Adaptive Sprayer Technology

Organizational Alignment and Consensus Standards to Enable Change

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Liquid Spray Product Placement

Drift
Pressure,
Nozzle selection

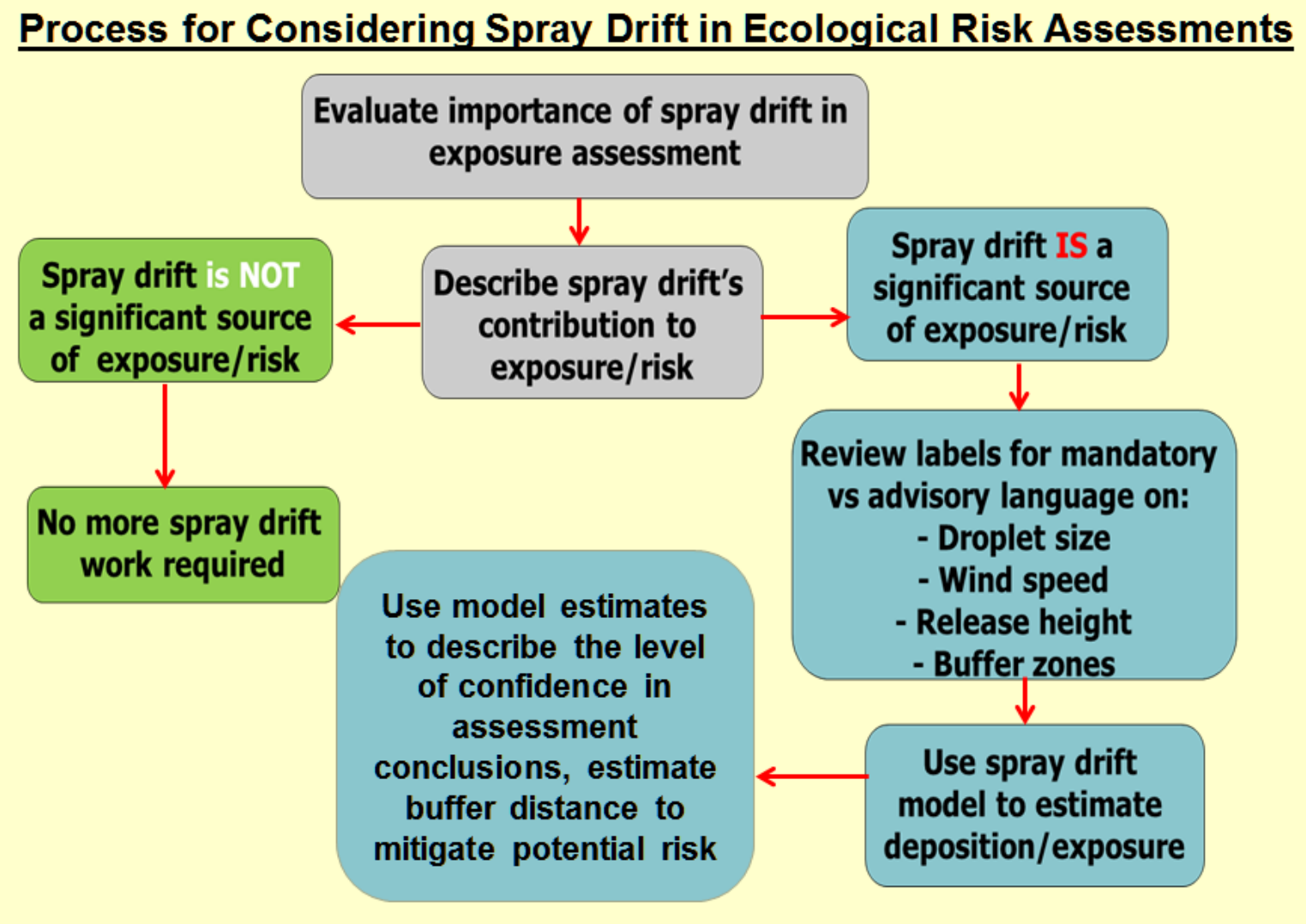
Drift
Variable conditions,
Buffer needs

Drift
Boom Position

Distribution
Chem Injection

Distribution
Verify even coverage

Distribution
Tank Agitation



Poster: *Encouraging the Use of Drift Reduction Technologies in the United States*, US EPA 2015

Spray Drift in Risk Assessments

Spray drift is one route of exposure considered in OPP risk assessments

Spray drift is normally included in

- Terrestrial plant exposure estimates
- Aquatic exposure estimates
- Human Health: Resident and bystander exposure to spray drift
- Human drinking water exposure estimates
- Off-site terrestrial animal exposure estimates

Poster: *Encouraging the Use of Drift Reduction Technologies in the United States*, US EPA 2015

"Paradigm"

- a theory or a group of ideas about how something should be done, made, or thought about *(Meriam-Webster)*
  - Constrained by technology
  - Based on prevailing wisdom
  - May limit possibilities

Today's approach to pesticide risk assessment is a paradigm.

Fixed Risk Assessment

- All factors combined into one label – Runoff, aerosol, vapor, evaporated liquid
- Conservative parameters applied to all scenarios, receive same assessment
- Assumption of constant meteorological conditions
- Prescriptive sprayer configuration
- Constant or limited buffer zone options

Drift mitigation aligned with today's fixed risk assessment paradigm…

"Static" drift mitigation plan:

- Spray planning occurs in advance
- Minimal adaptation to weather factors
- Pre-configured sprayer
- Single set of installed nozzles
- Operator manually assess site-specific factors – i.e. weather, windbreaks, canopy, inversion factors
- Operator may spray multiple fields, many farms

A fixed risk assessment does not leverage the *Precision Ag and Data Management* capabilities of modern sprayers:

- Continual access to mobile data and cloud services,
- Data analytics,
- On-board data processing and task planning,
- Spray parameter closed loop control,
- Cautions and recommendations assistance to operator.

Flexible Risk Assessment

- Sensitive areas and species documented and updated
- Runoff, aerosol drift and volatilization addressed independently
- Each scenario receives tailored risk assessment
- Meteorological data available throughout task
- Buffer zone is adapted based on risk assessment
- Sprayer configuration is adapted as needed throughout the task

