P2SAC
Purdue Process Safety & Assurance Center

Emissions Monitoring and Reduction

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Honeywell

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PRINCIPAL ENGINEER

HONEYWELL PROCESS SOLUTIONS

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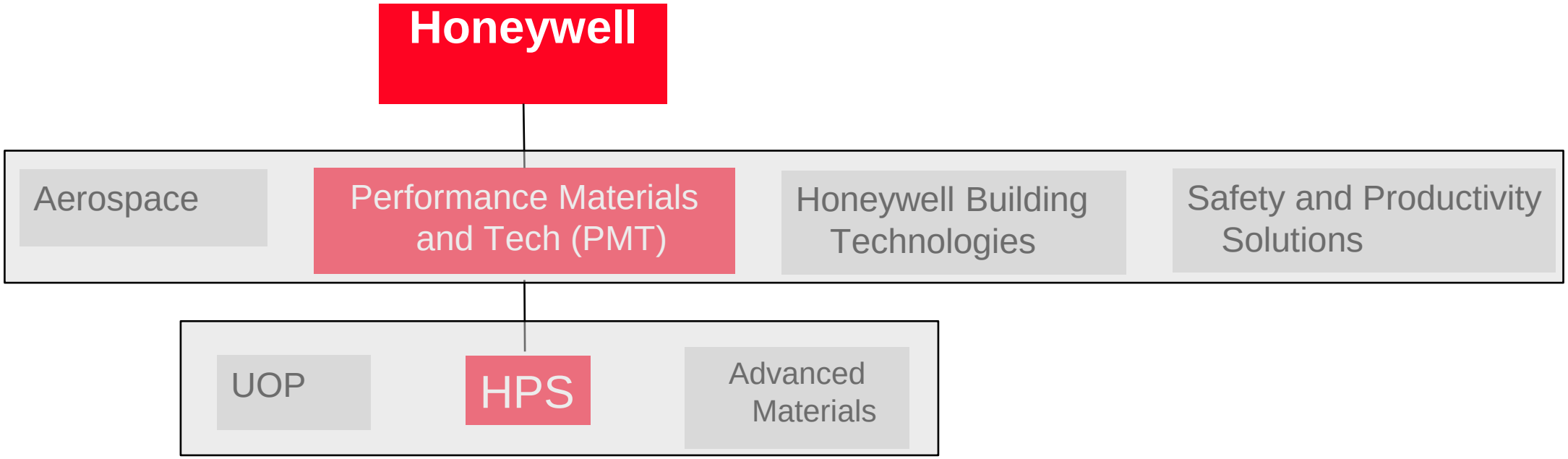
AGENDA

