



Presentation to Off-Road Equipment Fuel Cell Workshop | 09.22.2021

# | AEM's Core Purpose:

AEM is the leading organization in North America advancing construction and agriculture equipment manufacturers and their value chain partners in the global marketplace.

In enabling growth together, AEM and its members build momentum for the equipment manufacturing industry and the markets it serves.



# Our Product Leadership Mission

- **Do everything we can to make sure everyone returns safely to their loved ones**
- **Provide for global equipment interoperability**
- **Ensure our products can be sold in all markets**
- **Leave the world better than we found it**



# How do we do it?

## AEM's Safety & Product Leadership Department

- Regulatory Affairs
- Product Safety
- Compliance Surveillance
- Safety Materials
- Sustainability



# AEM Alternative Power Initiatives

- Regulatory Affairs Working Group
- Sustainability Council
- Engine Emissions Strategy Task Force
- Alternative Power Technical Committee
- Engine Emissions Technical Committee
- Construction Technology Leadership Group
- Autonomous Machines Coordinating Committee
- Components / OEM Liaison Committee
- Ag Technology Leadership Group
- (and others)



# Hurdles on the Minds of AEM Members

- Possibility of a prescriptive & mandated solution
- The manufacturing supply chain is complex
- Distribution and operational infrastructure
- Education of operators and end-users
- Timing required for design changes
- Machine standards cover multiple areas



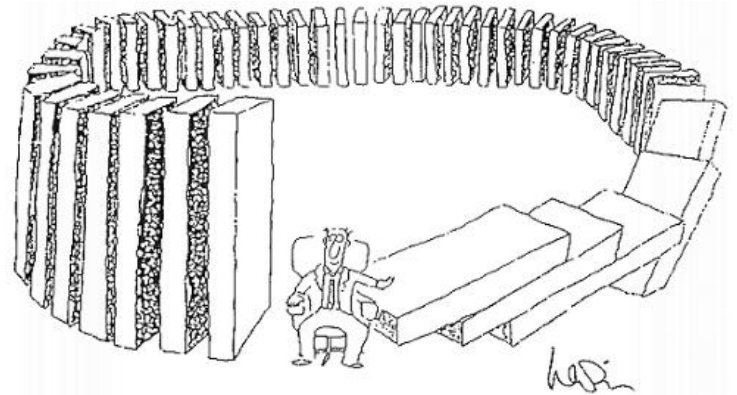
# Functional Areas Impacted by Standards