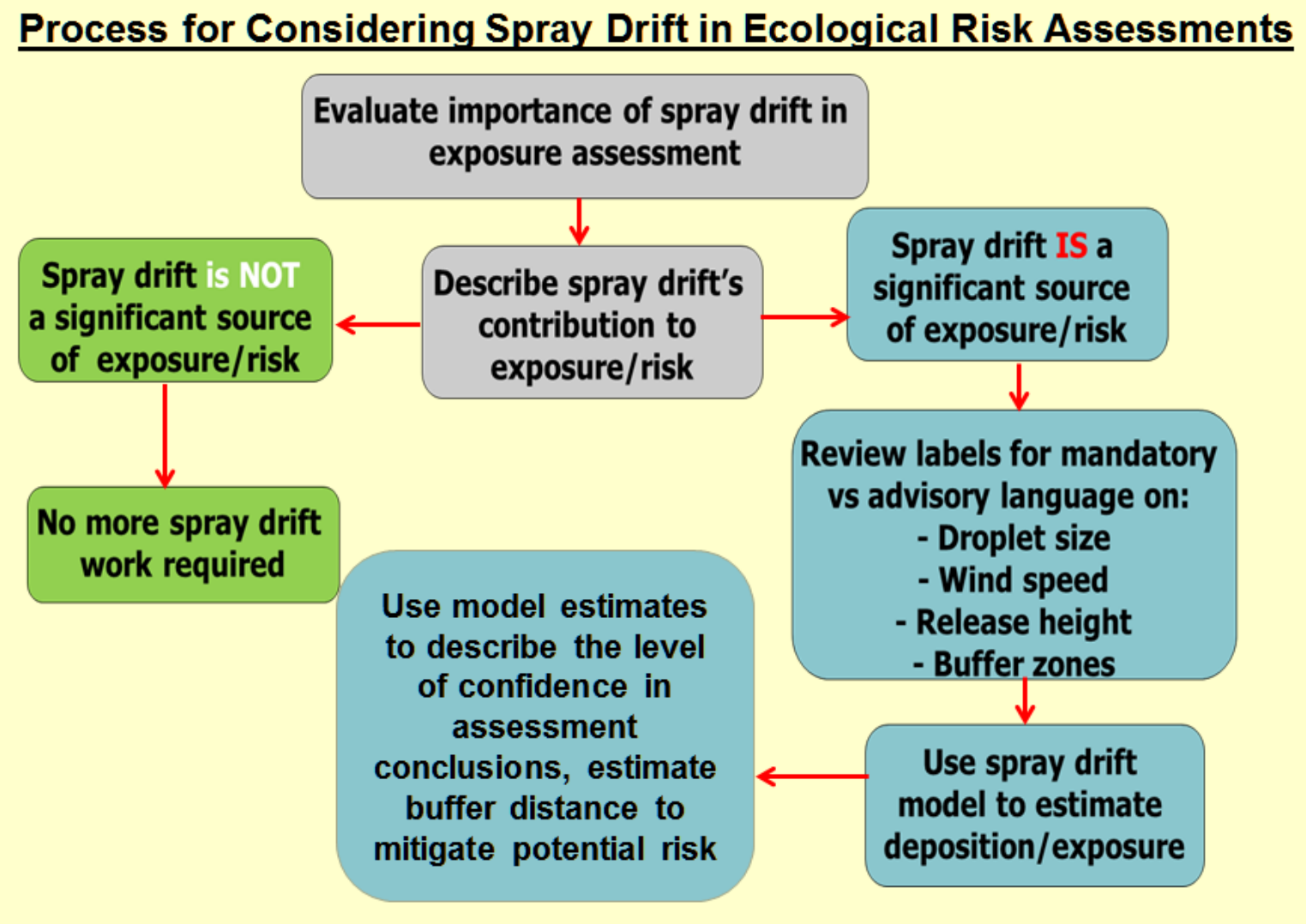
Drift mitigation possible with a flexible risk assessment paradigm:

"Dynamic" drift mitigation will use available state-of-the-art and precision ag technologies.

- Analyze data to assess potential hazards,
- Adjust configuration and parameters,
- Adjust task or path,
- Ensure optimum spray characteristic at the time of spray release.

Drift mitigation with an Adaptive Sprayer

- Spray task is continually evaluated for *OK to Spray*
- Spray parameters autonomously modified
- Variable buffers to optimize productive land use
- Variable application speed to optimize productivity
- Meteorology compliance
- Product as-applied documentation
- Sustainability metrics



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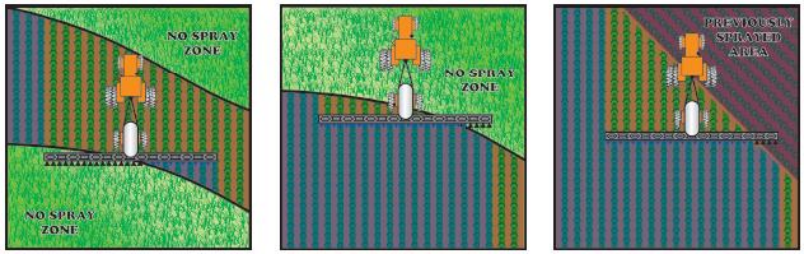
Future Path

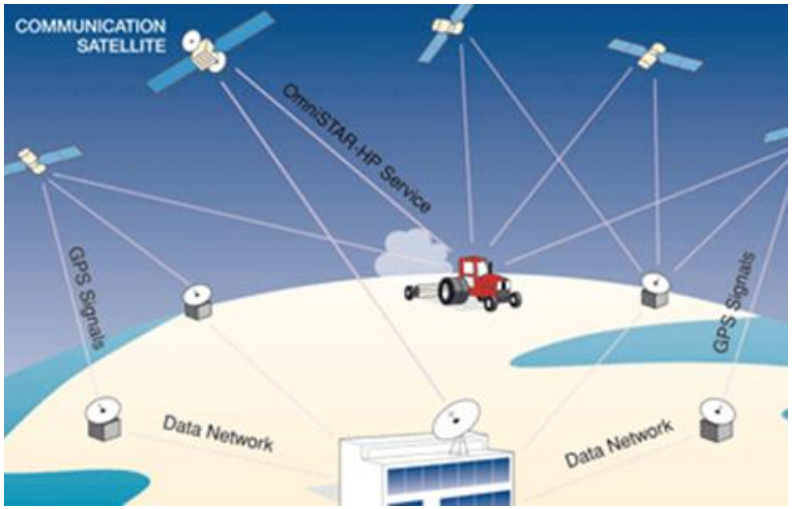
- Machine – Process control
- Machine – Data and Communications
- Sensitive Areas
- Drift Characterization
- Weather
- Product Label
- Mechanistic Physics Modeling

Machine – Process Control

- Management of spray parameters
- Boom height
- Boom section control
- Spray volume / spray rate
- Distance to sensitive area
  - GPS/GIS data
- Travel speed



