

Tegre Emissions Solutions – US Emissions / EU Imports

- **Key Questions to Address**

- What is going on with **methane emissions** in the US oil and gas industry?
- How do US LNG imports factor into **EU** future natural gas **consumption**?
- What impact will the **EU Import Standard** have on US LNG?

- **Topics**

- Evolution of LNG exports, emissions management since shale revolution (last 20 years)
- Overview of **emissions regulations** and reporting requirements
- Realities about the **gap** between **reporting** and **real-world** emissions
- What the **EU can expect** from US-based producers in the next 5-10 years

Important Themes:

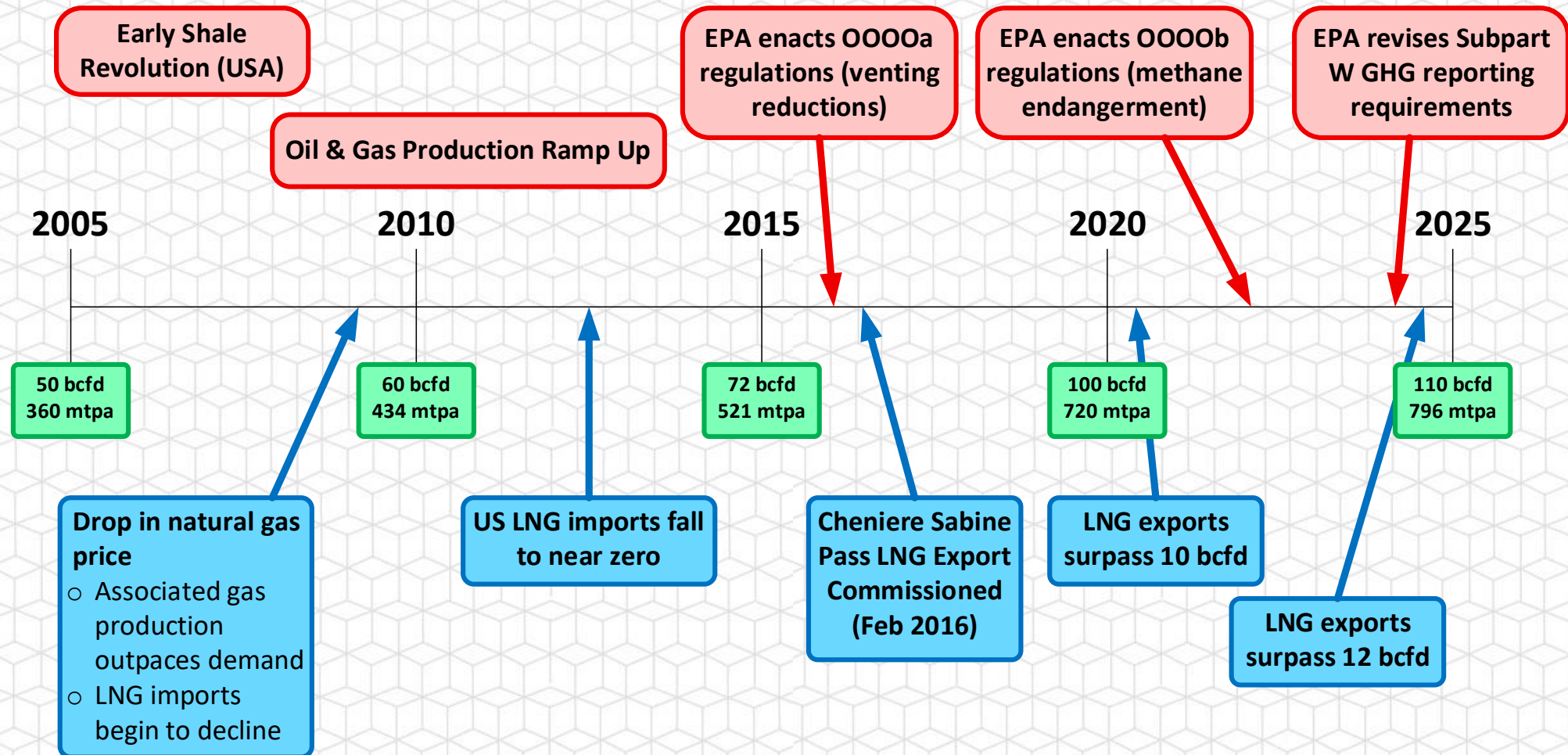
- The EU may become **more reliant** on US LNG as it moves away from Russian gas
- **Emissions** associated with US production is likely **MUCH higher** than previously reported
- The **EU Import Standard** will likely put pressure on US producers to improve



