

Basin-Level Surveillance (BLS): Reducing Social and Operational Risk

*Using Hyperspectral Data and Analytics for Surface
and Near Surface Surveillance*

BASIN LEVEL SURVEILLANCE

Blending existing information (infrastructure and facilities mapping, GIS, atmospheric and surface modeling, meta data, etc.) with emerging data (SWIR, MWIR, hyperspectral, etc.) to deliver “elevated” solutions that reduce social and operational risks.

SOCIAL RISKS

- **Public Opposition**
- **Political Pressures**
- **Heightened Publicity**
- **Uninformed Stakeholders**
- **Competing Land Use Interests**
- **Increasing Rural Densities**



OPERATIONAL RISKS

- **Encroachment**
- **Loss of Primary Containment**
- **Deteriorating Infrastructures**
- **Acquisition/Divestiture Information Gaps**
- **Fluctuating Regulations and Compliance**
- **Methane and VOC Emissions**
- **Tightening of Lease Operating Agreements**



SURVEILLANCE TECHNIQUES

Active Surveillance

Scheduled Facility & Infrastructure Stops
Constantly Manned Facilities
Visual Inspections



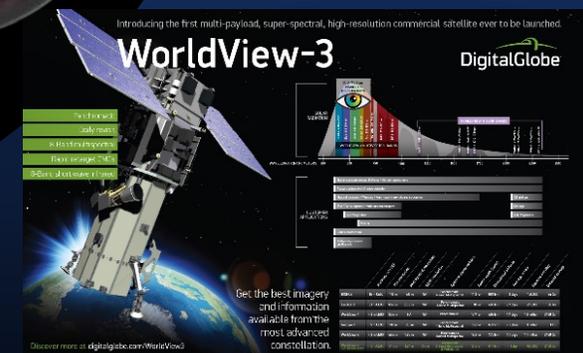
Mixed Surveillance

Remote Monitoring
Low-Altitude Aircraft
Drones/UAVs



Passive Surveillance

Large Payload Satellites
Small Payload "Nano" Satellites
Fixed/Persistent Platforms



WHY PASSIVE SURVEILLANCE

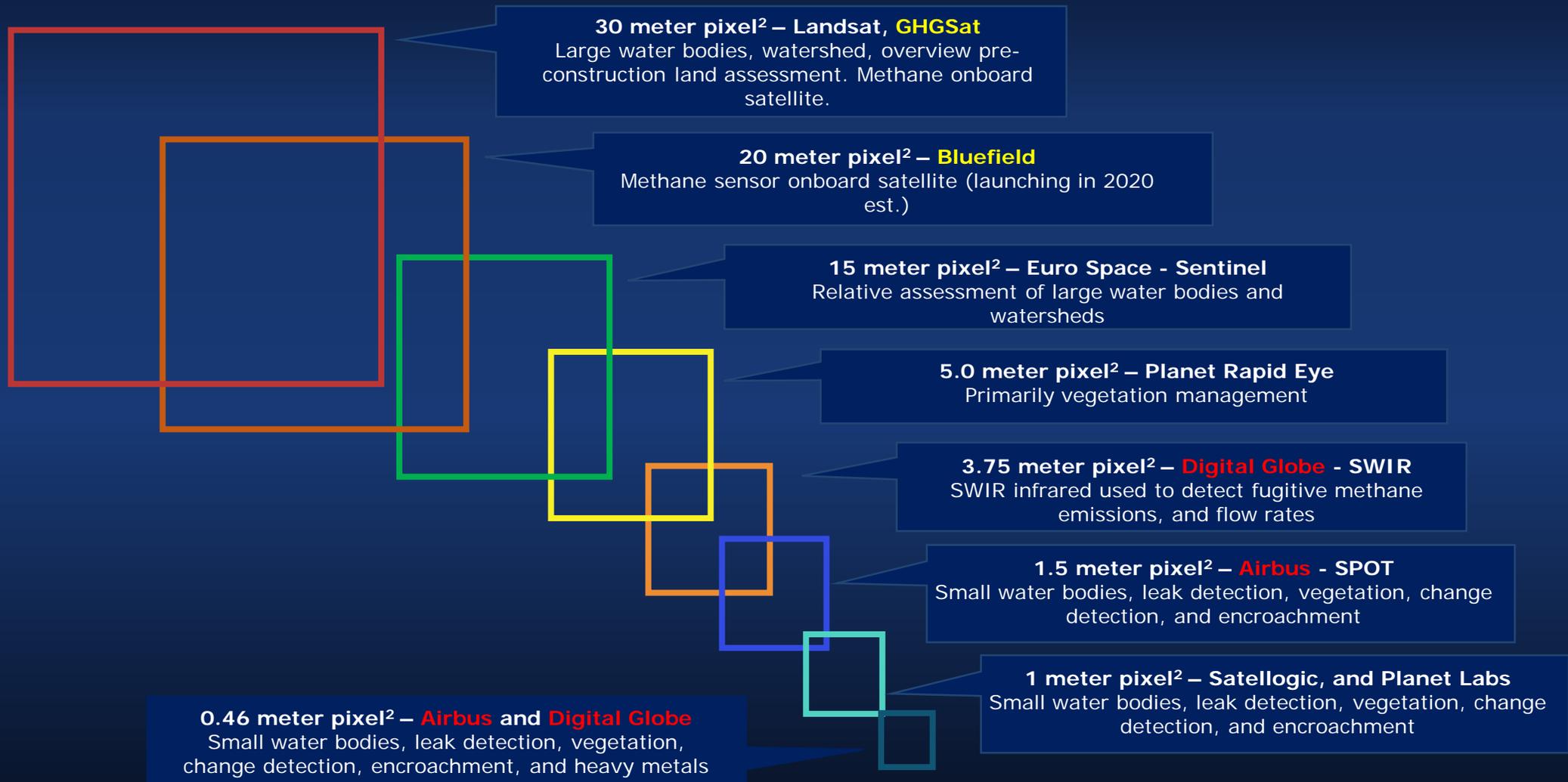
- ✓ **Widespread (Existing and Emerging Uses)**
- ✓ **Non-Intrusive**
- ✓ **Collaborative Industry-Wide Approach**
 - **Shared Data Resources**
 - **Better Asset and Infrastructure Delineation**
 - **Pathway to Operational Excellence & Improved Social License to Operate**

