Center for Global Public Safety

Industry Stakeholders' Forum
03/27/19

EVENT NOTES

OBJECTIVES: Identify the greatest research needs related to energy within the areas of Transportation, Fire Protection Engineering, Water Security, Food Safety and First Responder Technologies.

Brainstorm how to leverage the expertise and facilities available at WPI and CGPS academic partner institutions to drive education, outreach, and strategic alliances.

ATTENDEES PRESENT:

Table 1: Laurie Leshin, Matt Beaton, Linda Looft, John Harrington, Mike Lavoie, John McNeill, Wayne Moore, Albert Simeoni

Table 2: Martin Dyer, Fang Li, Carlo Pinciroli, Casey Grant, Victoria Valentine, Jing Xiao

Table 3: Cheri Cousens, Marie-Francoise Hatte, Rob Krueger, Paul Mathisen, Sheree Pagsuyoin, Madeline Snow

Table 4: Mike Ahern, Danielle Cote, John Khalil, Mark Macaulay, Tom O'Rourke, Mike Timko, James Trudeau

Table 5: Tom Connell, Philip Crombie, Dan Gottuk, Dan Weagle

Table 6: Wayne Bates, John Bergendahl, Michael DiBara, Natalie Farny, Brian Postale, Kent Rissmiller

Table 7: Galen Nelson, Justin Woodard, Roger Lin, Pratap Rao, Steve Taylor,

Table 8: Ken Fisher, Nicholas Kyriakos, Andrew Chase, Mike Kearns, Tahar El-Korchi, Karen Bean

Table 9: Kathleen Almand, Leo Subbarao, Pravin Gandhi, Milosh Puchovsky, Xin Yibing

Table 10: Paul Popinchalk, Wan-Ting Chen, Songbai Ji, Sneha Narra,

Add'l participants for Water Discussion: Dwayne Breger, Scott Jiusto, Steve McCauley, Creighton Peet, Wenwen Yao, Grace Chen

FORMAT:

- Keynote Speaker (Matt Beaton)
- Panel Discussion (John Khalil, Tom O'Rourke, Mark Macaulay, Justin Woodard, Galen Nelson, Pravin Gandhi, Leo Subbarao)
- Breakout Sessions (Energy, Water, Fire Protection)

KEYNOTE HIGHLIGHTS:

- **Energy resilience is critical to public safety**
- **Greenhouse gas reduction goals are a priority in MA**
    - Need to balance reliability with financial investment and sustainability
    - Working with local communities to identify key assets and strategizing to make investments to improve resiliency
    - Pursuing hydroelectricity from Quebec with support of colleagues in Maine (Requires a lot of interstate and international cooperation)
    - Transportation is another area to address mitigation, adaptation & resiliency
    - Engagement with private sector is critical (insurance & financial companies)
- **Merrimack Valley Explosions in Sept., 2018 gave first-hand experience with public safety threat related to energy – spent months trying to stabilize & recover**
    - This was a wake-up call to the nation on threats to public safety related to energy
    - On Sept 13th, 10,000 residential & business units lost natural gas
    - State of MA temporarily shifted rights of restoration to a different utility
    - Took over 3 months to restore service with the help of over 2500 people
    - Learned many lessons (responsibilities of companies vs. agencies)
    - Need to sharpen the pencil on safety management systems in utilities and prevent events like this from happening again

KEYNOTE Q&A:

Q: Future of hydrogen electric vehicles in MA?

A: Trying to create a landscape for *any* technology to enter the market. We need to be sensitive to safety concerns that are specific to hydrogen (esp. in tunnels). This presents a different set of challenges as compared to electric vehicles.

We are focusing on charging stations and infrastructure to allow for the exponential growth we expect for electric vehicles and hydrogen after safety concerns are addressed.

Policy makers don't favor one technology over another. We see what the private sector/industry is doing and respond accordingly. We need to set the stage and have rules and rate recovery that allow for the development of infrastructure.