1. Introduction
2. Why Emissions Monitoring
3. Emissions Management Solution
4. Summary and Conclusion

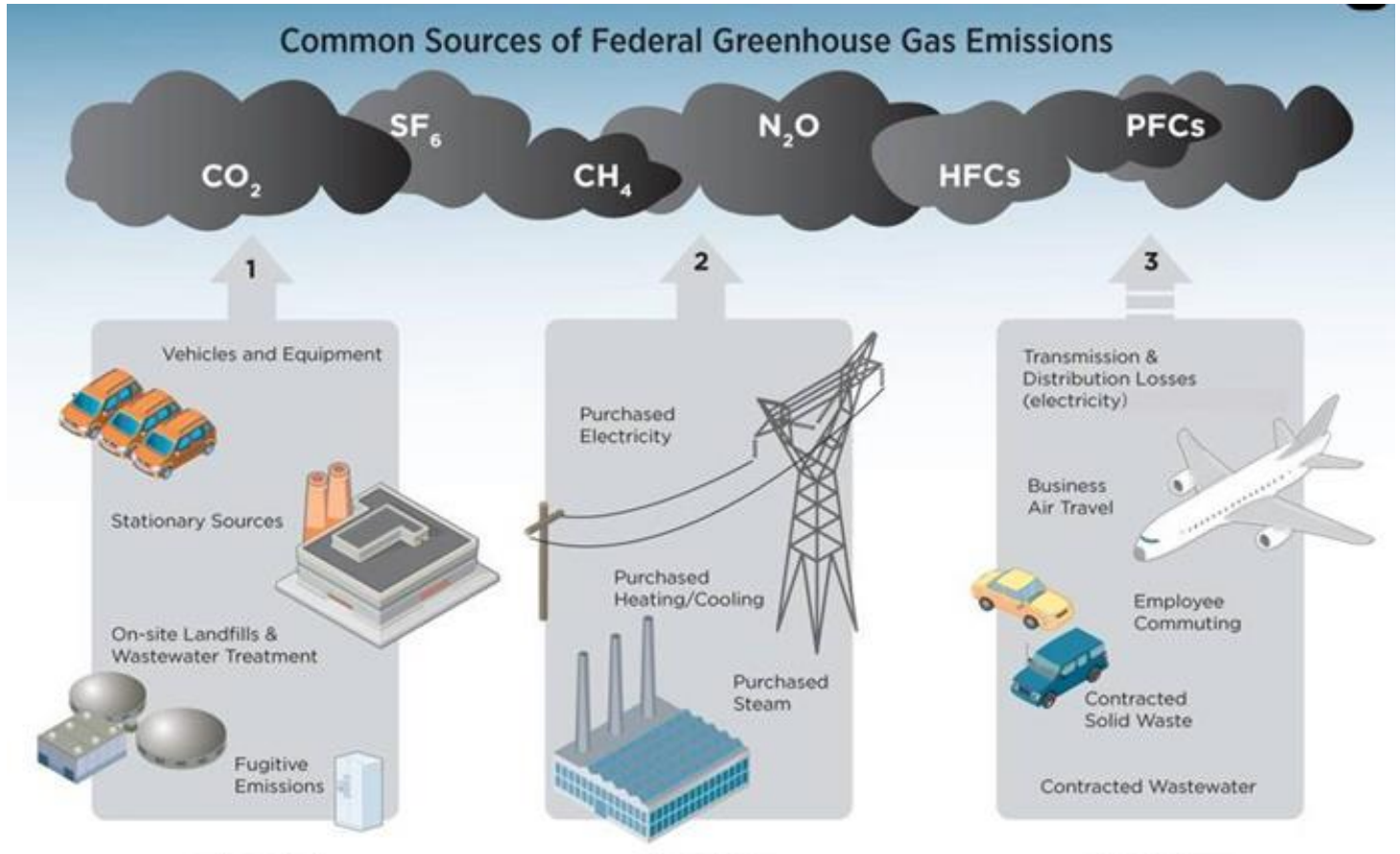


17 GOALS FOR PEOPLE, FOR PLANET

To limit global warming to 1.5C, as called for in the Paris Agreement, greenhouse gas emissions must begin falling by **7.6% each year** starting in 2020

Source: https://www.un.org/sustainabledevelopment/development-agenda/

3 TYPES OF GREENHOUSE GAS EMISSIONS



SCOPE 1:
Greenhouse gas emissions from sources that are owned or controlled by a Federal agency.

SCOPE 2:
Greenhouse gas emissions resulting from the generation of electricity, heat, or Steam purchased by a Federal agency.

SCOPE 3:
Greenhouse gas emissions from sources not owned or directly controlled by a Federal agency but related to agency activities.

To limit global warming to 1.5C, as called for in the Paris Agreement, greenhouse gas emissions must begin falling by **7.6% each year** starting in 2020