OPERATIONAL & SOCIAL BENEFITS

- ✓ **Proactive vs. Compliance Driven**
- ✓ **Improved Surveillance Frequency**
- ✓ **Expanded Surveillance Area**
- ✓ **Improved Public and Environmental Protection**
- ✓ **Improved Safety (Fewer Man-Hours)**
- ✓ **Reduced Operating & Environmental Costs**
- ✓ **Influence Public Perception**
- ✓ **Possible Alternative Compliance**



RESOLUTION



30 meter pixel² – Landsat, GHGSat
Large water bodies, watershed, overview pre-construction land assessment. Methane onboard satellite.

20 meter pixel² – Bluefield
Methane sensor onboard satellite (launching in 2020 est.)

15 meter pixel² – Euro Space - Sentinel
Relative assessment of large water bodies and watersheds

5.0 meter pixel² – Planet Rapid Eye
Primarily vegetation management

3.75 meter pixel² – Digital Globe - SWIR
SWIR infrared used to detect fugitive methane emissions, and flow rates

1.5 meter pixel² – Airbus - SPOT
Small water bodies, leak detection, vegetation, change detection, and encroachment

1 meter pixel² – Satellogic, and Planet Labs
Small water bodies, leak detection, vegetation, change detection, and encroachment

0.46 meter pixel² – Airbus and Digital Globe
Small water bodies, leak detection, vegetation, change detection, encroachment, and heavy metals

FUTURE EMISSIONS TRACKING



E&ENews
ENVIRONMENT

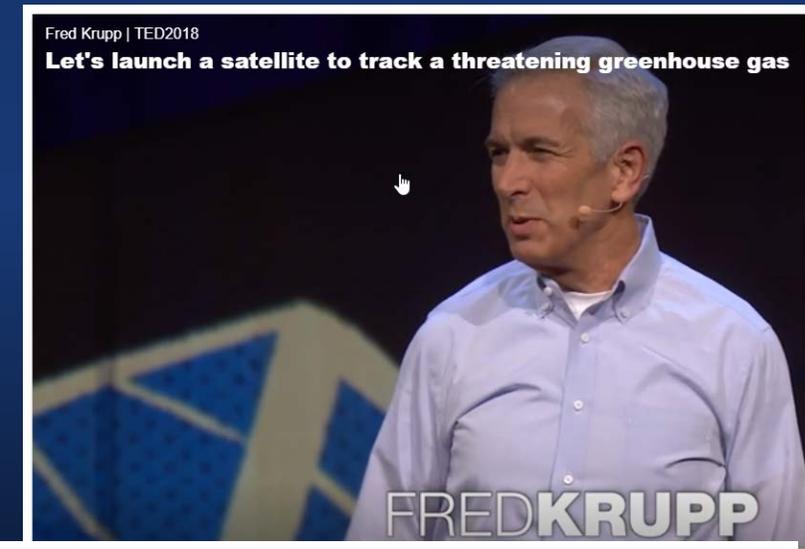
Meet the Satellites That Can Pinpoint Methane and Carbon Dioxide Leaks