Also working with other states in a regional manner to address these initiatives.

Q: With solar power and other alternative energy comes high capacity storage systems (big batteries in buildings). Are we looking at systems for suppression, containment and isolation to control the fire risk associated with these?

A: Yes, we realize that this type of battery storage creates a different kind of fire risk and that building codes need to be updated to allow for the way technology is changing in order to protect our citizens. We have state grants to support research in this area in an effort to promote new technologies that minimize fire hazards. Getting feedback from the fire service is critical.

Q: Do you have any suggestions for those of us who write federal grant proposals (EPA) where we are unable to use the term 'climate change'?

A: I have not heard of this. We have not had this issue with NOAA or FEMA. Thank you for bringing it to my attention.

Q: Biology has an important role to play in the future of energy. Are you engaging that industry regarding energy and if so, how?

A: Yes, it plays a huge role in the development of technology.

The intersection of energy and life sciences brings up question of resiliency at hospitals and other critical facilities. The state of MA has a $40M Clean Community Resiliency Initiative to support microgrids for critical facilities.

Also, agriculture is one of the largest energy hogs. This is an area where we need more research to find ways to use less energy/water/fertilizer for agriculture.

Q: How resilient is the prospective hydroelectric project in Quebec?

A: We want to do this energy transmission in the most efficient way possible. There are some losses related to distribution and others related to transmission. Siting of infrastructure is the single biggest obstacle we have because nobody wants it in their backyard (solar panels, sub stations, wind, etc.). Need to address this.

PANEL DISCUSSION POINTS:

- The backbone of the micro-grid is a Combined Heat and Power (CHP) system because it's a dispatchable system. You need an engine to be able to turn it on and give you that power but it gives you grid resiliency during an outage. CHP is an opportunistic technology when you need thermal & power. CHP systems are ideal for hospitals and other critical care facilities.

- Utilities are geared toward innovation but need to take into consideration safety and reliability concerns as a high priority

- Need to be mindful of water-energy nexus. It takes a lot of water to process energy. Also, loss of water can cause a mass migration event so safety and resiliency is of highest concern. Wastewater treatment plans need redundancy. These comprise 40% of the energy bill for many communities.

- When considering resiliency during power outages, remember that gas stations are critical facilities – especially for Fire/EMS Services (need power to pump gas). Fuel pumping services study & EV charging unit project is underway; would like to see this replicated and scaled across the state.

- Defense bases in MA are looking at microgrids and resilient power options. More combat planes are damaged by climate change than by combat in past few years.

- Energy storage has inherent fire safety concerns. Training is happening with fire professionals and utilities officials in conjunction with NFPA.

- Energy storage challenges include:
  - Research (making battery technology cells inherently safe)
  - Engineering (integrating fire mitigation to control thermal runaway propagation – detection, control & suppression)
  - Education (across stakeholder groups – regulators, manufacturers, insurance, building owners, fire service, etc.)

- Largest safety challenges with energy storage are fire, explosion and toxicity. Should use hazard based safety engineering to drive standards in innovation, safety & adoption. Need policy approaches to push advancement for battery management systems. Need to be proactive about fire management. Thermal runaway can re-appear days after a fire. NYC is leading efforts in this area.

- There are 29 states which have mandates or targets for energy storage as part of their renewable energy goals.

PANEL DISCUSSION Q&A:

Q: Why don't all 50 states have a proactive plan for energy storage?

A: It depends on the leadership in each state. Those with energy storage goals recognize the benefits in resilience, clean energy & climate goals. Price is also a driving factor. Where energy costs are high, there is more incentive to develop integrated solar & storage solutions. Hawaii is a good example of this.

Q: What is being done to develop energy resilience for residential homes and small businesses? Currently, solar power generated locally is fed back to the grid but if the grid goes down, home/business owners do not receive the benefit from the power they've generated. The development of local storage options could provide for critical life safety systems and improve survivability during outages.