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WHY EMISSION MONITORING?

Global Focus
United Nations Climate Change
COP27 Egypt Nov'22
COP28 UAE Nov'23

- Attain Net Zero global emissions by 2050
- COP 27 Restrict Climate Change to 2.0°C
- While continuing to drive to 1.5°C

Government Bodies
European Commission
Environmental Protection Agency
METHANE FOCUS

- **EC – Upcoming regulation on methane emissions reduction in the energy sector & amending EU2019/942**
- EPA - New Source Performance Standards and Emissions Guidelines (Nov '21)

INTERNAL AND EXTERNAL
PRESSURE IMPACT STOCK VALUE

- Reporting from independent sources (Satellites, Planes)
- Neighbourhood Air Sampling
- Claims of 'Greenwashing'

The Pessimist complains about the wind; the Optimist expects it to change;
THE REALIST ADJUSTS THE SAILS *WILLIAM ARTHUR BROWN*

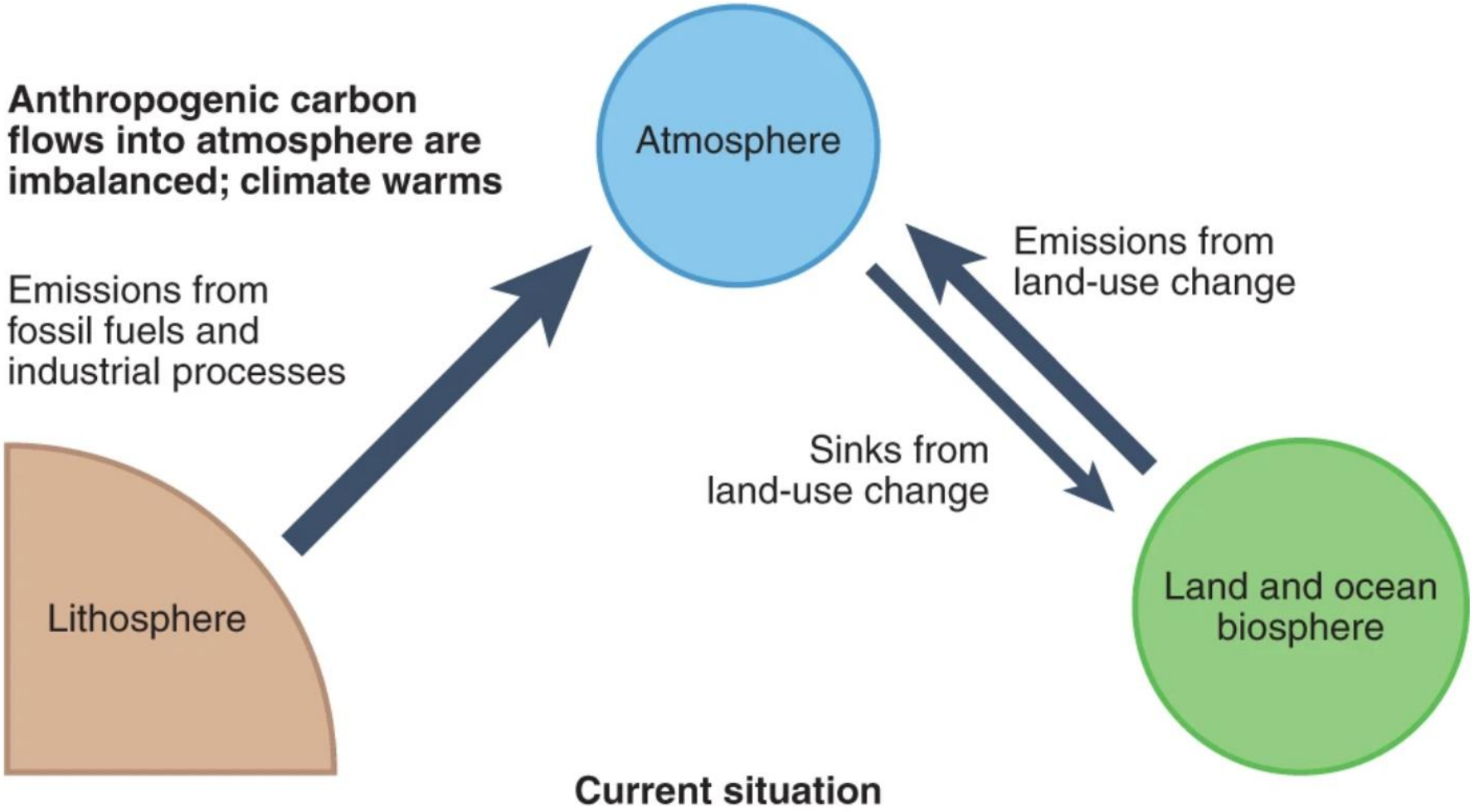
WHAT DOES NET ZERO MEAN ?