European :
▶



Fred Krupp | TED2018

Let's launch a satellite to track a threatening greenhouse gas



FREDKRUPP

EDF Announces Satellite Mission to Locate and Measure Methane Emissions

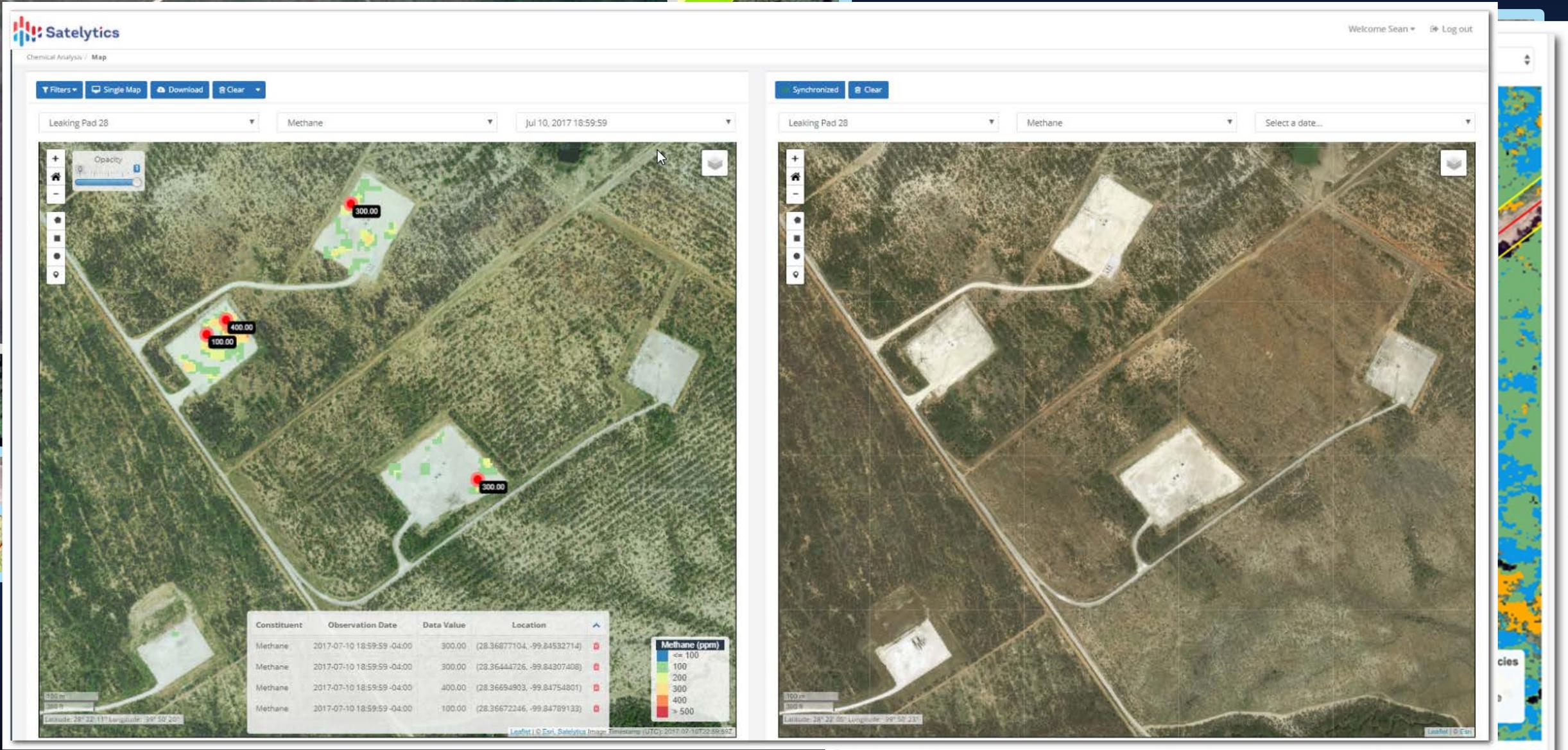
New TED Talk reveals collaborative vision designed to build better science, accelerate global reductions in oil & gas methane emissions