A: Progress is being made in the area of energy storage but we're not there yet. Microgrids with Combined Heat & Power (CHP) can be 90% efficient but they still require back-up power.

Q: Are there standards for in-home storage systems?

A: UL is working on developing standards to protect homes and thinking about how to work with local fire service people in these communities. Need to drive standards from three perspectives: utilities, fire service and the owners.

Q: What opportunities exist to repair and renew gas pipeline infrastructure, which often leaks, contributing to greenhouse gases and global warming?

A: Utilities are dedicated to replacing older infrastructure more prone to leaks. Highest priority are not necessarily the oldest but those most prone to leaks.

Q: What is the global context of these technologies?

A: Japan is far ahead of us in terms of hydrogen refueling stations and Europe is also ahead. But safety is still a concern. They have accepted more risks for the benefit.

Q: What can you do to help spread best practices for lithium ION battery installations (like those developed at NEC in conjunction with UL and NFPA)?

A: Education is very important. Energy storage manufacturers don't really speak with fire protection community. We're trying to help make those connections. The next step is training - fire services at all levels as well as manufacturers.

BREAK-OUT SESSION DISCUSSION POINTS:

Focus Group related to Energy:

- Energy needs related to life safety/fire safety
- Use of sensors to improve reliability
- What is a sufficient time period for back-up power during outages?
- Low power & low drain sensors
- Battery systems & energy harvesting
- Ability to prioritize highest power needs for extended power outages
- IoT or AI system that can evaluate and distribute power needs across buildings or community based on urgency
- Cyber security & communications concerns related to emergency power management systems
- Need more lithium-ion batteries
- Need better detection of battery faults (ie: thermal runaway before it happens) both in operation & manufacturing process for batteries
- Battery fires:
    - Traditional response is to apply water; alternative is more like bomb response
    - Method for stopping/suppressing thermal runaway (research area)
    - Codes for how you install those battieries (research area)
    - Wall units: if it goes off, what's the material behind it? Is a two hour barrier sufficient?
    - Longer term research into more robust battery chemistries - iron phosphate chemistry of batteries - next generation less susceptible to explosions and other problems
    - Education & research - WPI has distinctiveness in the intersection between fire & life systems (areas of strength/focus)

Focus Group related to Fire Protection:

PRESSING NEEDS: (Emergency Responders & Energy Storage Systems)

- Displacement
- Training (firefighting is grunt work but fire behavior and toxicity are more complicated – need to improve education on the front lines)
- Hazard identification (linked to smart cities)
- Overhaul/stranded energy (causes displacement problem if people can't return to the building for several days)
- Hydrogen transportation safety in US (R&D in other countries)
- Risk assessment - need data
- Cyber security for distributed energy systems/microgrids which are connected
- Explosivity/mitigation of explosive gases released by Energy Storage Systems

NEW TECHNOLOGIES:

- Design for emergency discharge
- Retrofit of flammable facade
- Non-invasive detection
- Water to high rise buildings
- Hydrogen risk
- Need for Systems Thinking
- Sensors for hazmat/fire
- Refrigerants (no greenhouse effects, not flammable, or not create toxicity/combustion products)
- Development of in-situ operations
- Extinguishing agents (water, mist, gas)
- H2 Material Compatibility
- Social media opportunities/threats (virtual operations support teams - harvesting social media info to help with response)
- DoE, DHS, DoT, Collaboration with industry

OPPORTUNITIES:

- Collaboration with International Emergency Agency (IEA)
- WPI can work with groups doing R&D on pressing energy issues
- Looking to hire more FPE personnel who can do research and fight fires
- WPI embracing questions around energy storage in our FPE curriculum
- Recognize responsibility to not only train students but also give back to society
- Training firefighters in Greece regarding wildfires, entrapment, etc.