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US Shale Revolution / LNG Exports – 20 Year Overview

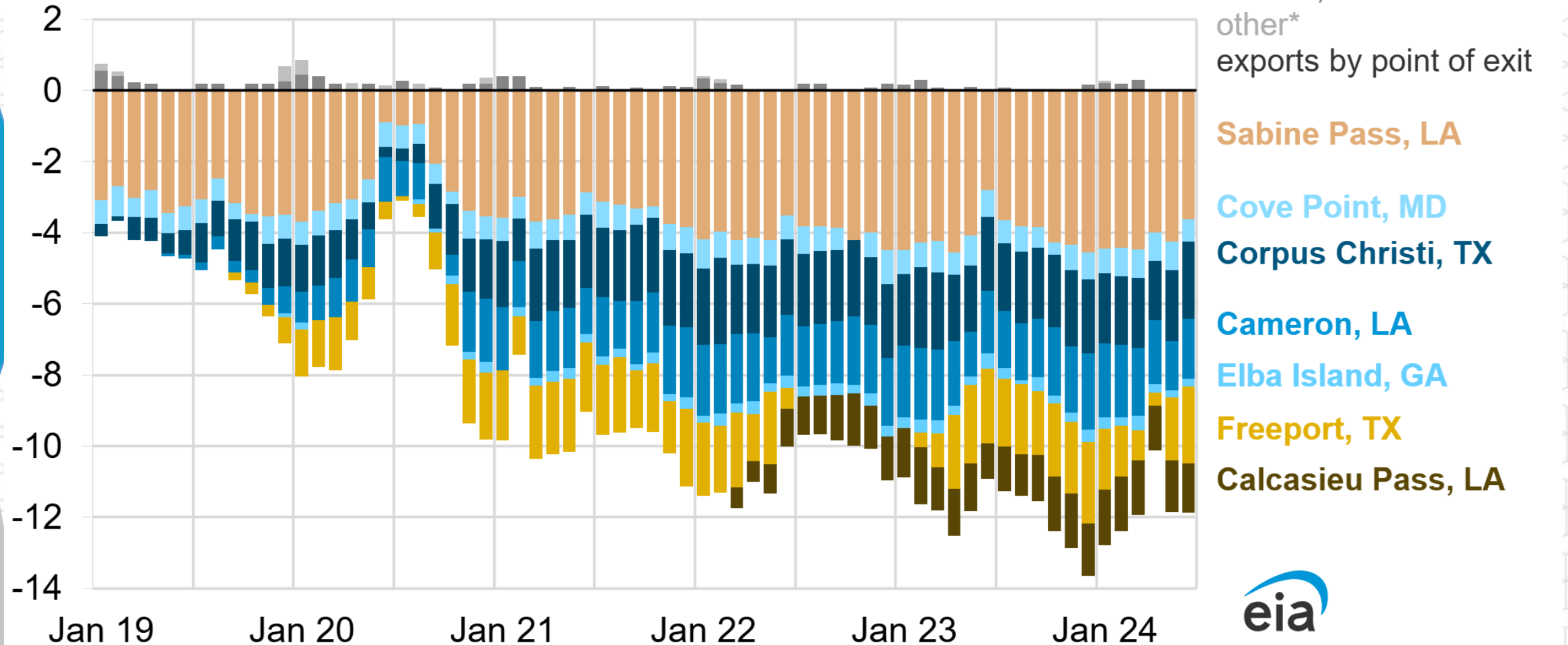
- US Industry / Regulatory Developments
- Domestic Natural Gas Production
- LNG Exports Key Milestones



US LNG Exports by Location

U.S. monthly liquefied natural gas trade (Jan 2019–Jun 2024)

billion cubic feet per day



Realities About US Methane Emissions

- **Background - Greenhouse Gas Reporting**

- The EPA started Greenhouse Gas Reporting Program (**GHGRP**) in **2011**
- Largely based on equipment inventories, NOT measurements or leak detection
- Some aspects led to **over-reporting**
 - Pneumatic controllers
- Most aspects led to **under-reporting**
 - Flares (either unlit or poor performance)
 - Tanks Relief Devices
 - Vapor Recovery Units (VRUs)
 - Blowdowns
- Reporting is often based on runtime, overall effectiveness **assumptions**
- Many operators have **lacked awareness** of rules, rigor around application