Net zero is intrinsically a scientific concept. If the objective is to keep the rise in global average temperatures within certain limits, physics implies that there is a finite budget of carbon dioxide that is allowed into the atmosphere, alongside other greenhouse gases. Beyond this budget, any further release must be balanced by removal into sinks

Net Zero is not the same as Absolute Zero

REF, https://www.nature.com/articles/s41558-021-01245-w#Fig1

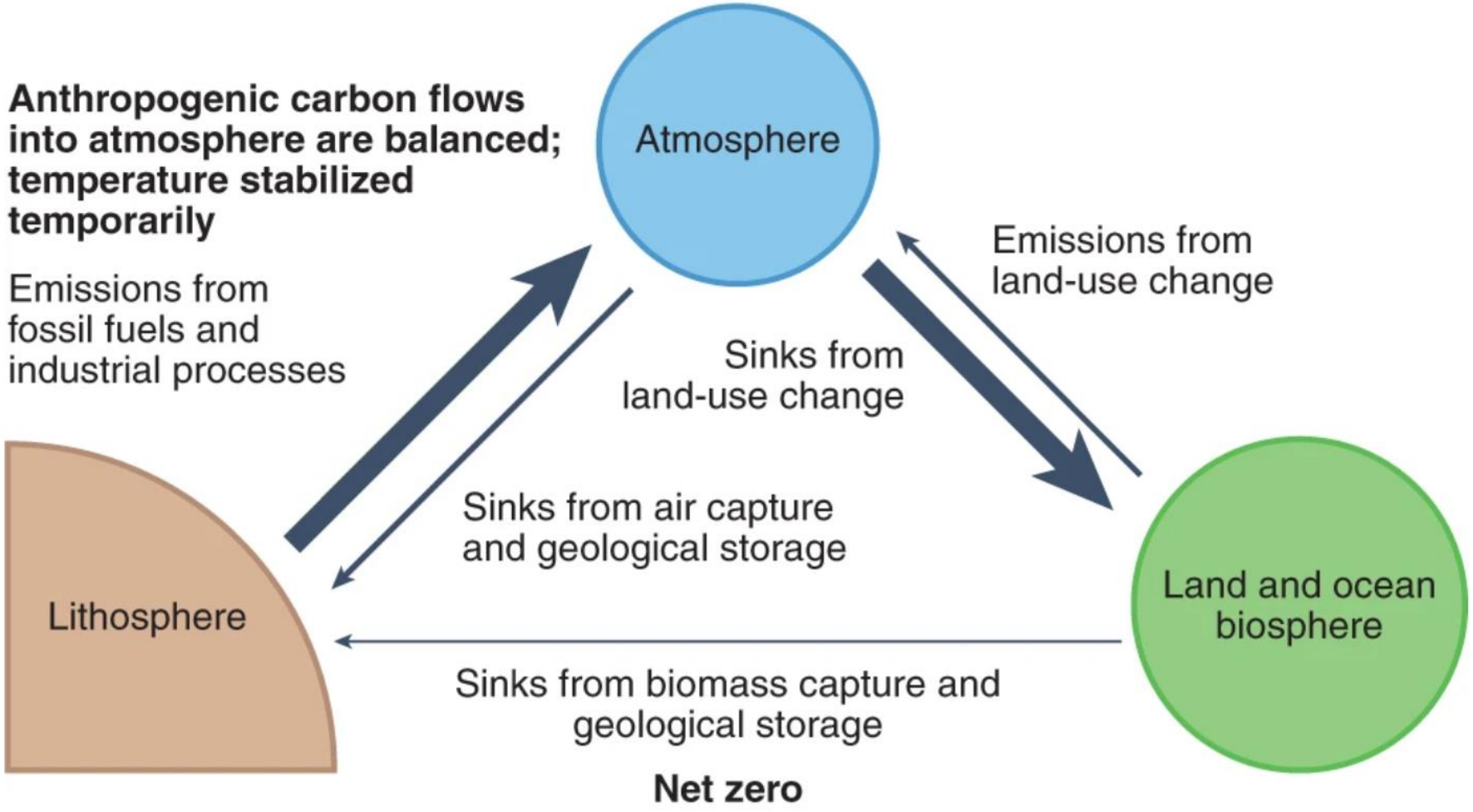
CURRENT SCENARIO



Excess GHG into the Atmosphere

REF, https://www.nature.com/articles/s41558-021-01245-w#Fig1

HOW TO ACHIEVE NET ZERO



Net zero balance of GHG into the Atmosphere

REF, https://www.nature.com/articles/s41558-021-01245-w#Fig1

WHY EMISSION MONITORING?

TARGET CARBON EMISSION

Methane emissions account for about 25% of the warming experienced today[1]

Methane has more than 80 times the climate-warming impact of CO_2 in the 20 years following its release[1]

PLANT EFFICIENCY

Leaks mean lost product – In 2021 alone, the global oil and gas industry wasted $19 billion of natural gas due to methane emissions[1]

Reduce time spent on LDAR measurements and periodic EPA emission audits

Find problems faster

PLANT WORKER SAFETY

Continuous detection system improves worker safety

Emission Monitoring supports Environmental, Tax and Efficiency Goals

[1]https://ogmpartnership.com/

RELATIVE GWP OVER 100 YEARS PERIOD

Global Warming Potential (GWP) is a comparison between ONE Ton of CO2 with ONE Ton of other GHG over a Period of time

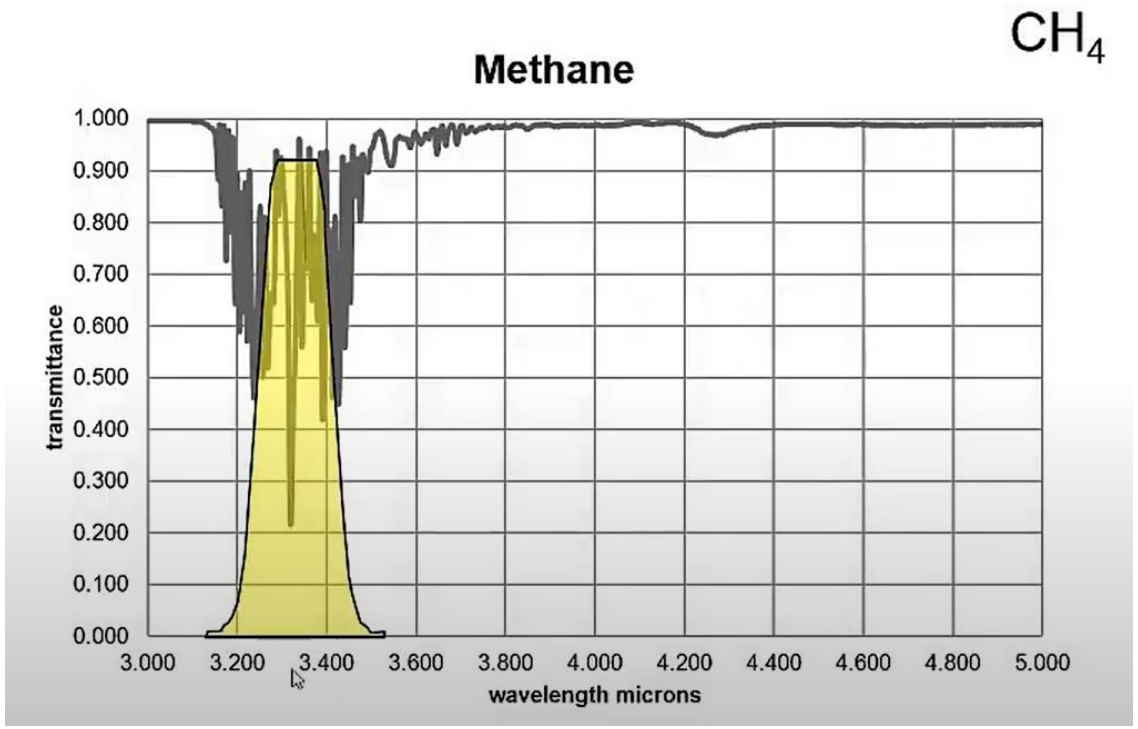
“Period of Time” because some gases dis-integrate or chemically react with other gases in the Troposphere

Greenhouse Gas	Global Warming Potential (GWP)
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298
Hydrofluorcarbons (HFCs)	124 – 14,800
Perfluorocarbons (PFCs)	7,390 – 12,200
Sulfur hexafluoride (SF_6)	22,800
Nitrogen trifluoride (NF_3)	17,200

FACT - First 20 years, Methane has a GWP of 80 !