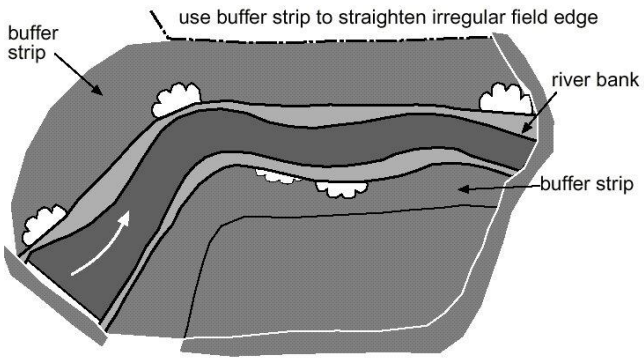
Machine – Communication

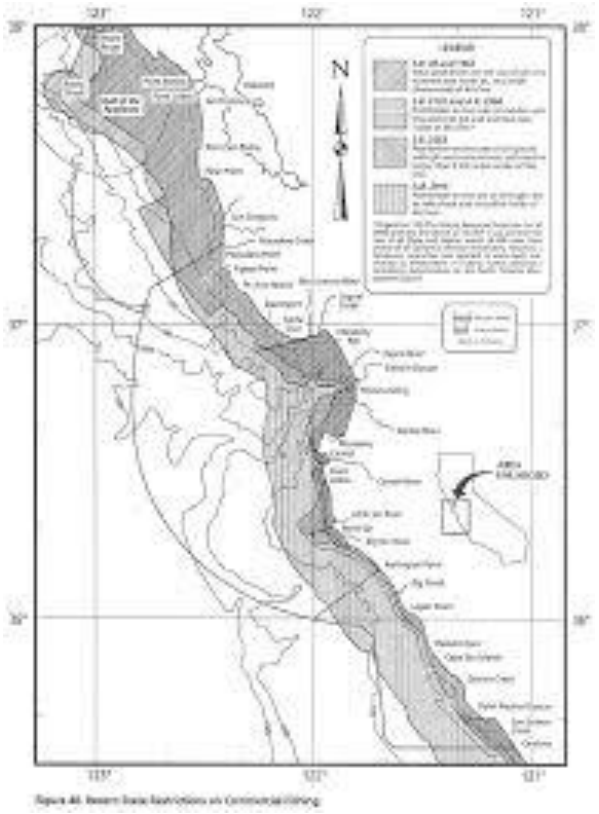


- Machine operational data
  - Location
  - Sprayer configuration
  - Performance
  - Weather data
- Application Program Interface (API)
  - Data formatting
  - Program-to-program data share
  - **Interoperability**

Sensitive Areas

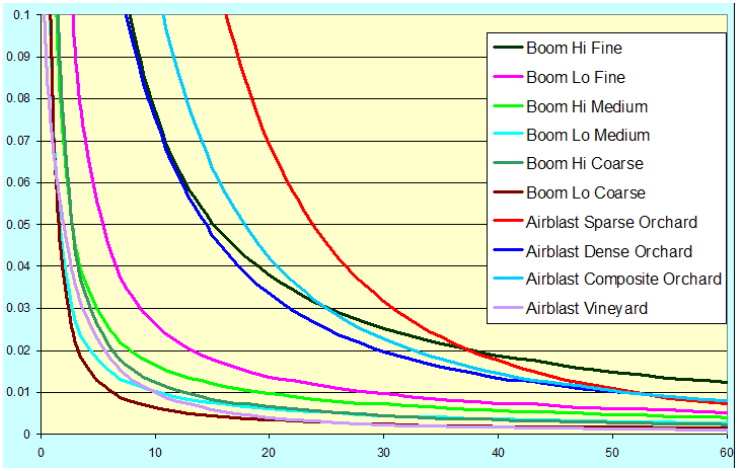
- Waterways, coastal land
- Endangered species
- Organic food production
- Non-compatible crops
- Populated areas





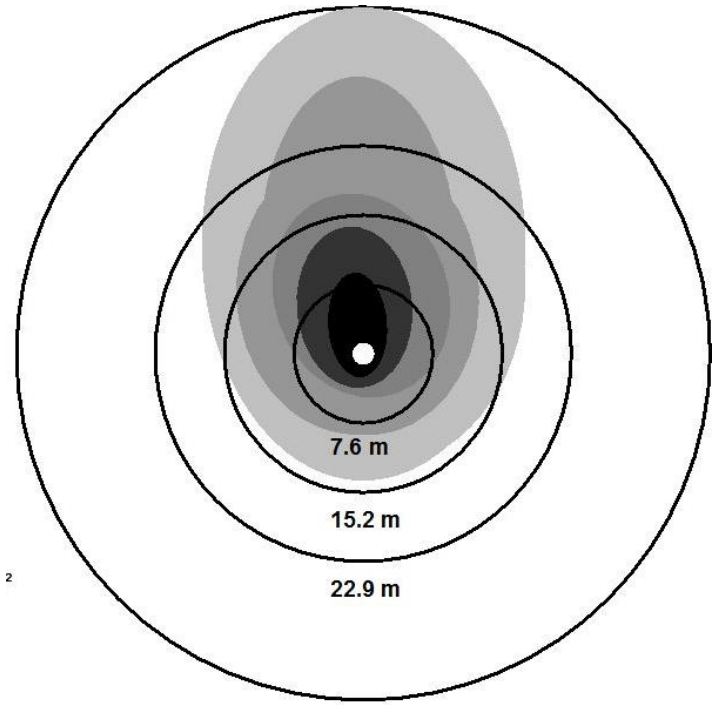
Drift Characterization

- Empirical models
  - Step changes across curves
  - Interpolation within curves
  - Nozzle
  - Droplet size class
  - Release height
  - Wind speed
  - Travel speed



Weather

- Macro
  - NOAA
- Regional
  - Mesonet (25 km)
- Local
  - Proprietary
  - Local ag networks
  - County Extension
  - Portable/mobile/on-board



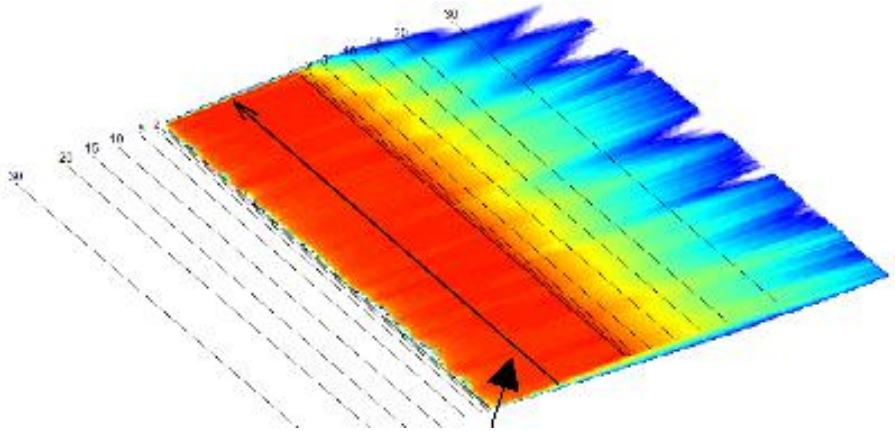
Product Label

- Contents of label
  - Specific environmental, species restrictions
  - Approved tank mixes
  - Multiple rates
  - Buffer possibilities

- Electronic label access
  - Regulatory demands
  - CRISTAL – barcode and traceability

Mechanistic Physics Models

- Atmospheric Models
  - AgDRIFT, AGDISP®, Spray Advisor (USFS), CalPUF, PERFUM, SOFEA, FEMS, -- *RegDISP/WTDISP*
- EPA Aquatic Models
  - SWCC, PFAM, KABAM, SWAMP, SCIGROW, SWIMODEL, Tier I Rice Model, PRZM-GW
- EPA Terrestrial Models
  - SIP, STIR, T-REX, TIM, T-HERPS, TerrPlant



Consensus Standards

- ISO 5682 – Sprayer performance, section/nozzle control
- ISO/TS 11356 – Spray parameters
- SC6/WG21 – Drift measurement protocols and capabilities
  - ISO 22866 Field Measurement of Drift
  - ISO 22369-1 Drift classification -- Part 1: Classes
  - ISO 22369-2 Drift classification -- Part 2: Classification of field crop sprayers by field measurements
- CRISTAL – Barcode
- ASTM – Adjuvants
- NOAA/ASTM – Weather, frequency of update, confidence
- Agricultural Meteorology – e.g. Regional data array

Outreach and Communication

- In June, the Association of Equipment Manufacturers (AEM) and the Agricultural Retailers Association (ARA) organized an event at a farm in Maryland to demonstrate the many layers of technology and innovation manufacturers have implemented to reduce spray drift.
- AEM members John Deere, AGCO, Case IH, GVM and TeeJet brought a variety of equipment to the demonstration. AEM member Hardi also set up a display to explain their technology, and Helicopter Applicators, Inc. was onsite to demonstrate aerial application technology.

https://www.aem.org/news/june-2016/video-policymakers-witness-spray-drift-reduction-technology/

Outreach and Communication

https://www.youtube.com/watch?v=3F7sfI-KMV0

Roles and Characteristics of Organizations

Characteristics of organizations

Vision, Mission, Role

Membership
- Open
- Closed

Funding
- Public
- Private

Authority
- Regulatory
- International
- National
- Informally aligned

ISO

International Organization for Standardization

ISO is an international standard-setting body composed of representatives from various national standards organizations.