- **Background - OOOO Regulations**

- Introduced in 2008
- Greatly **expanded** in 2015 (OOOOa)
 - Reduction in tank emissions
 - Better flare technology
 - Applied mainly to **VOCs** (Volatile Organic Compounds)
 - Did NOT include **methane emissions** in regulation
- Revised in 2023 (OOOOb)
 - **Incorporated methane emissions** into applicability criteria
 - More potential sources included in requirements for **NEW** locations
 - Introduced **Super-Emitter Program**

Realities About US Methane Emissions

- **Net Effect of GHGRP & OOOO**

- Behaviors **misaligned** with greatest needs
 - Reduction in pneumatic controllers
 - Continued **poor performance** of flares, VRUs
- **Enforcement** was originally lacking...
 - This has **improved** in recent years thanks to more flyovers, public scrutiny
 - **Enforcement action** for repeat offenders is **slow** (>2 years)
 - May be **reduced** under new administration
- The latest GHGRP (2024) is **greatly improved**, initial implementation **underway**
- Reporting does **NOT** match reality
 - Most companies that comply with **OGMP 2.0** find that their real-world emissions are **3-5X** what they have been **reporting**

- **Pitfalls / Common Issues**

- Operators often carry out **False Fixes**
 - **Process variability** can be hard to pinpoint
 - Emissions from **relief devices** are normally **NOT caused** by faulty relief devices
- Example of **misreporting**
 - Oil processing facility with storage **tanks**, **VRU**, and **flare**
 - Original permit calls for 95% runtime on VRU, 98% destruction efficiency for flare
 - **No** runtime / flowrate **instrumentation** on VRU or flare
 - Reporting consultant assumes performance matches permit
 - **ESG Director** gets report that actuals **exactly** match forecast (!)
- **Sad Reality:** Many companies have been **hiding** behind superficial reporting methodology

EU Natural Gas Import Standard

- **Key Ideas**

- LNG importers must report Methane Intensity (MI) of sourced natural gas
- Data will be based on **OGMP 2.0**
 - Oil and Gas Methane Partnership
 - Created by the UN in 2014 / 2020
 - Largely based on measurement, not equipment inventories
- Quantification (such as OGMP 2.0) requirement goes into effect in **January 2027**
- **MI Limit** will start being enforced in **2030**
 - Exact MI limit has not been established by EU
- Potential Consequences
 - Import access blocked
 - Fees
 - Alternate pricing

- **What does this mean for US LNG in the next 5 years?**

- US LNG export capacity **expected to double** by 2030
- **Pressure to comply** will cascade from LNG exporters to **upstream** producers
- **Very few** US operators are following OGMP 2.0 standard
- Main focus: Molecules that flow to **US Gulf Coast**
 - Haynesville
 - Permian
 - Mid-Continent
 - Appalachia
- Many companies **will struggle** to get **actual emissions** down to acceptable level
- **Hardest hit:** Private and PE-backed operators who do not have diversified portfolios

Discussion / Notes / Conjecture

- What will the EU MI limit be?
 - Proposed Methane Intensity Limit: 0.2%
 - Previous US administration was working towards national level equivalency w/ taxation above this level
- What if critical suppliers do not meet this limit?
- What if critical suppliers meet this limit but lack transparency?
- Current LNG import sources:
 - USA
 - Qatar
 - Russia
 - Algeria
 - Nigeria
 - Other (15%)



Get Ready for the Berlin Gas Lift



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Tegre Emissions Solutions

Moving Beyond Super-Emitters



- Super-Emitters have been the primary focus for many countries and organizations. However...
- Global methane emissions are **not decreasing** at the rate expected
- The contributions from the large number of **medium sources** are not being addressed quickly enough
- Medium-Emitters require a **different** approach
 - Most super-emitters are “find-it-fix-it” solutions.
 - Most **medium-emitters** are systemic and require **engineering solutions**
- Types of Sources
 - Relief devices
 - Vapor recovery systems
 - Flares
 - Important: The **source** may not be the **cause**!
- Medium-Emitters May Be Intermittent
 - Process variability may lead to inconsistent equipment performance
 - **Good News:** Solutions are often scalable
 - **More Good News:** Finding solutions **may take time**, but they are often **low cost**

