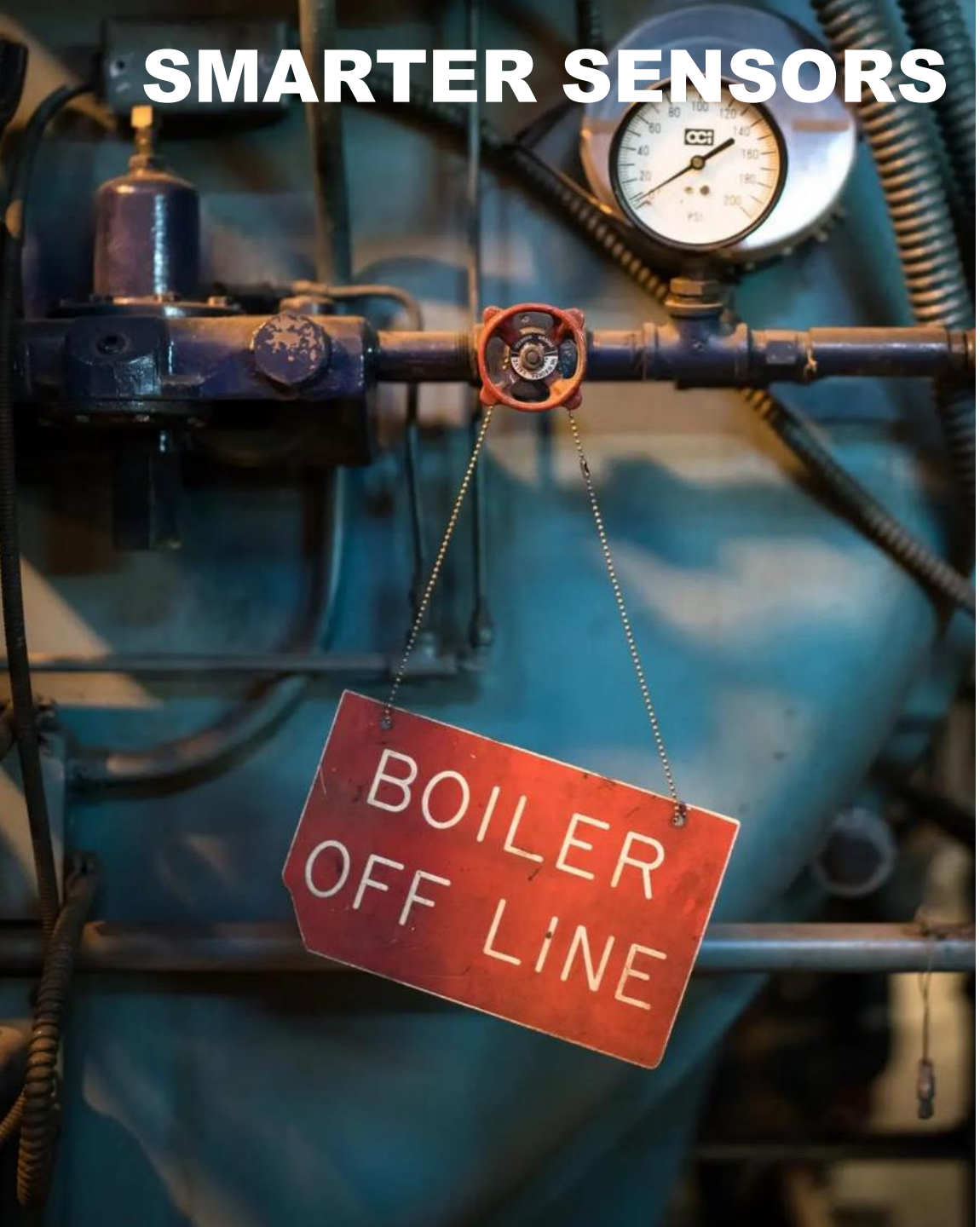
Other Outcomes

- Reduce Overfiring
- Reduce Excess Air
- Eliminate High Cycling

Other OBS

- Gas Leakage Surveys
- Air / Energy Loss Surveys
- Remote Monitoring & Reporting
- Field Validation of GHG/Energy Project Performance
- Service Level Agreements