TECHNOLOGY TO DETECT METHANE AND OTHER GHG

Typically by using Infra Red (IR) spectroscopy techniques



Every gas has a specific absorption wavelength in the IR band of the EM spectra

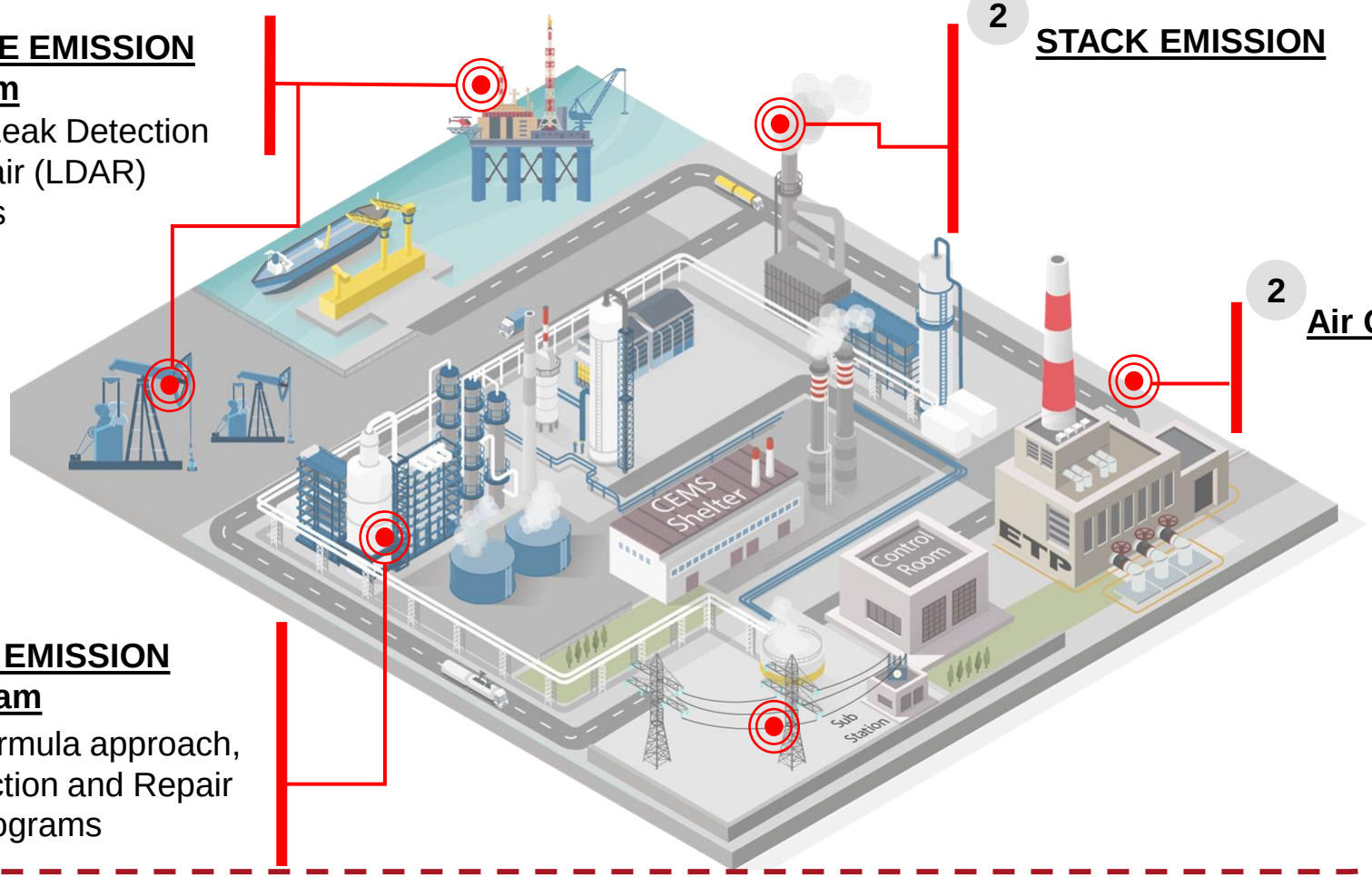
INDUSTRIAL EMISSIONS TYPES

PROCESS EMISSION
- Mass Balance Approach
- Unlikely seen by LDAR
- Continuous Monitoring Essential

1 **FUGITIVE EMISSION Upstream**
Sensor, Leak Detection and Repair (LDAR) Programs

2 **STACK EMISSION**

2 **Air Quality**



1 **FUGITIVE EMISSION Downstream**
Sensor, Formula approach, Leak Detection and Repair (LDAR) Programs

1 Fugitive Emissions
Accidental GHG emissions that occur from leaks at valves, pumps, and other equipment. EPA estimates that 5-10% of total VOC's (Volatile Organic Compounds) are from equipment leaks.

2 Direct Emissions
Direct GHG emissions associated with fuel combustion. Typically estimated using process calculations. With predictive calculations, you may under or over report.