Satelytics



Change Detection for Methane Detection



Opportunities

- Leak Detection
 - Land or Waterways
 - Hydrocarbons
 - Produced water
 - Methane
- Encroachment
 - Rural Development
 - PHMSA, DOT
- Surface Disturbance
 - Land Erosion
 - Waterways
- Reclamation
 - Vegetative Speciation
 - Vegetative Health & Growth
 - Encroachment & Removal
- Water Quality
 - Retention Ponds
 - Sediment Deposition
 - Constituents
- Wastewater
- Remediation
- Baseline Studies
 - Historical Lookbacks
- Emergency Response
- Litigation Support
 - Early Detection
 - Quantification
- Cross Applications
 - Agricultural
 - Municipalities

Integration of Software Applications



DATA, ANALYSIS, AND ALERTS STORED ON SATELYTICS CLOUD



Cleared Alerts & Updated Statuses



DATA, MAPS, AND ALERTS

DOT Compliant Audit Trails

ID	LAT	LOX	DATE	STATUS	ALERT
8311032	29.8772	-94.1105	7/4/2015	1057	P1
8311033	29.8801	-94.1213	7/4/2015	1040	P2
8311034	29.883	-94.1321	7/4/2015	991	P1
8311035	29.8859	-94.141	7/4/2015	961	OK
8311036	29.888	-94.1538	7/4/2015	954	OK
8311037	29.8917	-94.1646	7/4/2015	916	OK
8311038	29.8946	-94.1754	7/4/2015	917	P1
8311039	29.9003	-94.1863	7/4/2015	910	P2
8311040	29.9032	-64.1971	7/4/2015	917	P2

Web Accessible Alert Dashboards

Selection	Analysis Result	Workflow Status
<input type="checkbox"/>	Major	Resolved
<input type="checkbox"/>	Major	Resolved
<input type="checkbox"/>	Minor	Resolved
<input type="checkbox"/>	Minor	Resolved
<input type="checkbox"/>	Moderate	Investigate
<input type="checkbox"/>	Major	Resolved

Phone and Mobile Device Alerts

Warning: Potential Hydrocarbon Leak.
Active: 33.998333, -118.373756

Warning: Right of Way Encroachment.
Active: 34.183790, -118.048159

Warning: New Construction near Right of Way.
Active: 34.369643, -118.566293

PROS

- **Satellite data provides efficient data transfer methods to the cloud**
- **Acquired data can be analyzed as Big Data using AI**
- **Algorithms are agnostic to data source**
- **Currently affordable to individual operator or consortium**
- **Can Include historical data**
- **Can handle terabytes of data**
- **Makes sense at regulatory level.**
- **Emerging players in the passive surveillance data space – cost reductions**
- **Long term potential for daily/hourly data acquisition (nano and fixed platform)**

CONS

- **Not well-known or understood by Oil & Gas Industry**
- **Emerging technology – false positives require additional ground truthing**
- **Will likely require increased diligence from operators**
- **Methane monitoring limited by satellite availability, frequency, and number of players**
- **Requires adaptive changes and collaboration with existing operational protocols and processes**
- **Frequency of data acquisition can be costly in terms of SWIR and MWIR**
- **Requires clear skies and minimal interference.**
- **Not nearly as fun as UAVs**

iPIPE

INTELLIGENT PIPELINE INTEGRITY PROGRAM

An Industry-Led Program to Advance Emerging Technologies to Provide Additional Tools for Pipeline Leak Prevention and Pipeline Leak Detection

SELECTION OF DEMONSTRATIONS



- EERC coordinates “Shark Tank” events.
 - Technology providers pitch solutions to executive committee.
 - 30-minute presentations (*overview, cost model, demonstration schedule, expected outcome*).
- Five-seat executive committee:
 - Rotating seats to ensure all industry members have a voice.
 - Meets annually to select next demonstrations.
 - EERC serves a nonvoting, advisory role.
 - Directs EERC to contract with one or more demonstrations each year.