- |  |   |  |  |
|--|---|--|--|
| <input type="checkbox"/> Acceptance Criteria                   | <input type="checkbox"/> Engine, Power                  | <input type="checkbox"/> Lock, Boom                        | <input type="checkbox"/> Seat                      |
| <input type="checkbox"/> Access & Access Systems               | <input type="checkbox"/> Engine, Smoke                  | <input type="checkbox"/> Lock, Cab and Dumper body support | <input type="checkbox"/> Seat Belt                 |
| <input type="checkbox"/> Accumulator                           | <input type="checkbox"/> Environmental protection       | <input type="checkbox"/> Lock, Steering Frame              | <input type="checkbox"/> Secondary Exit            |
| <input type="checkbox"/> Acoustics                             | <input type="checkbox"/> Ergonomics                     | <input type="checkbox"/> Lock, Unauthorized Start/Move     | <input type="checkbox"/> Serial Number Plate       |
| <input type="checkbox"/> Air Conditioning                      | <input type="checkbox"/> Extensible boom aerial devices | <input type="checkbox"/> Lubricant                         | <input type="checkbox"/> Service Tools             |
| <input type="checkbox"/> Air Reservoir                         | <input type="checkbox"/> Fenders                        | <input type="checkbox"/> Maintenance                       | <input type="checkbox"/> Serviceability            |
| <input type="checkbox"/> Alarm, Backup                         | <input type="checkbox"/> Filter, Fresh Air              | <input type="checkbox"/> Manual, Operators                 | <input type="checkbox"/> Signals                   |
| <input type="checkbox"/> Alarm, Travel                         | <input type="checkbox"/> Fire prevention                | <input type="checkbox"/> Marking                           | <input type="checkbox"/> Signs                     |
| <input type="checkbox"/> Attachments                           | <input type="checkbox"/> Fittings, Lubrication          | <input type="checkbox"/> Mass, Machine                     | <input type="checkbox"/> Slow-Moving Vehicle (SMV) |
| <input type="checkbox"/> Auxiliary Starting Connector          | <input type="checkbox"/> Flammability, Operator Station | <input type="checkbox"/> Measurement                       | <input type="checkbox"/> Spark Arrestor            |
| <input type="checkbox"/> Battery                               | <input type="checkbox"/> Fluid power systems            | <input type="checkbox"/> Mirrors, Interior & Exterior      | <input type="checkbox"/> Speed, Transport          |
| <input type="checkbox"/> Brake, Parking                        | <input type="checkbox"/> FOGS                           | <input type="checkbox"/> Miscellaneous                     | <input type="checkbox"/> Stability                 |
| <input type="checkbox"/> Brake, Service (Primary)              | <input type="checkbox"/> FOPS                           | <input type="checkbox"/> Mowing Equipment                  | <input type="checkbox"/> Stairways                 |
| <input type="checkbox"/> Brake, Service (Secondary)            | <input type="checkbox"/> Fuel Tank                      | <input type="checkbox"/> Neutral Start Protection          | <input type="checkbox"/> Starting system           |
| <input type="checkbox"/> Brush cutting                         | <input type="checkbox"/> Glazing                        | <input type="checkbox"/> Noise, airborne                   | <input type="checkbox"/> Steering                  |
| <input type="checkbox"/> Brush Cutting/Grass Trimming          | <input type="checkbox"/> Gradeability                   | <input type="checkbox"/> Noise, Bystander                  | <input type="checkbox"/> Steps                     |
| <input type="checkbox"/> Bypass Start Protection               | <input type="checkbox"/> Guardrail                      | <input type="checkbox"/> Noise, Forward Horn               | <input type="checkbox"/> Sustainability            |
| <input type="checkbox"/> Chocks, Wheel                         | <input type="checkbox"/> Guards, General                | <input type="checkbox"/> Noise, Operator                   | <input type="checkbox"/> Symbols                   |
| <input type="checkbox"/> Controlled Load Lowering Device       | <input type="checkbox"/> Hand-held tools                | <input type="checkbox"/> Noise, Reverse/Travel Alarm       | <input type="checkbox"/> Telematics                |
| <input type="checkbox"/> Controls, Color Code                  | <input type="checkbox"/> Handrail/Handhold              | <input type="checkbox"/> Nomenclature                      | <input type="checkbox"/> Terminology               |
| <input type="checkbox"/> Controls, Operator (Remote)           | <input type="checkbox"/> Hazardous substances           | <input type="checkbox"/> Operator Station                  | <input type="checkbox"/> Testing                   |
| <input type="checkbox"/> Controls, Operator (Station)          | <input type="checkbox"/> Health risks                   | <input type="checkbox"/> Operator training                 | <input type="checkbox"/> Tires                     |
| <input type="checkbox"/> Danger zones                          | <input type="checkbox"/> Heater                         | <input type="checkbox"/> OPS                               | <input type="checkbox"/> TOPS                      |
| <input type="checkbox"/> Definitions                           | <input type="checkbox"/> Hitches & Hitch Pins           | <input type="checkbox"/> Paver                             | <input type="checkbox"/> Trimmer / Pruners         |
| <input type="checkbox"/> Defrosting                            | <input type="checkbox"/> Horn, Warning (forward)        | <input type="checkbox"/> Performance                       | <input type="checkbox"/> Tying-Down Device         |
| <input type="checkbox"/> Design                                | <input type="checkbox"/> Horns & Alarms                 | <input type="checkbox"/> Pictorials                        | <input type="checkbox"/> Verification              |
| <input type="checkbox"/> Dimensions / Measurement              | <input type="checkbox"/> Hot Surfaces                   | <input type="checkbox"/> Platforms                         | <input type="checkbox"/> Vertical towers           |
| <input type="checkbox"/> Doors                                 | <input type="checkbox"/> Hybrid                         | <input type="checkbox"/> Plugs                             | <input type="checkbox"/> Vibration                 |
| <input type="checkbox"/> Drawbar (front, rear, retrieval)      | <input type="checkbox"/> Hydraulic Hoses and Tubes      | <input type="checkbox"/> Power Take-Off (PTO)              | <input type="checkbox"/> Visibility                |
| <input type="checkbox"/> Edges, Sharp                          | <input type="checkbox"/> Import Duties / Criteria       | <input type="checkbox"/> Preservation & Storage            | <input type="checkbox"/> Walkway                   |
| <input type="checkbox"/> Electrical systems / Harness / Wiring | <input type="checkbox"/> Inspection                     | <input type="checkbox"/> Pressurizer                       | <input type="checkbox"/> Wheel                     |
| <input type="checkbox"/> Electromagnetic compatibility (EMC)   | <input type="checkbox"/> Instruments, Machine Operating | <input type="checkbox"/> Product identification            | <input type="checkbox"/> Winch                     |
| <input type="checkbox"/> Emergency                             | <input type="checkbox"/> Labeling                       | <input type="checkbox"/> Radiator Cap                      | <input type="checkbox"/> Wiper, Window             |
| <input type="checkbox"/> Emissions                             | <input type="checkbox"/> Ladder                         | <input type="checkbox"/> Rating                            | <input type="checkbox"/> Wiring                    |
| <input type="checkbox"/> Energy use                            | <input type="checkbox"/> Lifting                        | <input type="checkbox"/> Reflectors                        |  |
| <input type="checkbox"/> Engine, Emissions                     | <input type="checkbox"/> Lifting Device                 | <input type="checkbox"/> Retarder                          |  |
| <input type="checkbox"/> Engine, Exhaust                       | <input type="checkbox"/> Lights, Exterior (Roading)     | <input type="checkbox"/> ROPS                              |  |
| <input type="checkbox"/> Engine Noise                          | <input type="checkbox"/> Lights, Exterior (work)        | <input type="checkbox"/> Safety                            |  |



