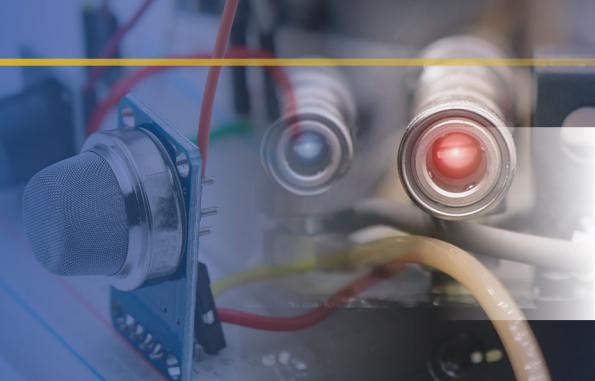




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# Sensing Opportunities and Needs: Industry, University, and National Lab Perspective Panel

**Moderator – Dr. Ruishu Wright – NETL**

**Panelist 1 – Susan Maley, Electric Power Research Institute (EPRI)**

**Panelist 2 – Dr. Elizabeth Cook, Duquesne Light**

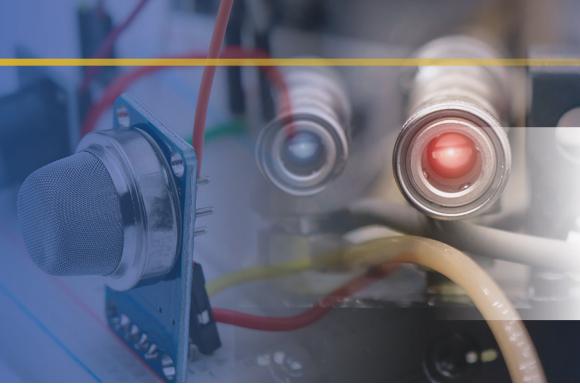
**Panelist 3 – Dr. David Alman, NETL**

**Panelist 4 – Gary Choquette, Pipeline Research Council International**



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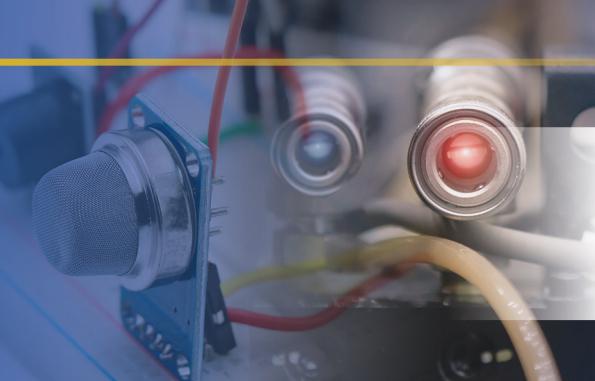
## Panelist 1

**Susan Maley, Electric Power Research Institute (EPRI)**



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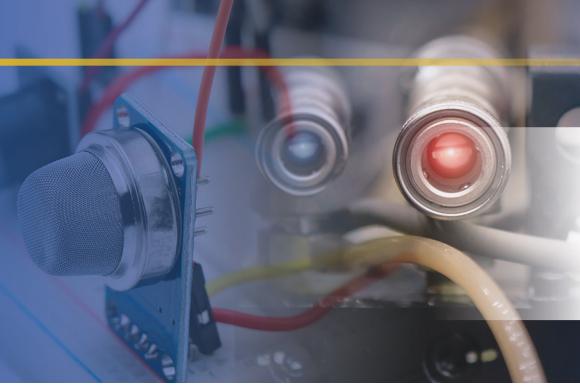
## Panelist 2