Membership

- Open
- ISO has 162 national members

Funding

- Organizations that manage the specific projects or loan experts to participate in the technical work.
- Subscriptions from member bodies.
- Sale of standards.

Authority

- International consensus standards, Only given authority when adopted or referenced in other national regulation

Expertise

- All topics, all disciplines

ASABE

American Society of Agricultural and Biological Engineers

An ANSI accredited SDO and an educational / scientific organization dedicated to the advancement of engineering applicable to agricultural, food, and biological systems.

Membership

- Open
- ASABE comprises 8,000 members in more than 100 countries.

Funding

- Direct organizational support
- Subscriptions from organizations.
- Sale of standards.

Authority

- North America consensus standards, no legal authority unless referenced in US or Canadian regulation

Expertise

- Agriculture, all aspects of production and supporting systems

AgGateway

Vision: Become the recognized North American source for enabling the use of information and communication technologies for agriculture.

Mission: Promote, enable and expand eBusiness in eAgriculture.

Membership

- Open; over 240 members, primarily businesses.
- Other organizations typically join as Associate members
- There is a category for individual memberships.

Funding

- Member dues, project fees, and service subscriptions, dependent on volume of business.

Authority

- *De facto*: Implementation by stakeholders.

Expertise

- Supply chain and field operations business processes

AEF

Agricultural Industry Electronics Foundation

AGRICULTURAL INDUSTRY ELECTRONICS FOUNDATION

Role

- Direct and prioritize standards development effort
- Support standards adoption
- Fund prototyping and tests

Membership

- Open to industry
- Equipment, hardware and FMIS manufacturers

Funding

- Service fee
- No cost to universities

Authority

- Supportive of consensus standards,

Expertise

- Electronics and connectivity

AgGateway

ASABE

AEM

Association of Equipment Manufacturers

Mission Statement

AEM will serve equipment manufacturers operating in North America to create a strong voice for its members and the industries it represents in the global marketplace by delivering superior services in public policy, market information, trade shows, technical and safety services, education and market support.