SMARTER CONTROLS

15%

Increasing Control

- 7800 / BCU

- 7800/BCU + UDC

- 7800/BCU + UDC + **sensors**

- SLATE + **Actuators**
- SLATE + **sensors**

- KS **Pulse Firing**

- PLCs PCD-RTU-HC900 + **sensors**

- DCS + **sensors**

Direct Coupled F/A Actuators

USE CASE | BETTER CONTROLS INCREASE FURNACE EFFICIENCY

Data examples on two different products

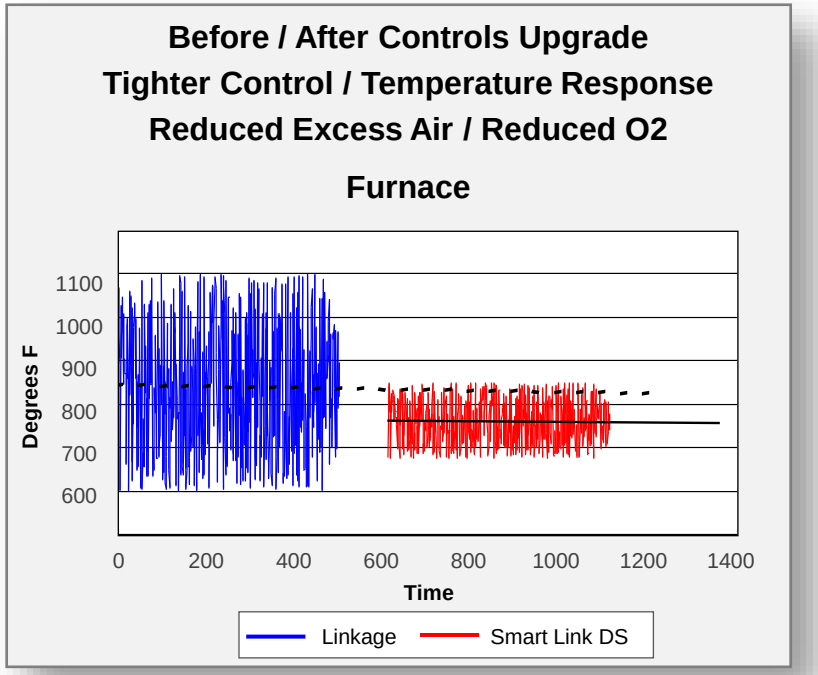
(Before & After SLATE Upgrade)

Product 1	Before	After
Total Gas Usage (ft3/min)	2085	1931
Exhaust O2 (%)	8	5.9
Burner1 Output (%)	76	62
Burner 2 Output (%)	74	44

- Gas usage reduced by 7.4%
- Exhaust O2 reduced by 26.3%
- Kiln Efficiency Increased by 6.5%
- Reduction of 2945 tCO2e*

Product 2	Before	After
Total Gas Usage (ft3/min)	2144	2063
Exhaust O2 (%)	8	5.78
Burner1 Output (%)	81	62
Burner 2 Output (%)	74	51

- Gas usage reduced by 4.0%
- Exhaust O2 reduced by 27.8%
- Kiln Efficiency Increased by 3.1%
- Reduction of 1549 tCO2e*



Value Calculation of Averaged Reduction

Redux	Redux %	CF / Hour	CF / Day	CF / Year	Therms	MCF	MMBTU**	Nat Gas Savings $/MMBtu
118	6%	7,050	169,200	42,300,000	423,000	42,300	43,654	$ 216,085

Annual 2,323 tCO2e Reduction + $216K Fuel Savings

Don't Forget Free Money!

- Utility Energy Efficiency Rebates
- $/Therm up to 50% of Project Costs
- **Example:** $100K upgrade could get up to $50K rebate.