CURRENT MANUAL STATE

TOP DOWN
PERIODIC

BOTTOM UP (most popular)
PERIODIC
- Leak Detection & Repair (LDAR)
- LDAR + Optical Gas Imaging OGI

ESTIMATED
RETROSPECTIVE
- Based on number of assets & factors

CHALLENGES
- Sees leaks as a snapshot in time
- Labour intensive, human element
- Limited visibility of the emissions related to process venting
- Reactive maintenance
- Losses of product and impact of potential fines and/or taxes

Legislation will require accurate data for total methane emissions

CREATING THE FOUNDATION FOR NET ZERO PATHWAYS

MEASURE

Automated Real-time Emissions Coverage

Gas Cloud Imaging

Detectors close to leak source working on molecular spectroscopy

- Near real-time emissions monitoring
- "Top-down + Bottom-up" source level measurement

MONITOR & REPORT

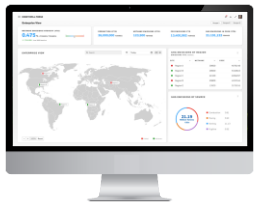
Site & Enterprise Level Trending & Visualization

Site Level Software

- Precisely locate methane emissions leak
- Notify methane leaks that may cause production loss or impact the safety

Sustainability+ Emissions Management

- Enterprise-wide emissions accounting, visualization and reporting.



REDUCE

Enable Automated & Manual Emissions Actions

Proactive Leak Monitoring & Measurement

Emissions Outcome Based Programs

Energy Efficiency

Carbon Capture

Hydrogen Transition

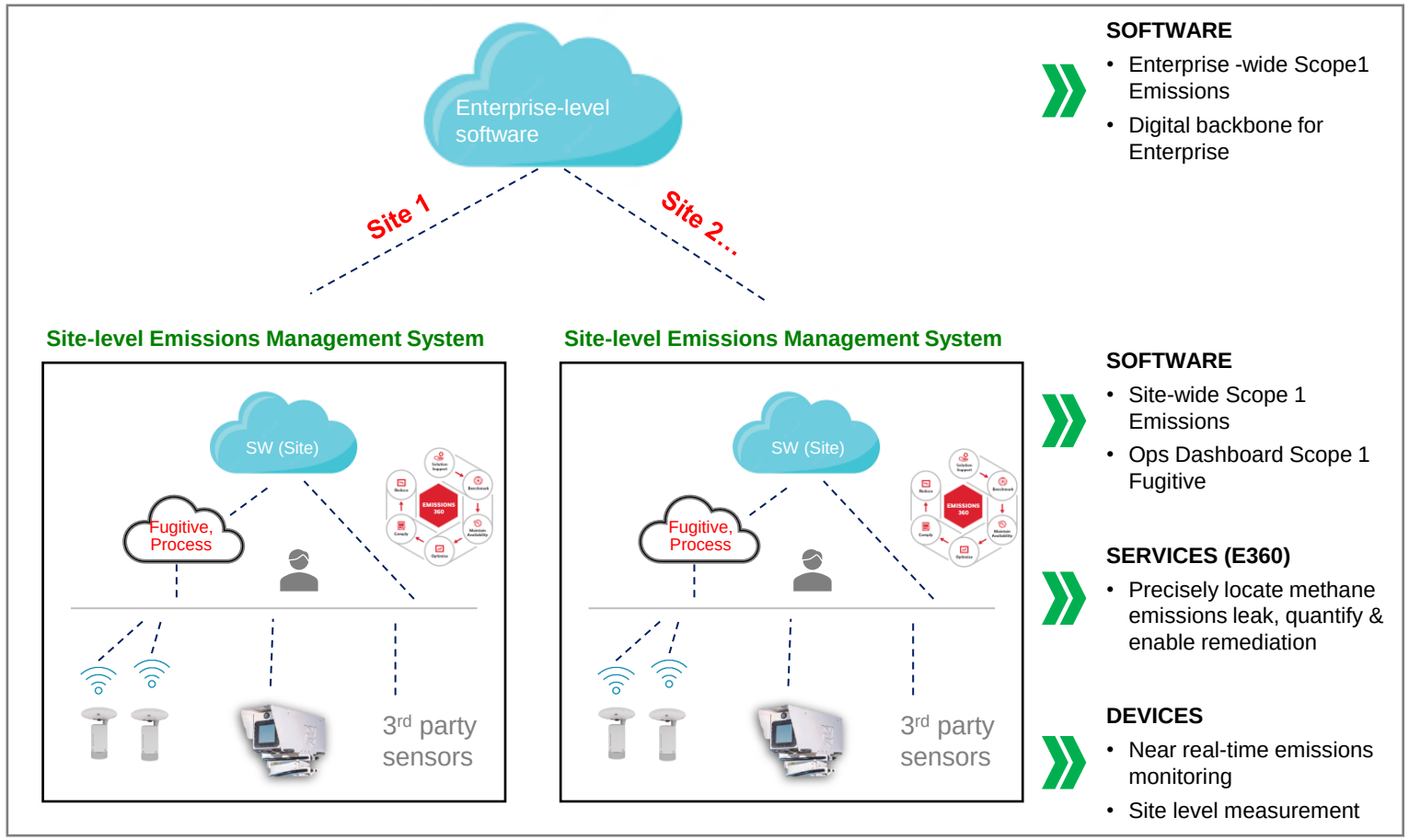
Green Electricity & BESS

Closed-loop Programmatic Transformation and Carbon abatement programs

EMISSIONS MANAGEMENT SOLUTION

Emissions Offerings / Outcomes

Scope 1 baseline measurement and enable Methane Remediation:
Near real-time measurement, monitoring and analytics, outcome-based methane remediation service