Membership

- Equipment manufacturers

Funding

- Member dues, tradeshows

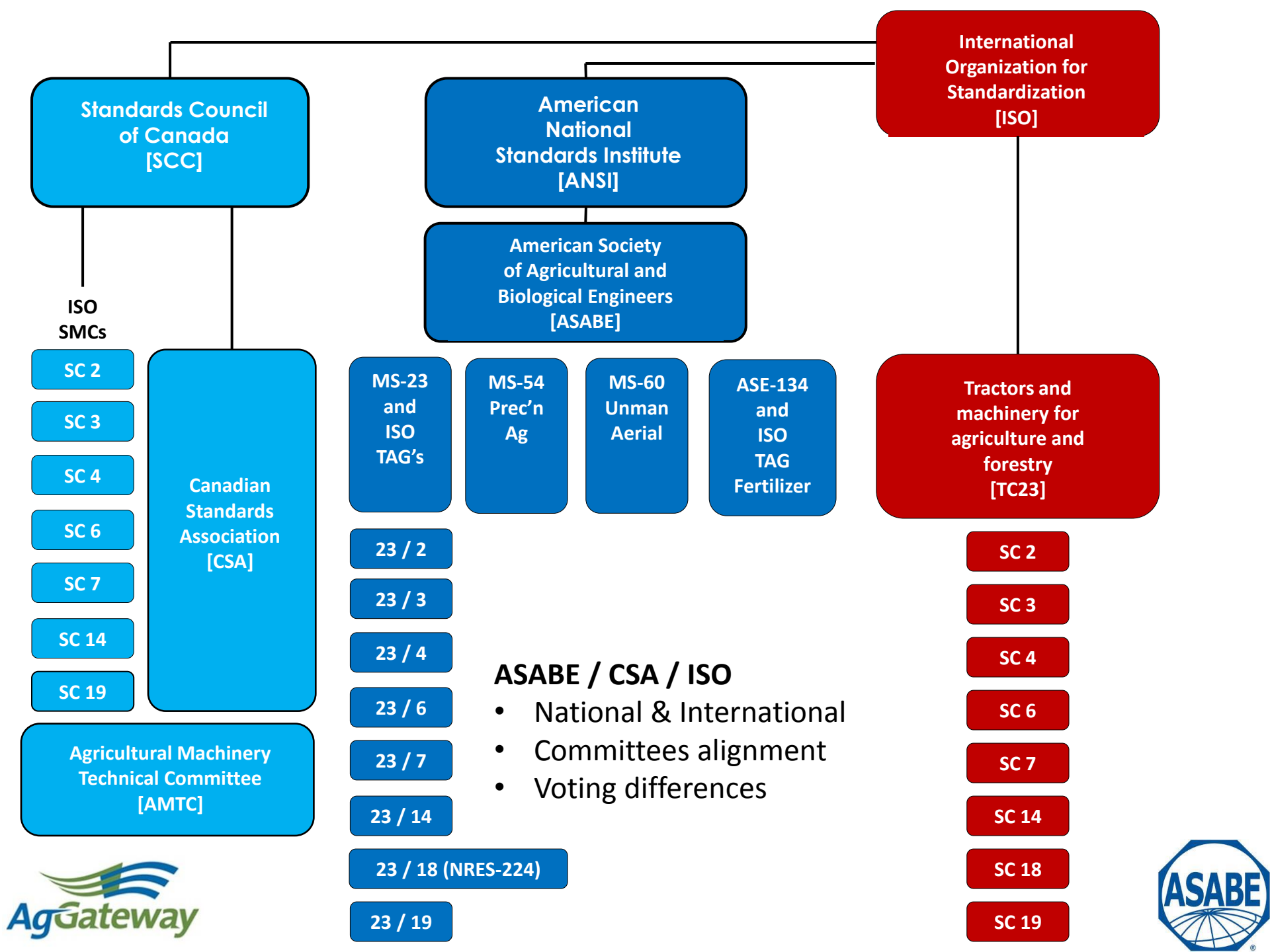
Authority

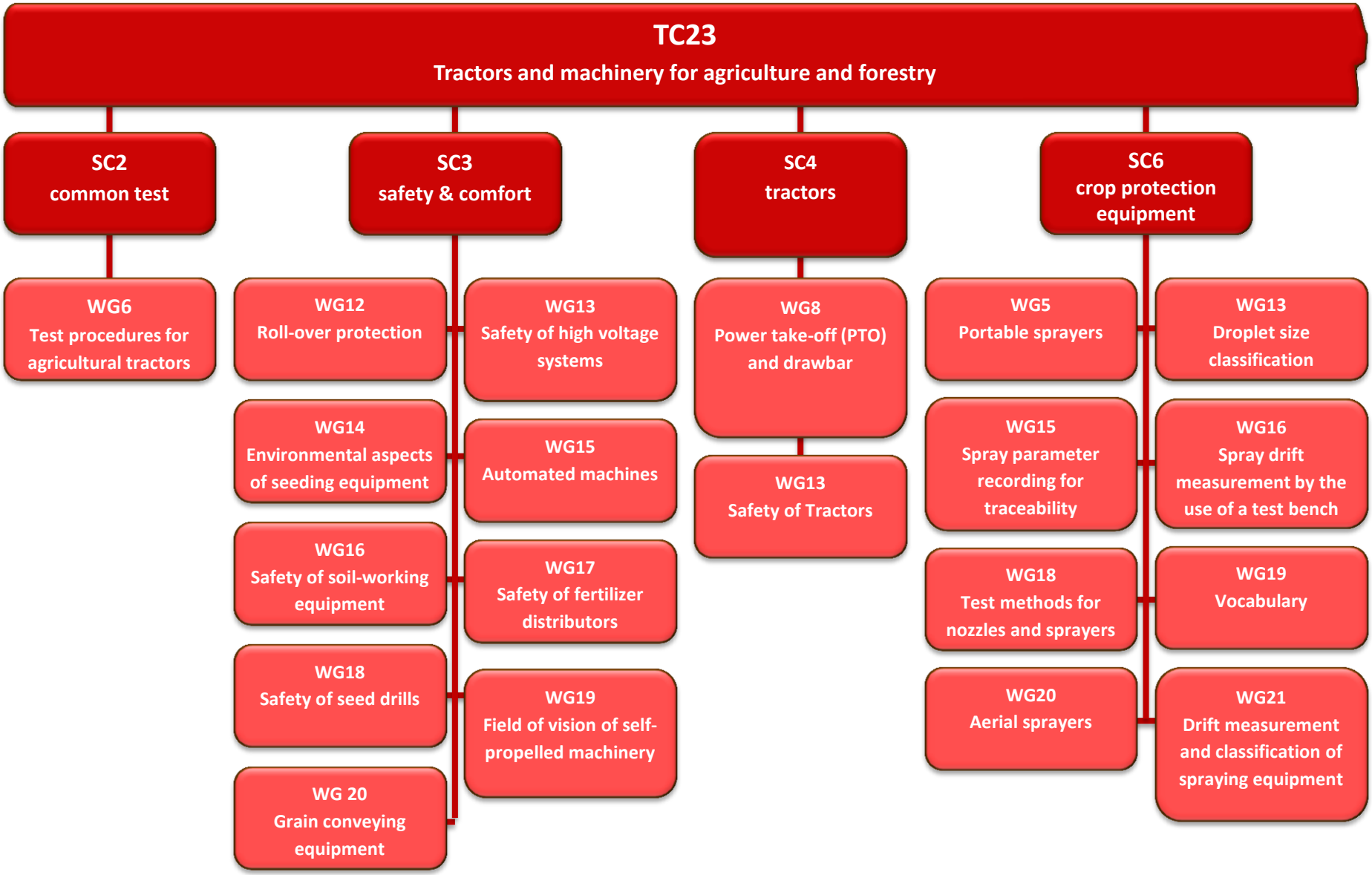
- Influence public policy, Promote use of consensus standards

Expertise

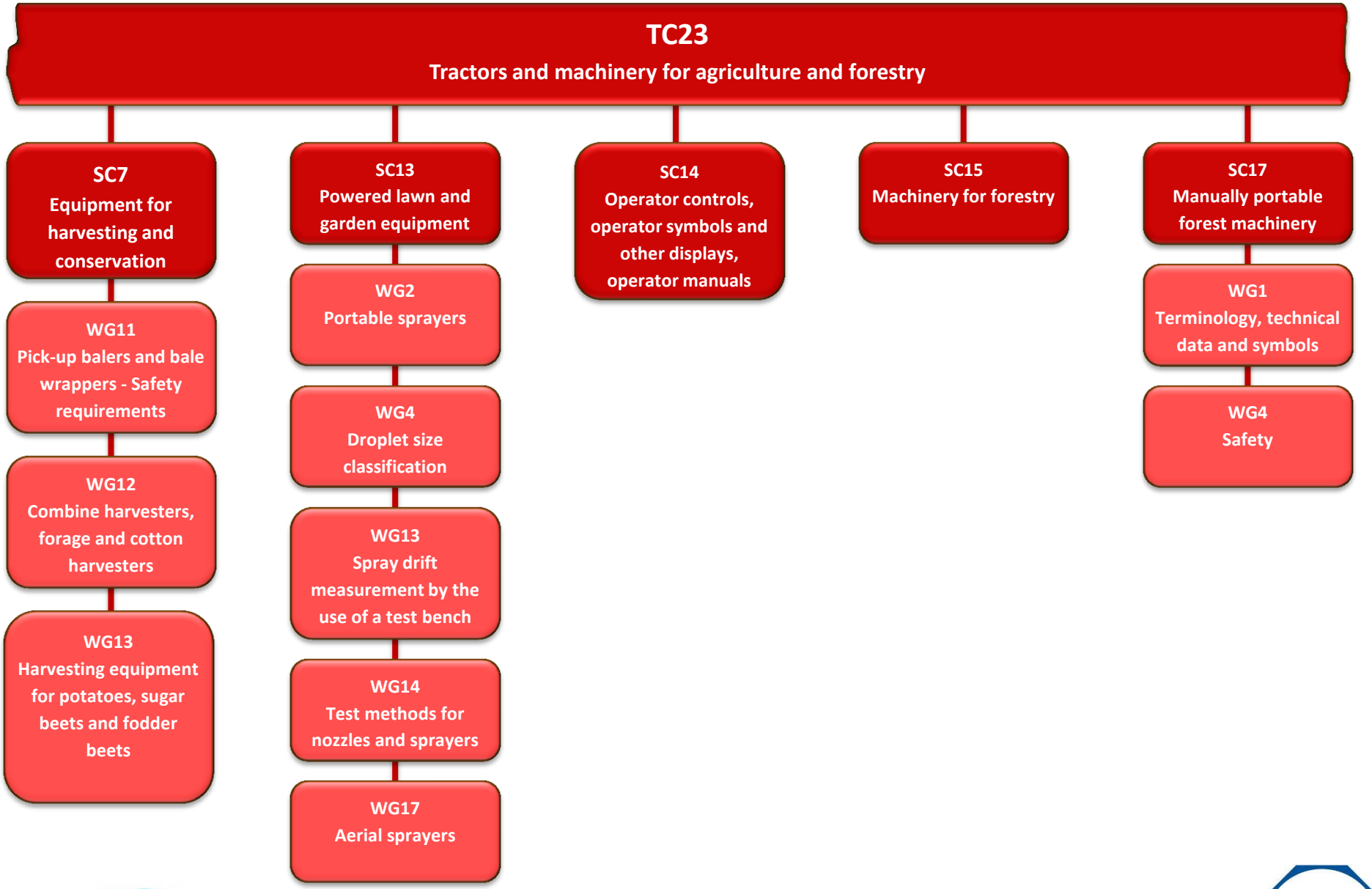
- Agricultural, construction, forestry, mining and utility industries