Focus Group related to Water:

PRESSING NEEDS RELATED TO WATER, ENERGY & FOOD THAT IMPACT PUBLIC SAFETY:

- Water, Energy & Food are intrinsically related; need to recognize importance of all of these
- Water & Energy infrastructure very important - especially related to extreme events
- Resilient systems are critical - various treatment technologies - emerging compounds & contaminants (chemistry & biology) - technical & cost aspects
- Treatment systems - understanding & looking at energy efficiency - reduce carbon footprint
- Waste infrastructure: need economical way to handle waste & manage waste systems
- Global water shortages
- Security related to public safety
- End of pipe issues in terms of food safety. Food waste and discharge. Incentivizing the change rather than penalizing the current condition. Opportunity for recovery. Economic incentive doesn't work yet in municipalities. Before regulatory leads the way.

CONSIDERATIONS:

- Systems approaches - need to be integrated into different analyses
- Importance of society/economics - realistic approaches to address problems
- Local & global issues - cost is a real concern for developing countries so need to find low-cost solutions of local products
- Regulatory considerations vs. science
- Grants will require a multidisciplinary approach to address these problems
- Biology/data science/chemistry - need to come together to address these issues; need to partner to address these topic areas
- Really important to bring together government agencies and non-profits to play a role
- Consulting world: algae-based solutions UB using CO2 as feedstock from incinerator to feed algae to create plastics?
- Municipal-industry-research nexus: Measurement of performance of e-pumps at wastewater treatment plant or in sewer pipes.
- Food safety new modernization act. Hydroponics. Large manufacturer of soups. Chemicals in water. Huge business issue.
- Agriculture: Taiwan pig farmers biodigesters anaerobic digestion, clean water from sty into digester on a small scale. Water would irrigate the fields.

- Food waste, biofuels interest. Brewing industry facing intense scrutiny. Digesting anaerobic units, some manufacturers working on a model. Hauling, storage issues. Supply chain source of waste, source of energy production, scale is the issue. Source reduction, but waste is an issue to move the waste around economically to produce energy. Clean the line between products. Creates waste. Need a place to bring it and dispose of it. Getting a return on it is a challenge. Grace Chen can talk about organic ways to deal with waste
- Cannabis cultivation: where does this fit in to food safety? Abundant water in Massachusetts, but cold so grown inside. Will use huge amounts of water. Incentivize to recycle water, also energy to minimize impact. From regulatory perspective. What are incentives for industry? Technology to compete with reverse osmosis. To reduce water use, reuse water. Incentivize to not dump water into sewer. Madeline Snow working on energy side of this. John Bergendahl also working on this issue with students.
- Other research: bio pharma with funding. Fermenters, growing cells, pumping out nutrients. Need to haul out waste. N organics. Dead cells when they harvest.
- The cleanest, safest, cheapest energy is the energy you don't use

OPPORTUNITIES:

- DEP project wastewater and energy. Tool to analyze wastewater treatment plants that have renewable power. Work with utility companies. Look for municipalities to work with.
- Water: PFAS - how to measure and what are their biological effects? EPA will set numbers but is there science behind them?
- WPI has 50 project centers around the world exploring various themes; make linkages to collaborate

NEW TECHNOLOGIES:

- Key areas of research: using university tech connect with government guidance and policy (emergent contaminants such as PFAS).
- Nutrient loading from discharge from pharma industry; coastline abatements
- Water supply issue is global: DOE and desalinization. How to do that cost effectively.
- Food safety

NEXT STEPS:

- How do we communicate & share opportunities to collaborate?
- Work to build partnerships, figure out where are the opportunities for collaboration
- Write a one-pager, each person could contribute a paragraph for topic they discussed. From that we should find opportunities for project funding. Example collaboration on PFAS between DEP and WPI.
- Tangible big issues and smaller projects could be done with this group.
- NSF currently has initiative on this tri-topic. Must connect to another of their priorities. Interdisciplinary work with a big impact
- Research convergence ENFUSE. Big NSF idea this year is BIG DATA
- NIH interested in environmental impacts on disease (neurological, degenerative)