Dr. Elizabeth Cook, Duquesne Light



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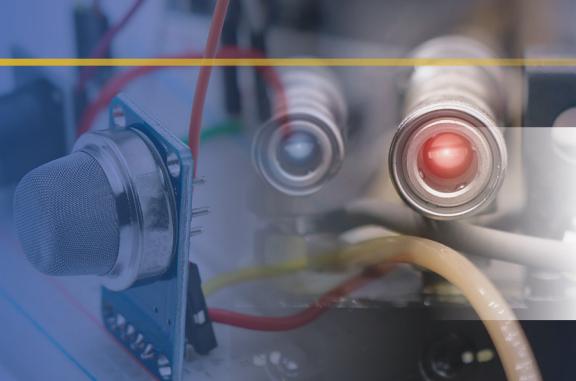
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## Panelist 3

Dr. David Alman, NETL





## Panelist 4

### Gary Choquette, Pipeline Research Council International



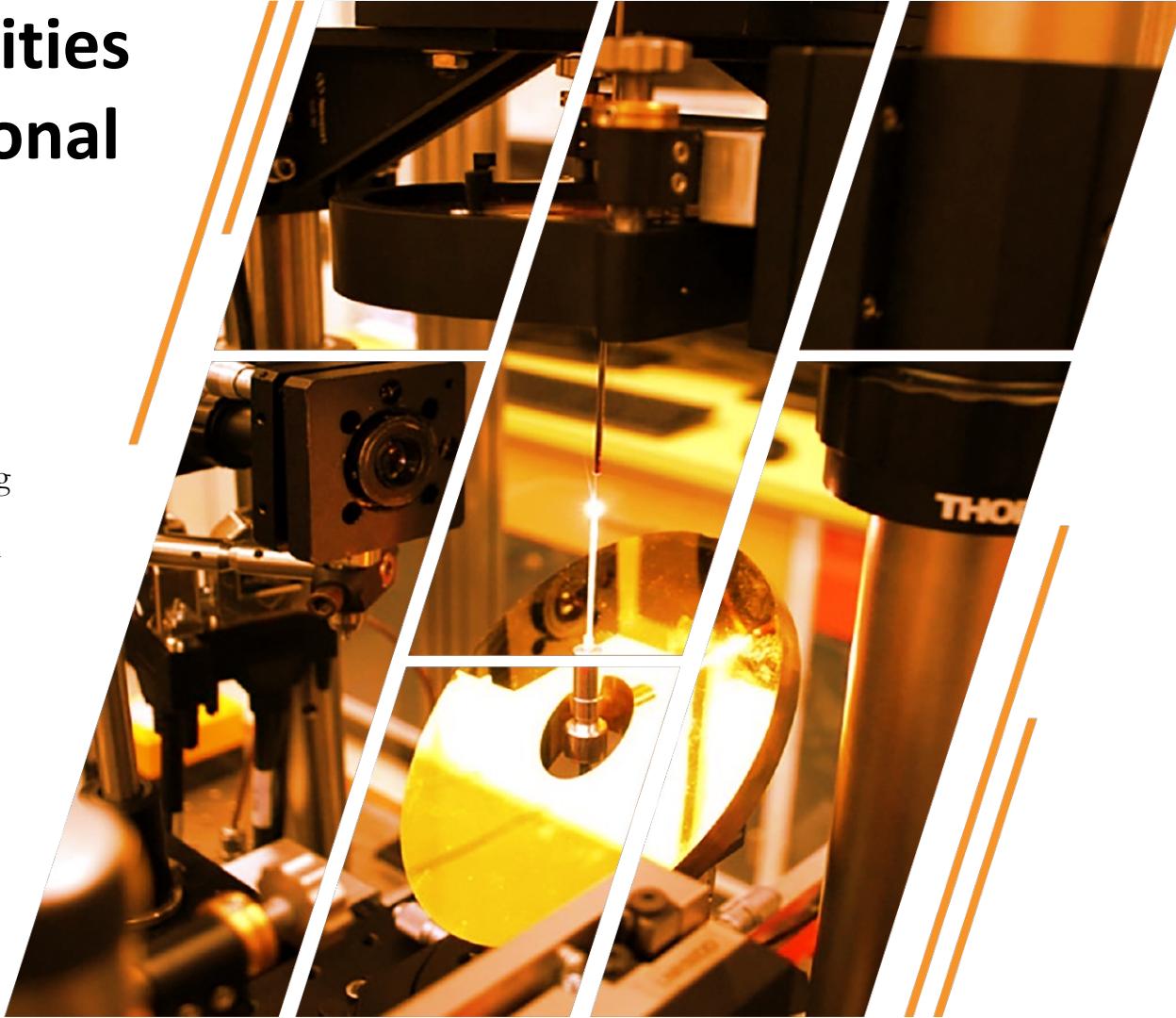
Gary Choquette joined PRCI as a Senior Program Manager in February 2012 and currently is an Executive Director. He has worked in the natural gas transportation industry for more than 35 years. He has experience in facility design, construction, technical support, hydraulic modeling, compression performance, noise, vibration, pulsation, controls, software design, SCADA, gas measurement, and gas control. He has served in management roles in gas measurement, engineering design, construction and right of way, operations software development and SCADA support, and gas control. He has numerous publications related to pipeline hydraulics, controls, and operations. He currently manages the execution of PRCI's research efforts as well as PRCI's information management systems. Mr. Choquette has a bachelor's degree in mechanical engineering from the University of Nebraska and is a registered professional engineer in the state of Texas.