SOFTWARE
- Enterprise -wide Scope1 Emissions
- Digital backbone for Enterprise

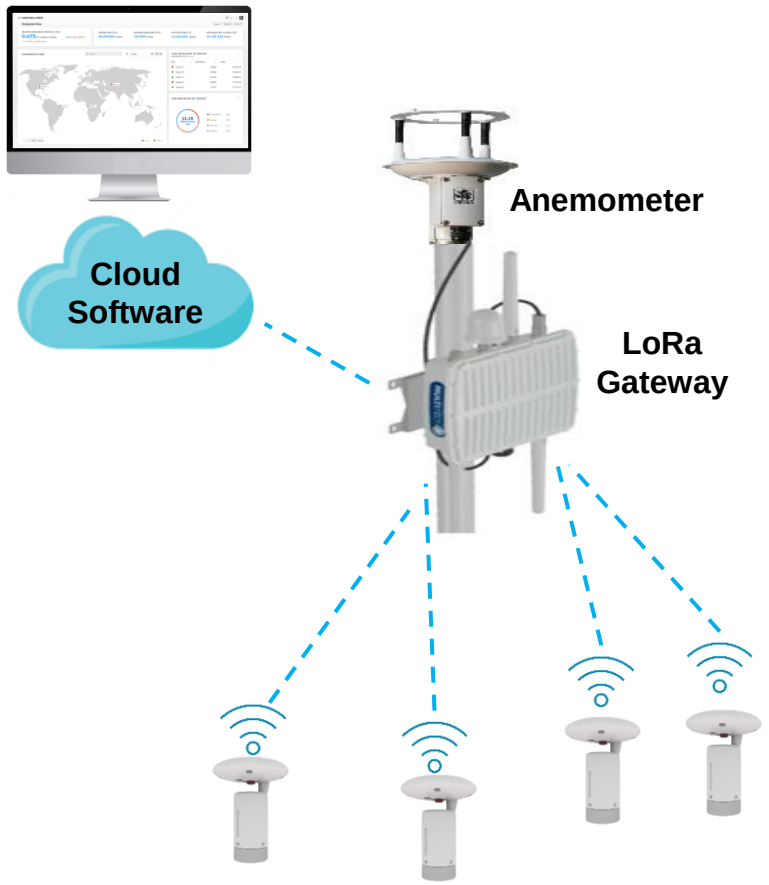
SOFTWARE
- Site-wide Scope 1 Emissions
- Ops Dashboard Scope 1 Fugitive

SERVICES (E360)
- Precisely locate methane emissions leak, quantify & enable remediation