* Four - 25MMBtuh burners

** 6000 hours and GHG Protocol Natural gas 53.114 kgCO2e/unit

BOOST FUEL EFFICIENCY | Reduce Emissions

20%

SELF-RECUPERATIVE BURNERS

ECOMAX

ECOMAX LE

BURNERS COUPLED WITH RECUPERATORS

Tube Firing Burners

Bayonet Ultra Recuperator

UNI RAD

CONTROL FOR PRECISE A/F CONTROL

Smartlink MRV

SLATE

SEPARATE HEAT RECOVERY SYSTEMS

THERMJET

BIC / ZIC

BIO / ZIO

Menox / BIC..M

TRIOX

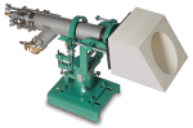
HEAT EXCHANGERS

Dimple Heat Exchanger

Tubular Heat Exchanger

Sinusoidal Heat Exchanger

Low Emissions Burners

Low Temp	High Temp
	
	

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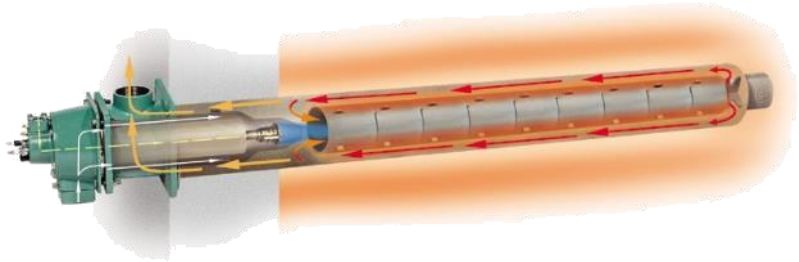
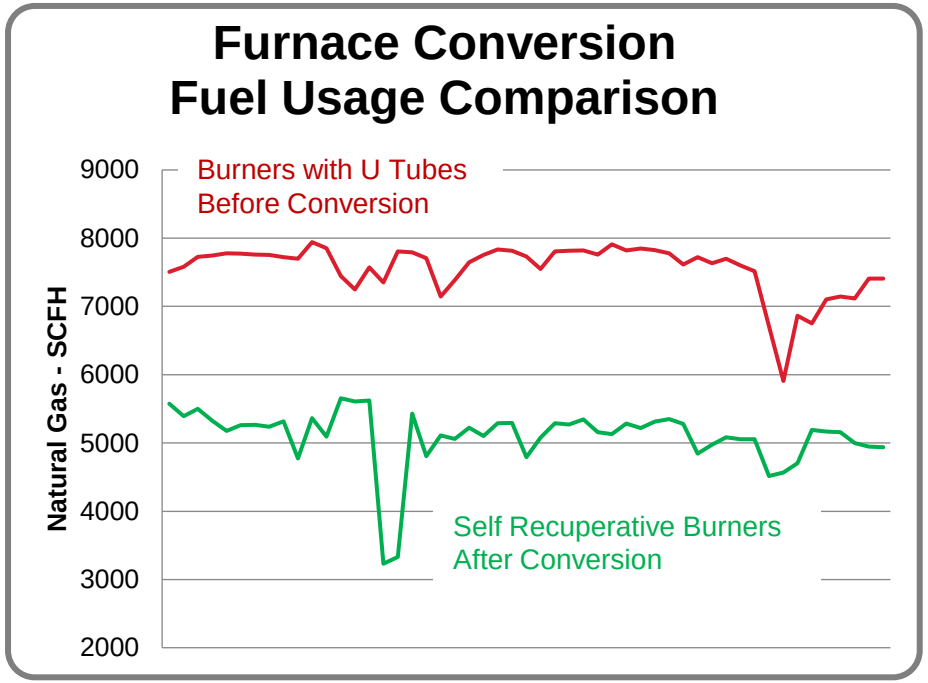
USE CASE | Heat Recovery Case Study

Upgrade U-tubes to Self-Recuperative, Single Ended Radiant Tube Burner

- 18.3% Increased production tons
- Hot Spots Removed
- ~30% reduction in fuel usage
- ~$70,000 Annual Fuel Savings ($4/MMBtu)
- ~980 tCO_2 emissions reduction annually