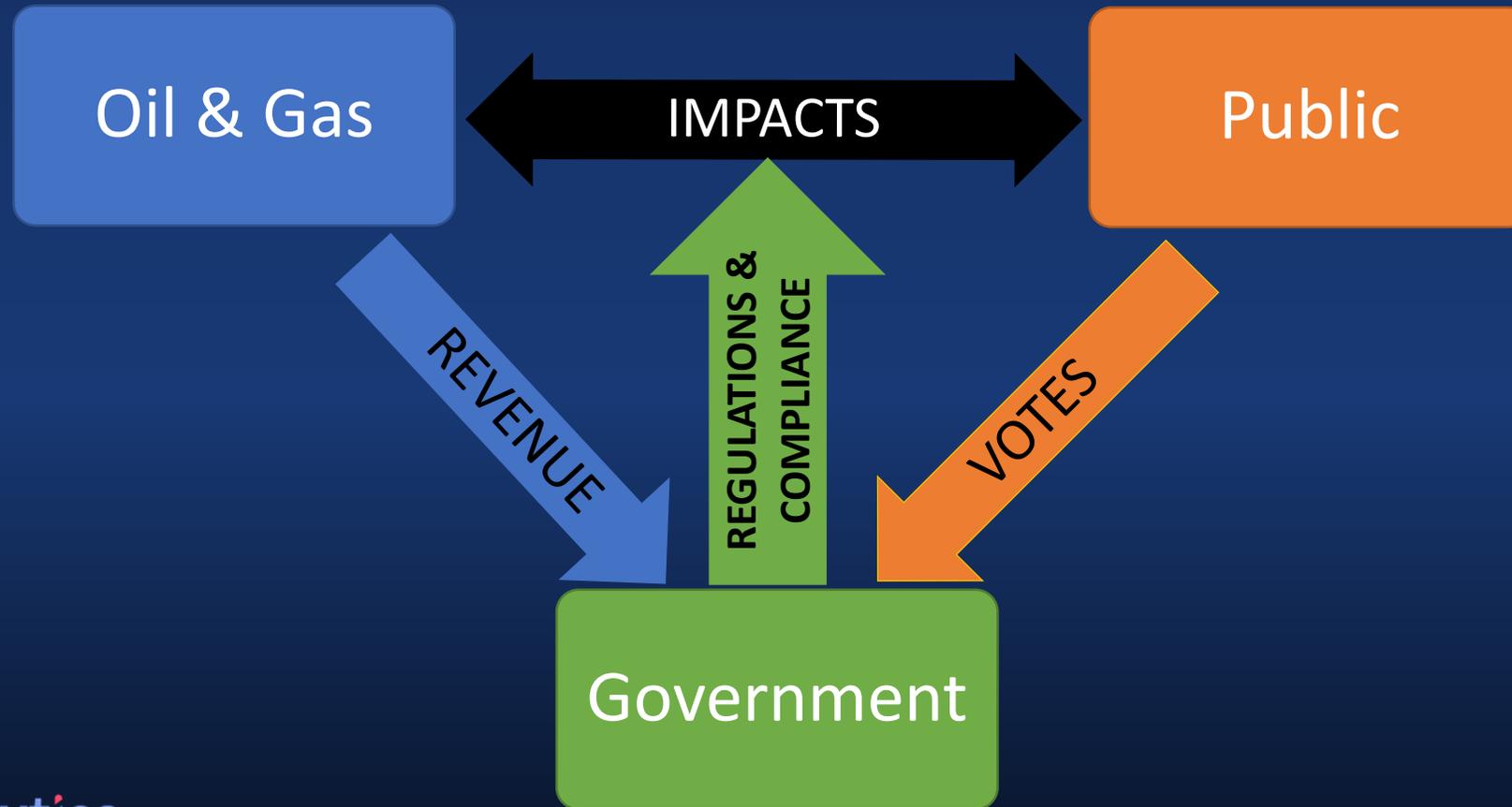
MAY 2018 “SHARK TANK” PARTICIPANTS

 Satelitycs	DETECTION: Opportunistic data collection + AI
	DETECTION: UAV + advanced analytics + BVLOS
 eSmart SYSTEMS  Microsoft  Polaris	DETECTION: UAV + AI + novel sensor suite
	DETECTION/PREVENTION: Golf ball-sized free-floating sensor
	DETECTION: AI + multiple sensors
	DETECTION/PREVENTION: Fiber optic leak and land movement detection
	DETECTION: Noncontact, Internet of Things monitoring of pipelines

IPIPE CONSORTIUM



IT TAKES A VILLAGE



NO  **ON**
PROP 112



HSE
HEALTH - SAFETY - ENVIRONMENT
ANADARKO



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