DEVICES
- Near real-time emissions monitoring
- Site level measurement

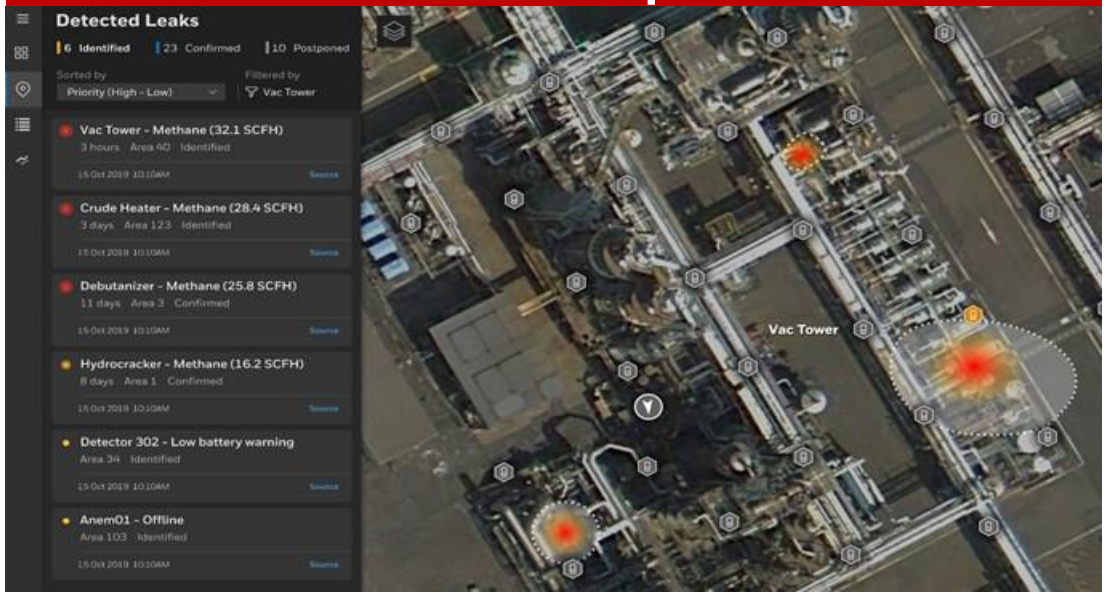
EMISSIONS MANAGEMENT SOLUTION

Architecture



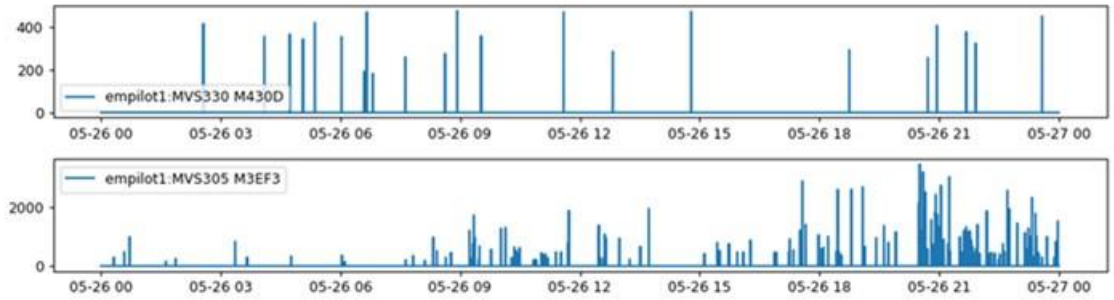
EMISSIONS MANAGEMENT SOLUTION

Leak Location & Inspection Area



Device Deployment

Fugitive



Process

Industry First breakthrough with Hazardous Area Certified devices

SUMMARY

FOCUS ON HEART OF THE PROCESS

Continuously MEASURE

- **Rebellion Gas Cloud Imaging**
- **Honeywell Versatilis™Signal Scout™**
- Automated near real-time
- Low-cost Wireless Technology
- Easy installation & Low Maintenance
- Deployed in the hazardous area

Continuously MONITOR

- Accurate leak location
- Leak size & quantification
- Classification of fugitive & process emissions
- Trending emissions with process data

Near real-time REPORT

- Honeywell Emissions Management solution
- Visibility of actual scope1 emissions
- Scalable to multi-site enterprise operations
- External reporting for compliance

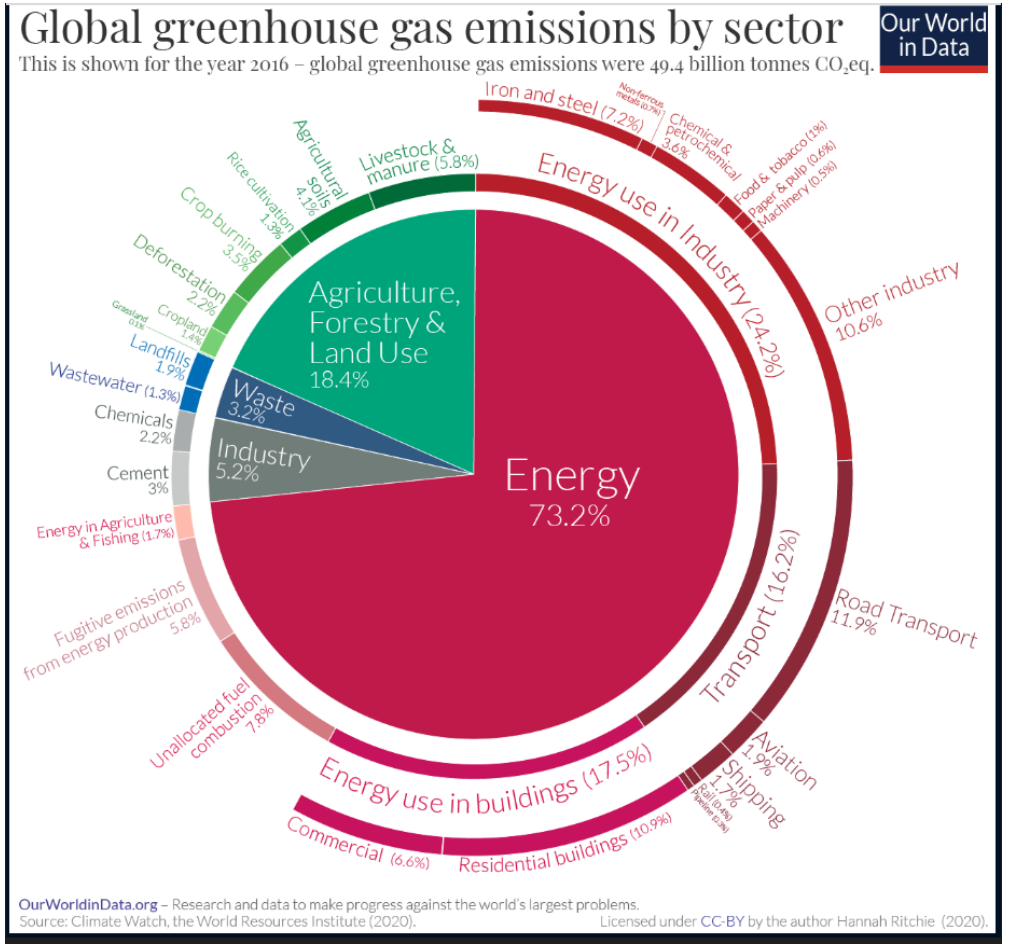
REDUCE Emissions

- Enable automated and manual emissions actions
- Software enabled process optimization
- Emissions reduction programs
- Outcome based service programs for reduction

Creates total methane emission data enabling compliance & reduction

CONCLUSION

- **Need more viable techniques to detect and monitor all GHG**
- **Monitoring is required not just in the industrial setup but all sectors which produce GHG**
- **Even more important is , how to REDUCE GHG ! That is for another presentation……**



Monitoring and Reduction of GHG will help achieve Net Zero

THANK YOU

Honeywell