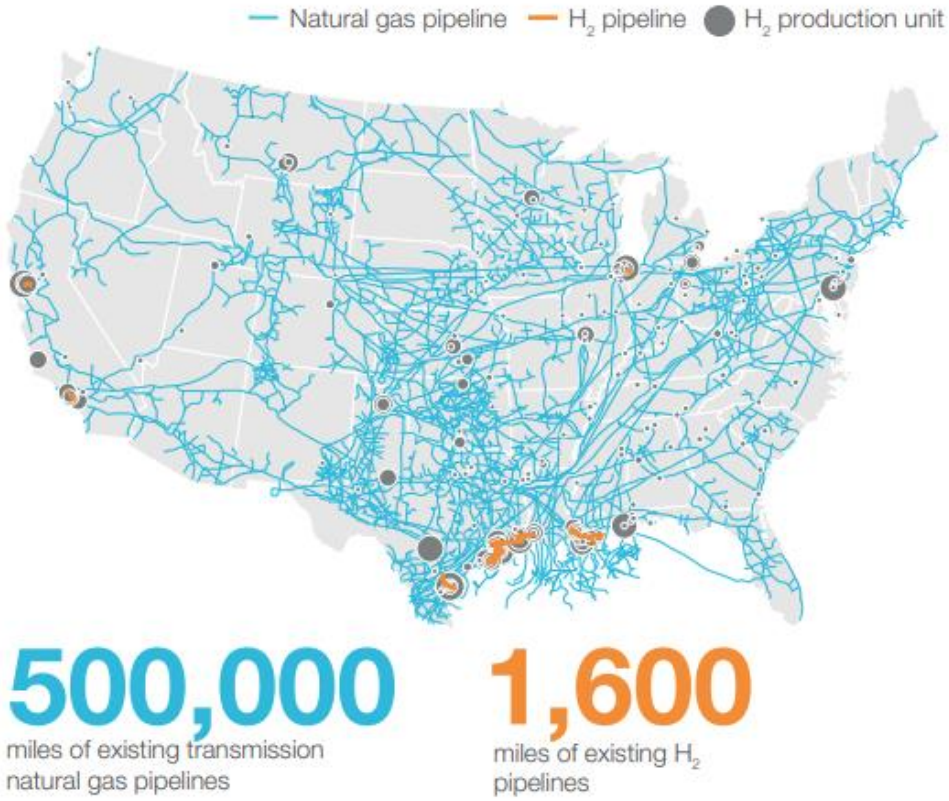
Post Upgrade



Hydrogen | Challenges / Considerations

5 - 100%

1. **What is the market supply and availability today, 2030, 2050?**
2. **What is your regional access and delivery costs?**
    1. Trucks and Pipelines limitation create regionalized concentrations
    2. 1000x more expensive to truck H2 500 miles vs oil in pipeline 500 miles
3. **Where you live globally impacts type of H2 and costs?**
4. **What are the Operational Costs?**
    1. Roughly 10x higher than natural gas (2023)
    2. Future goals 1.5x - 2x
    3. DOE “Hydrogen Shot”: clean hydrogen cost target of $1/kg (1x) H2 by 2030 - and interim target of $2/kg (x2) H2 by 2025
5. **Meeting 2030 and 2050 Goals**
    1. Scale up Needed
    2. Infrastructure Needed
    3. Funding Needed



Hydrogen Insights May 2023. Hydrogen Council, McKinsey & Company

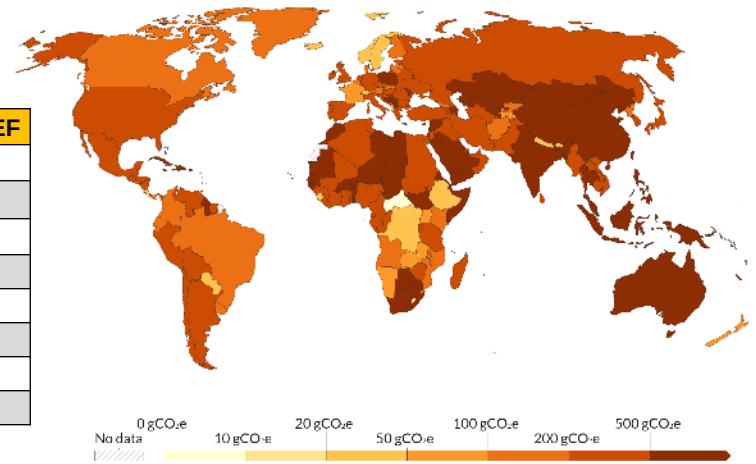
ELECTRIFICATION | Challenges/Considerations