# Potential Unintended Consequences

- Stifled innovation due to limited research resources
- Difficulty for small & mid-sized manufacturers to compete
- Significant costs for wholesale adoption at end user level
- Total cost of ownership (including pricing by KWh)
- Design concerns with compliance
- Disruption to 'Up-Time'
- Impact on global regulations





# Impact on Global Regulatory Compliance

- Emissions
- Ontario Tires
- ICES 002
- Quebec Braking
- Pressure Vessels
- Refrigerants

- Cal OSHA Autonomy
- Cal Prop 65
- CARB Emissions

- Conflict Minerals
- Lighting & Marking
- Braking Req.

- Chilean Engine Emissions
- Brazilian Noise & Engines
- Brazil RoHS
- NR 12
- NR 31

- Mass Rentals
- Illinois IOH
- WI IOH
- NY Crane Rules
- OSHA Crane Regs
- Silica Regs
- MSHA Col. Avoidance
- Seat Belt Rules

- Gulf State Machinery Directive (Modeled after CE Mark)
- UAE RoHS (United Arab Emirates)
- Turkey RoHS

- EU Stage V
- EU REACH
- EU RMI Regs
- GDPR
- Refrigerants

- EU Tractor Testing
- Rooding
- Tractor Mother Reg
- EU RoHS
- Ukraine RoHS

- Russian Eurasian Alliance
- ROPS Testing
- ANTAM
- EAEU RoHS (Eurasian Economic Union)

- China NR 4 Emissions
- China RoHS
- China NR 5 (IP)
- Refurbishing Stds

- Japan Emissions, Chemicals
- Korea Emissions, Chemicals, Recall Regs

- Indian Emissions, Standards, Testing
- Australia Risk Assessment, Testing, Chemicals



# Opportunities for Innovation

- Paradigm changes in design
- Re-thinking power creation (specifically for H2)
- Appetite for new entrants and thinking
- Move from mechanical and hydraulic power to electric



# What Happens When Power Changes?



1920's



2020's



**There is no perfect  
solution to address  
carbon reduction in  
equipment industry**



**But... the equipment industry is committed to working together to find the right mix of solutions**



# Thank You!

Curt Blades

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Association of Equipment Manufacturers