Organization	Role	Membership
ISO	• International standards	Open
ASABE	• National standards	Open
AgGateway	• Business processes • Industry identifiers • Message definitions	Open
AEF	• Electronics	Industry
AEM	• Industry support • Public policy	Industry


Standards Council of Canada [SCC]
American National Standards Institute [ANSI]
International Organization for Standardization [ISO]
American Society of Agricultural and Biological Engineers [ASABE]
ISO SMCs
SC 2
SC 3
SC 4
SC 6
SC 7
SC 14
SC 19
Canadian Standards Association [CSA]
Agricultural Machinery Technical Committee [AMTC]
MS-23 and ISO TAG's
MS-54 Prec'n Ag
MS-60 Unman Aerial
ASE-134 and ISO TAG Fertilizer
23 / 2
23 / 3
23 / 4
23 / 6
23 / 7
23 / 14
23 / 18 (NRES-224)
23 / 19
Tractors and machinery for agriculture and forestry [TC23]
SC 2
SC 3
SC 4
SC 6
SC 7
SC 14
SC 18
SC 19
ASABE / CSA / ISO
• National & International
• Committees alignment
• Voting differences
AgGateway
ASABE



TC → Technical Committee SC → Sub Committee WG → Working Group



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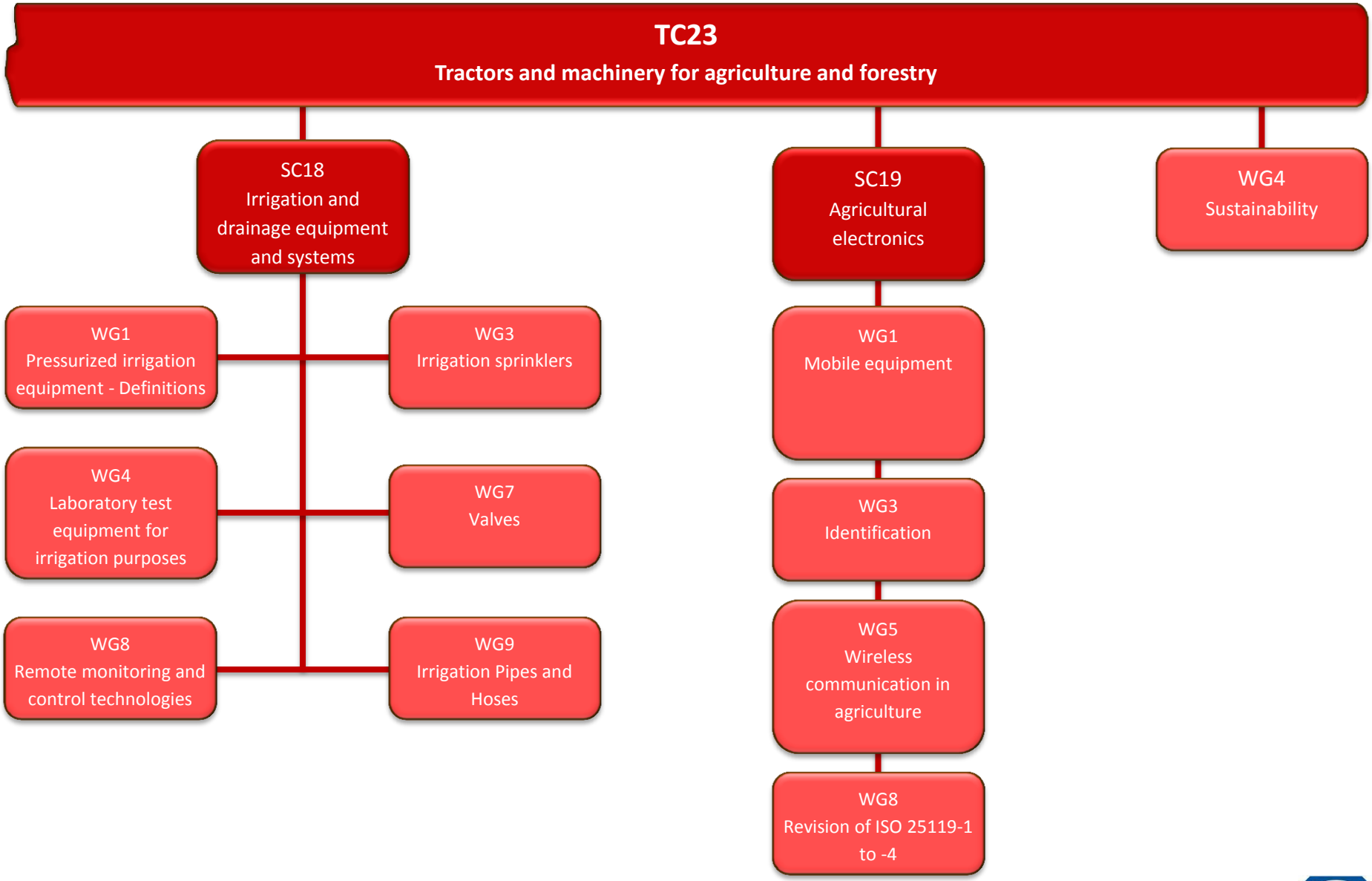