1. **What is the market supply and availability today, 2030, 2050**
2. **What is your regional blend?** Electrifying could increase your CO2 emissions based upon location
3. **How much of a premium for the renewable supply?**
4. **Do you have enough incoming service?** If not, many MW do you need? How far is the substation? Each mile will cost $X
5. **Do you have enough on-site step-down transformers**
6. **Can your facility handle the increased load?** Does your facility have the right network of transformers, cable tray runs, switchgear
7. **What are the Operational Costs?**
    1. Electricity cost is roughly 2.5x higher than natural gas (2023)
    2. Future forecast 1.1x - 1.5x higher

Country	Relative EF
US	1.00
Canada	0.33
Mexico	1.05
France	0.16
Sweden	0.03
China	1.52
India	1.75
Japan	1.17

Global Carbon Intensity Of Electricity, 2022

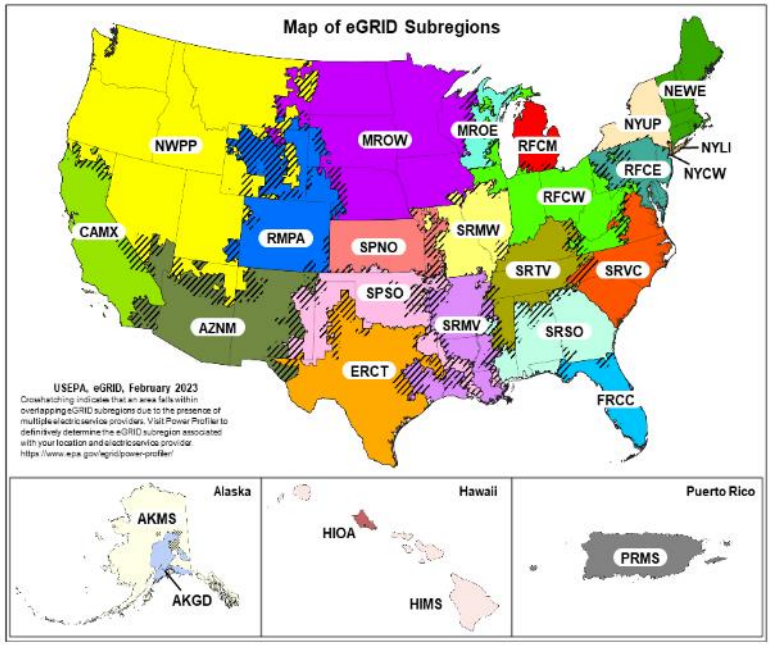
Carbon intensity is measured in grams of carbon dioxide-equivalents emitted per kilowatt-hour of electricity.



Source: Ember's Yearly Electricity Data; Ember's European Electricity Review; Energy Institute Statistical Review of World Energy
OurWorldInData.org/energy • CC BY