# Sensor Opportunities and Needs - National Lab Perspective

**David E. Alman**

Associate Director  
Materials Engineering and Manufacturing  
Research and Innovation Center  
National Energy Technology Laboratory

**University of Pittsburgh  
Infrastructure Collaboration  
Workshop**  
August 25, 2022



# Sensors for Critical Infrastructure

## Advanced Sensors for Energy Efficiency, Safety, Resilience, and Sustainability

- ✓ Monitor systems and conditions
- ✓ Improve performance & efficiency
- ✓ Enhance reliability & safety



**GENERATION**

**Turbines:** Real-time fuel composition and combustion temperature for improved service life and efficiency

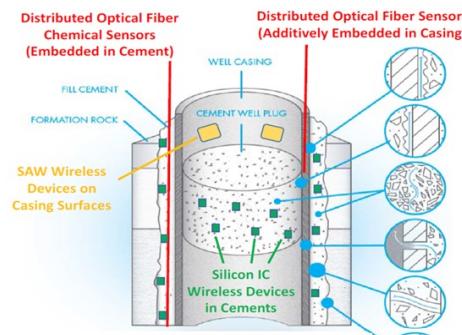


### ENERGY DELIVERY & STORAGE

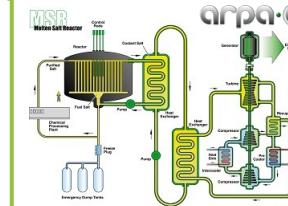


**Pipelines:** Monitor corrosion, gas leaks, T, acoustics to predict/prevent failures. NG, H<sub>2</sub>, CO<sub>2</sub>

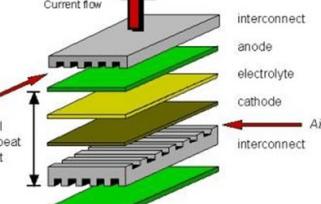
**Grid:** Transformer, powerline failure prediction, fault detection, state awareness



**Subsurface:** Wellbore integrity, failure prediction, leak detection. Geologic storage of CO<sub>2</sub>, H<sub>2</sub>/NG, or abandoned wells.