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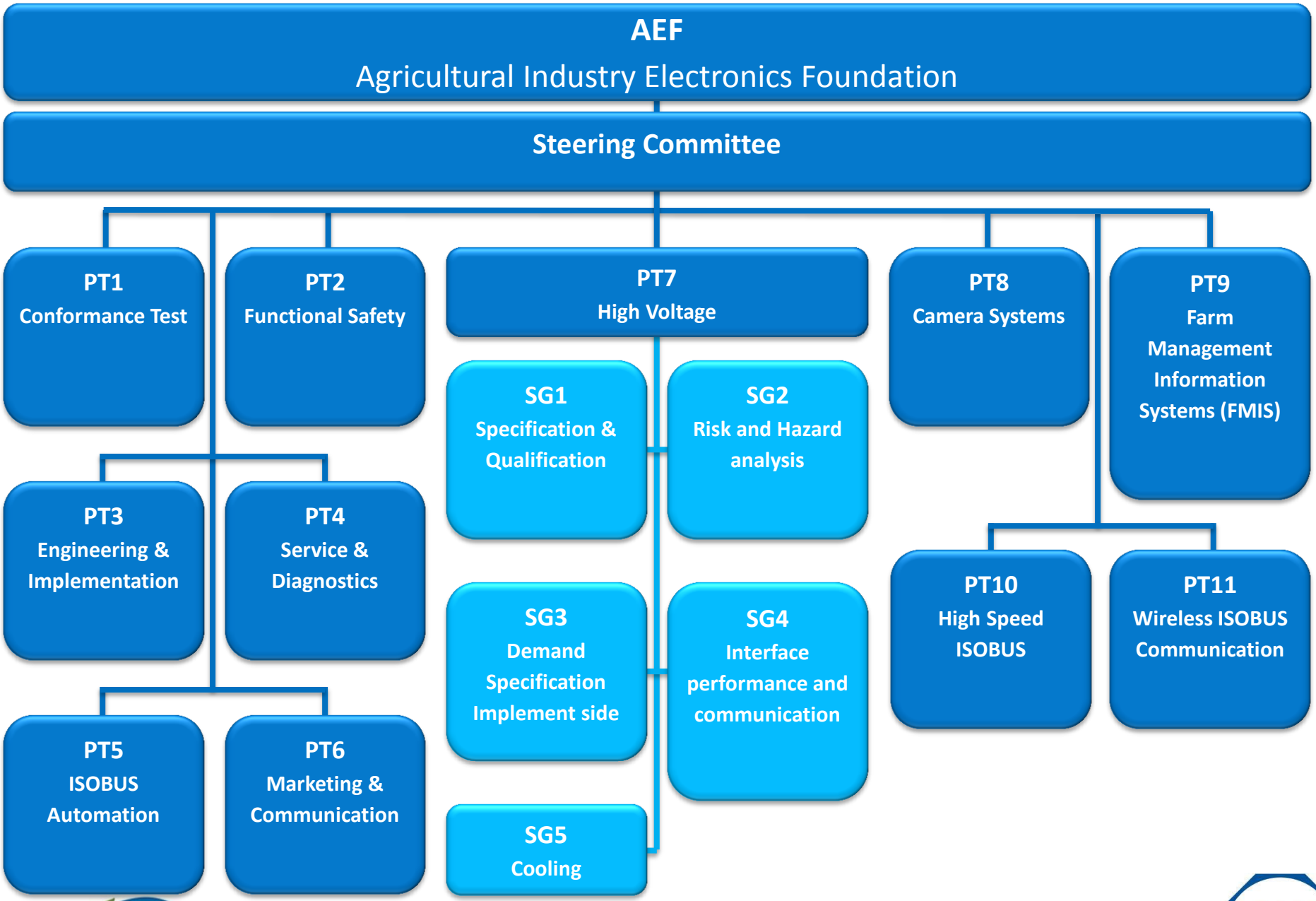