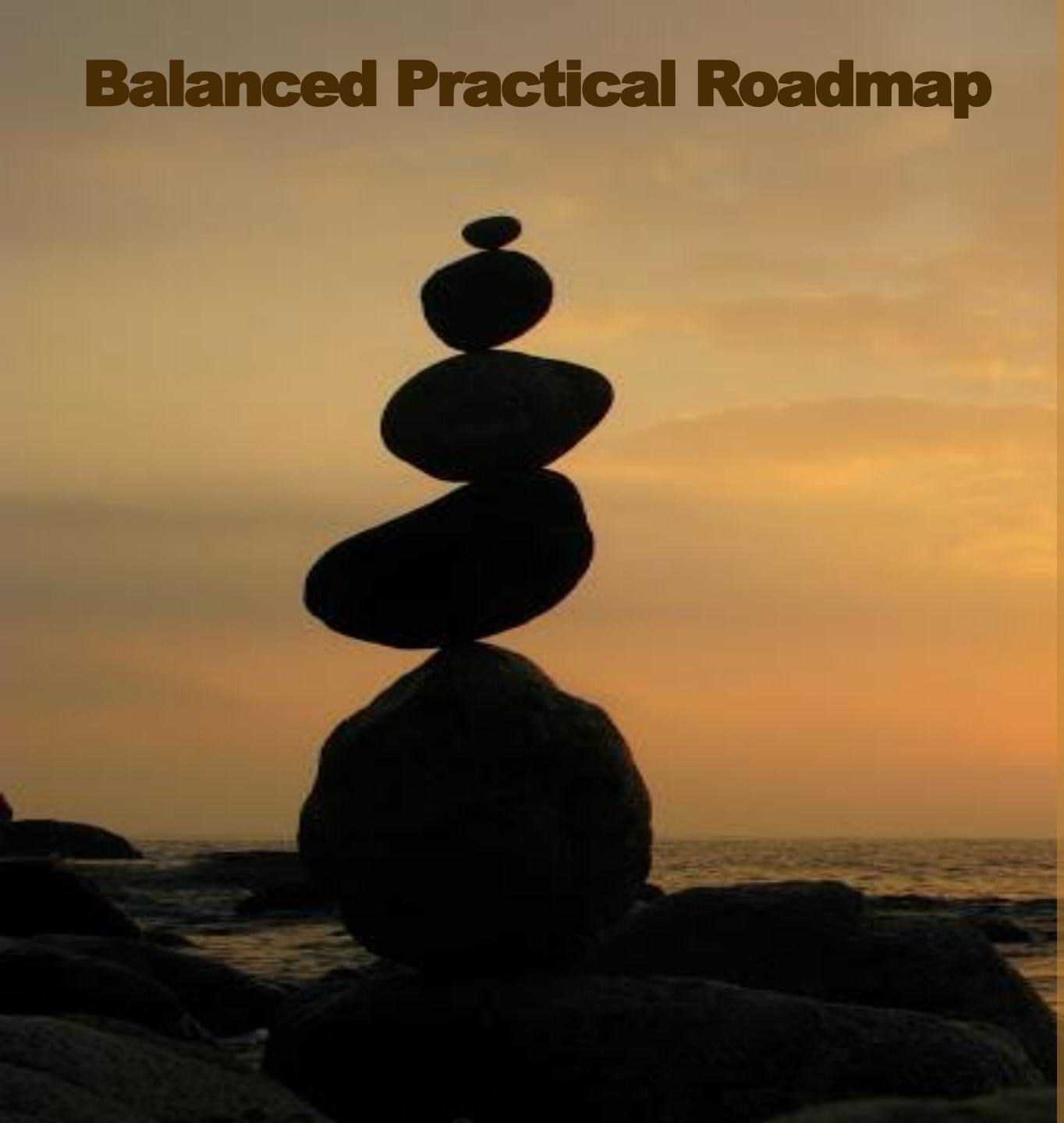
eGRID Subregion Name	Emission Factors kg CO2e / kWh Total Output	Non-Baseload
AKGD (ASCC Alaska Grid)	0.48	0.56
AKMS (ASCC Miscellaneous)	0.22	0.69
AZNM (WECC Southwest)	0.37	0.56
CAMX (WECC California)	0.24	0.48
ERCT (ERCOT All)	0.37	0.53
FRCC (FRCC All)	0.38	0.46
HIMS (HICC Miscellaneous)	0.51	0.75
HIOA (HICC Oahu)	0.74	0.81
MROE (MRO East)	0.72	0.71
MROW (MRO West)	0.45	0.82
NEWE (NPCC New England)	0.24	0.41
NWPP (WECC Northwest)	0.29	0.7
NYCW (NPCC NYC/Westchester)	0.37	0.42
NYLI (NPCC Long Island)	0.55	0.6
NYUP (NPCC Upstate NY)	0.11	0.4
PRMS (Puerto Rico Miscellaneous)	0.71	0.73
RFCE (RFC East)	0.31	0.62
RFCM (RFC Michigan)	0.55	0.78
RFCW (RFC West)	0.47	0.82
RMPA (WECC Rockies)	0.53	0.73
SPNO (SPP North)	0.45	0.87
SPSO (SPP South)	0.47	0.72
SRMV (SERC Mississippi Valley)	0.35	0.53
SRMW (SERC Midwest)	0.7	0.8
SRSO (SERC South)	0.4	0.63
SRTV (SERC Tennessee Valley)	0.42	0.74
SRVC (SERC Virginia/Carolina)	0.29	0.62
US Average	**0.39**	**0.64**

Electric Emission Factors: US



Source: US EPA Emission Factors for GHG Inventories, April 2023

Balanced Practical Roadmap



- Ignore the 2030 to 2050 Hype - Transition will take a while
- Good Partners + Educate
- Work on What You Can Control
  - Decarb Audit & Roadmap What You Have
  - Digitize - BTU + Bits/Bytes = BLEE
  - Service Tuning & Maintenance
  - Better Controls
  - Better Burners / Heat Recovery
- Awareness to Future Proof
  - Low Carbon Fuels
  - Electrification, Heat Pumps, Carbon Capture, etc.