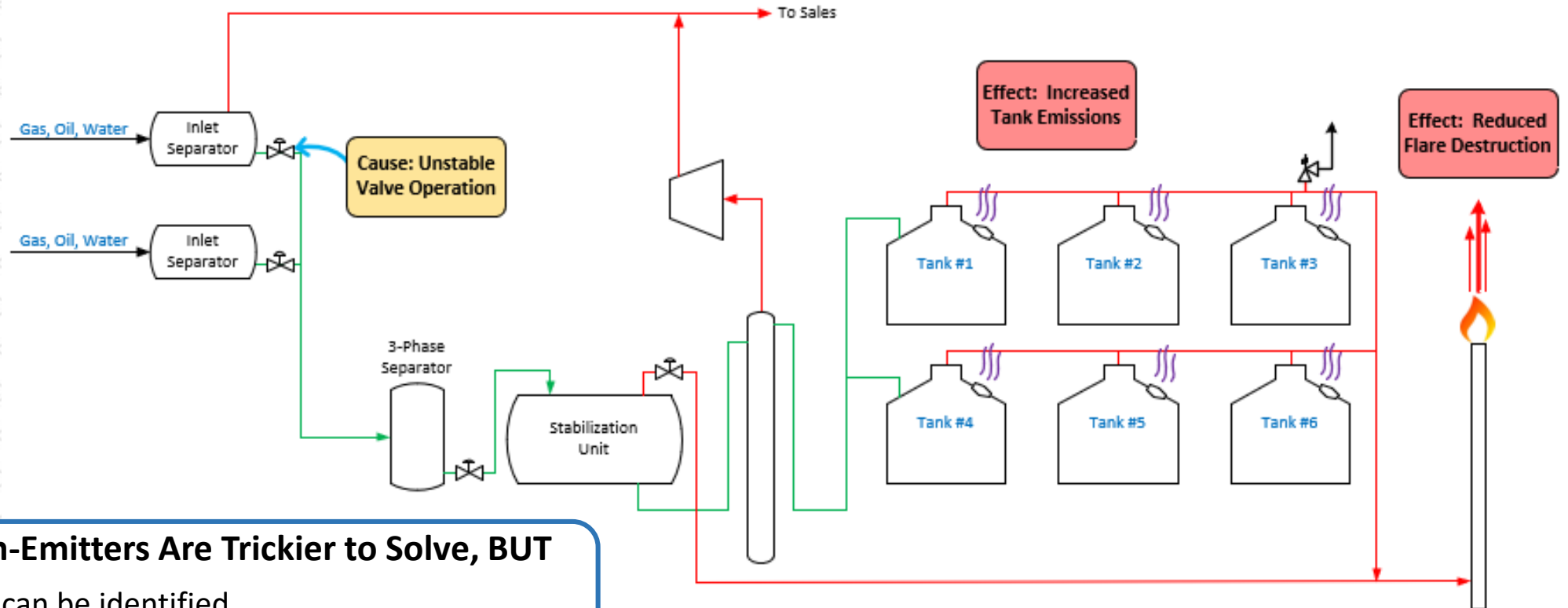
Key Idea: Start Addressing Medium-Emitters Now

- **Medium-Emitters** often add up to **larger emissions** than Super-Emitters
- More **time** is needed to analyze individual situations, **engineer** solutions
- These sources are often **intermittent** and require effective **remote** monitoring

Tegre Emissions Solutions

Process Variability Example

- **Cause:** Unstable Valve Operation
- **Effects:**
 - Uncontrolled tank emissions
 - Poor flare destruction efficiency
- **Solution:** Improved process controller tuning
- **Scalability:** This solution can likely be implemented on **similar** locations



Key Idea: Medium-Emitters Are Trickier to Solve, BUT

- **Low-cost** solutions can be identified
- Once found, solutions can be **scaled and replicated**

The Tetre Emissions Solutions Way

- Don't do everything, but do a **little bit of everything**
- Work on solutions to Super-Emitters and Medium-Emitters in **parallel**
- Identify **low-cost solutions** that can be scaled and replicated **quickly**
- Utilize effective **remote monitoring** and **measurement** technologies



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