**SOFCs:** Fuel concentration & temperature gradients for improved lifetime and efficiency



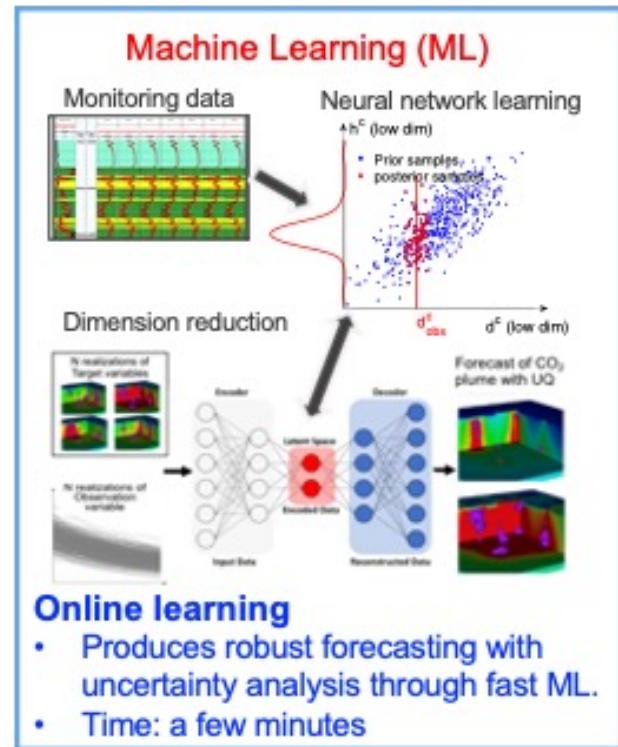
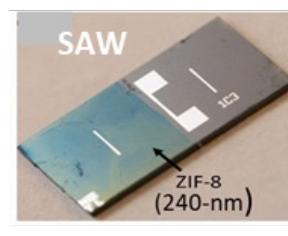
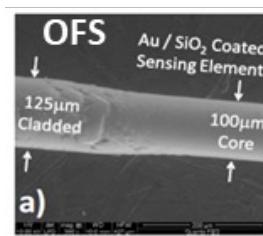
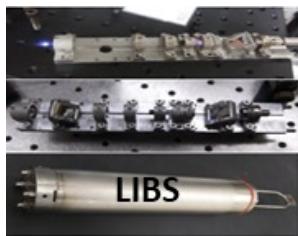
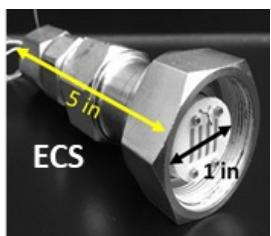
**Nuclear:** Core monitoring and molten salt temperatures for reactor fuel efficiency & reactor safety

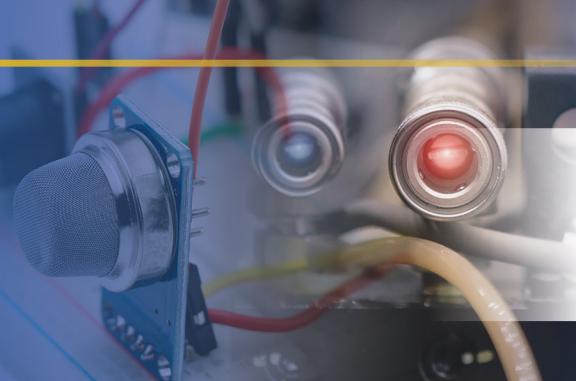
# Opportunity – Do things better

Transformation to net-zero carbon emissions



- ★ Example: large scale hydrogen production, transportation and storage.
- ★ Materials & manufacturing to enable ireless, multi functional sensors and platforms.
- ★ Materials development Composite nano-materials, thin films & fiber optics, sensor devices development,
- ★ Computational materials and HPC to accelerate development.
- ★ Digital twins for predicting system health, reduced order models and workforce development.





## Pipeline of things – IoT/IoT adapted for the pipeline industry

- Requirements

- Intrinsically safe
- Private/virtual private SMS protocol
- Interfaces to conventional SCADA
- Plug and play
- Low power
- Low cost
- Secure
- Low bandwidth
- On demand and report by exception
- High reliability
- Timestamped data

- Applications

- Geohazard monitoring
  - RTK differential w/ IMU
  - Strain measurement
  - Seismic vibration
- Leak detection
  - Ambient sensors
  - Valve sensors
  - Slack line pressure
- Valve management
- Flow calculation
- Fluid properties/quality
- Cathodic protection monitoring

- Advanced in-line inspection tools

- Pipe material properties
- Crack identification and sizing, internal and external
- IMU path tracing – lower cost alternatives