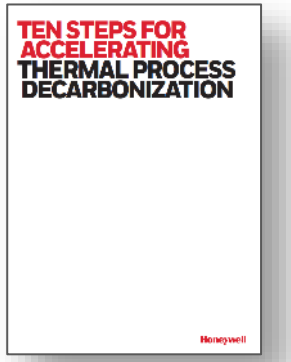
Free Tools and Information

Click Image Tiles to Access Sites

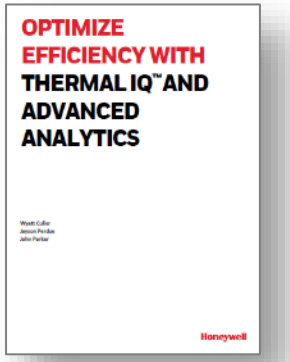
- TIQ Operate Live Feed Demo
- Digitize your Thermal Systems
- Get the App, Its Free!
- Real-time, Remote, Early Performance Alerting

TIQ 2.0 Coming 2024!

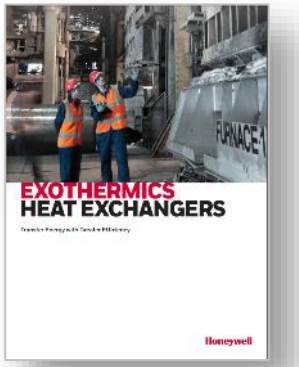
- Advanced Analytics and Reporting
- Enterprise Desktop
- Expanded Edge Devices and Communication Protocols
- Much more…



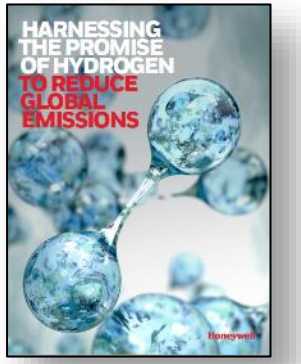
Decarbonization Whitepaper



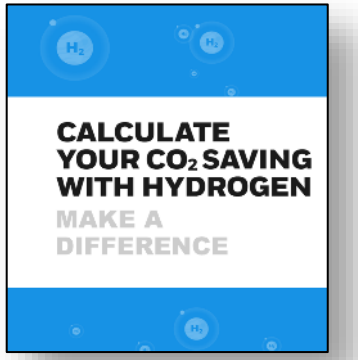
Efficiency Whitepaper



Heat Exchangers

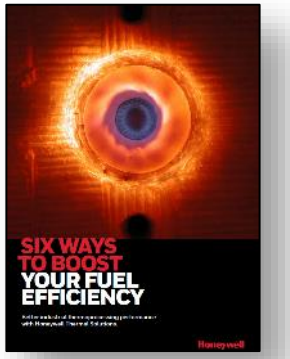


H2 Intro



Calculate H2 Emissions

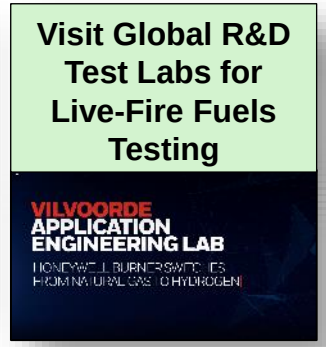
Ecomax Low Emission Burner



Efficiency Platforms

Low NOx

H2 Approved Burners / Components



H2/NG Blend Live-Fire Demos

Your Roadmap for Thermal System Carbon Redux & Business Continuity

Free Tools | Decarbonization Sites

Click Image Tiles to Access Sites

LOW EMISSIONS

Reduce Emissions To Meet Tightening Global Regulations

LEARN MORE

CONNECTED OFFERINGS

Complete suite of IIOT ready products for your combustion processes

LEARN MORE

EXOTHERMIC HEAT EXCHANGERS

Lower Emissions More Control

LEARN MORE

COMBUSTION SAFETY & SERVICES

Thermal Services Decarbonization & Energy Transition

LEARN MORE

Your Roadmap for Thermal System Carbon Redux & Business Continuity

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THANK YOU

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