PT → project team SG → sub group

CEN

European Committee for Standardization

TC 144

Tractors and machinery for agriculture and forestry

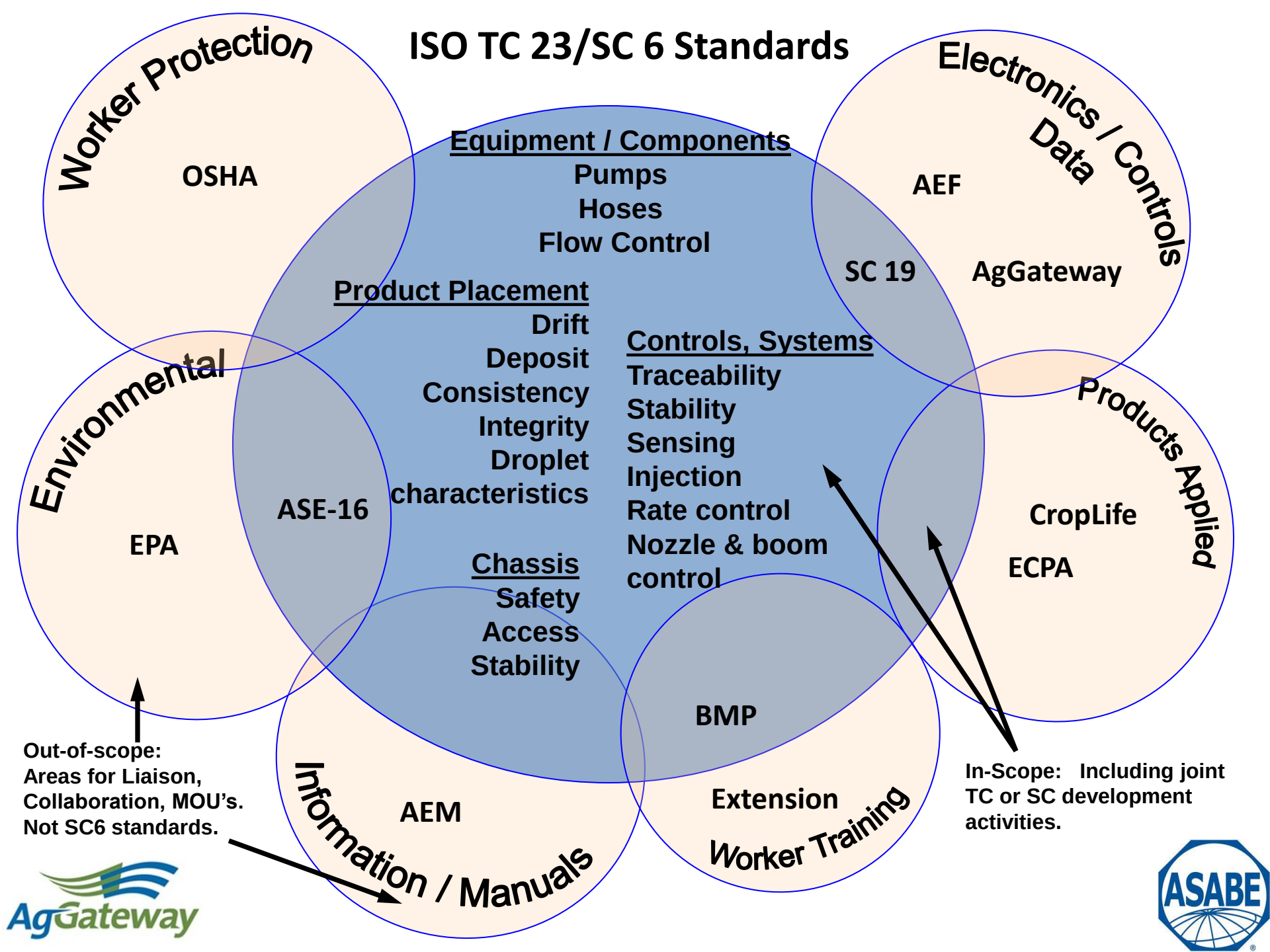
UN ECE

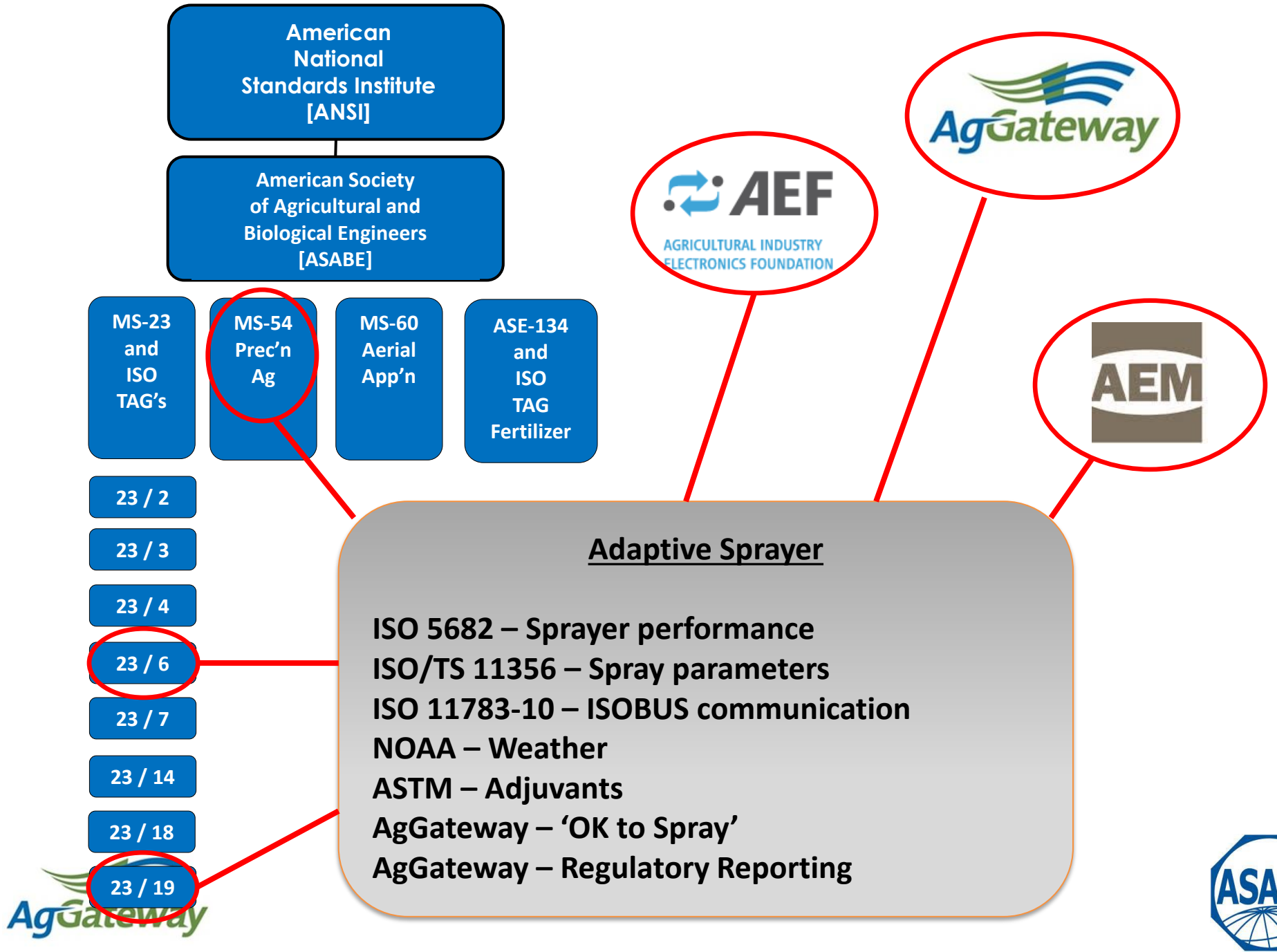
United Nations Economic Commission for Europe

Environment Protection

OECD

Organization for Economic Cooperation and Development


ISO TC 23/SC 6 Standards
Worker Protection
OSHA
Electronics / Controls Data
AEF
SC 19
AgGateway
Equipment / Components
Pumps
Hoses
Flow Control
Product Placement
Drift
Deposit
Consistency
Integrity
Droplet characteristics
Controls, Systems
Traceability
Stability
Sensing
Injection
Rate control
Nozzle & boom control
Chassis
Safety
Access
Stability
Environmental
EPA
ASE-16
Products Applied
CropLife
ECPA
BMP
Out-of-scope:
Areas for Liaison, Collaboration, MOU's.
Not SC6 standards.
Information / Manuals
AEM
Extension
Worker Training
In-Scope: Including joint TC or SC development activities.
AgGateway
ASABE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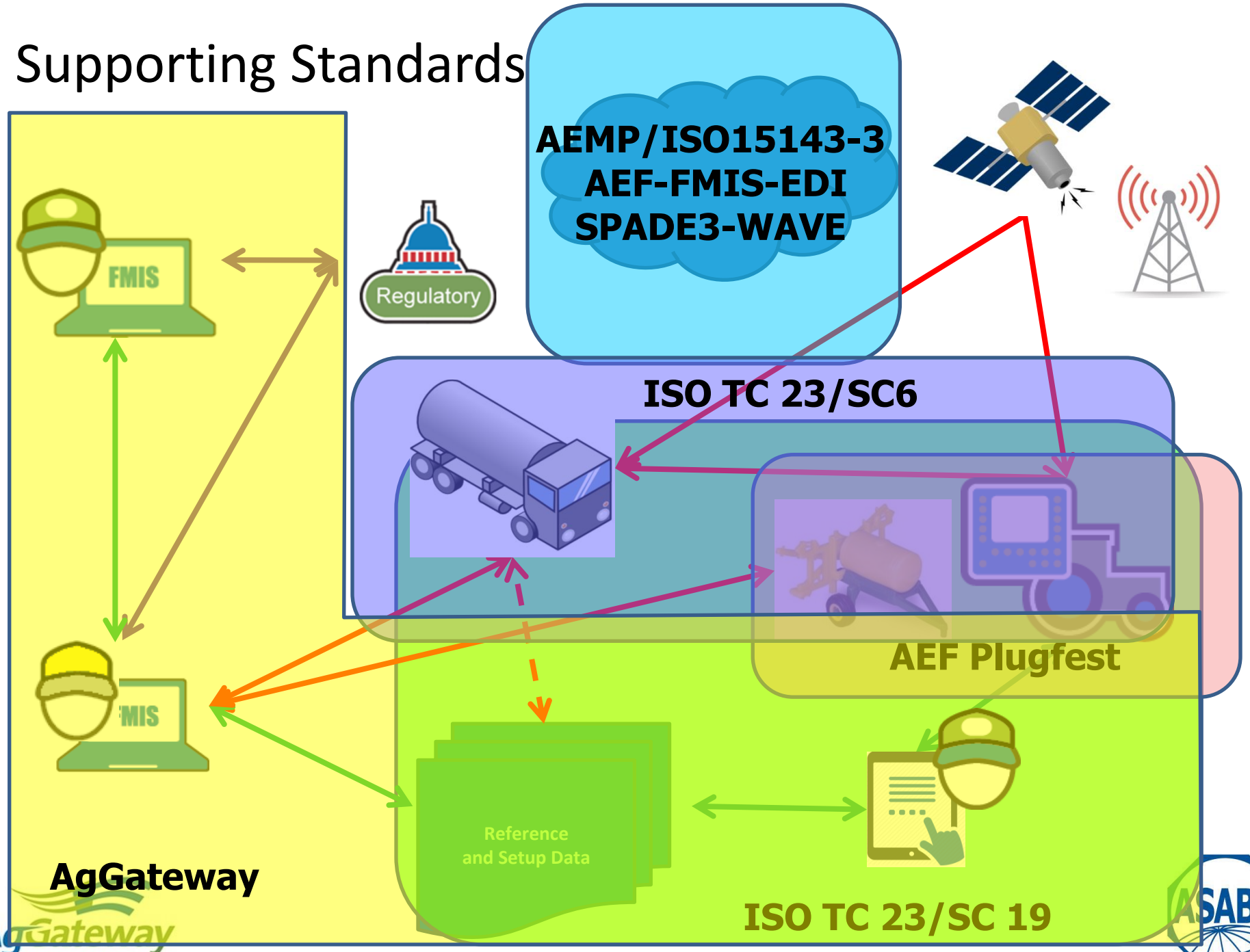
23 / 19
Adaptive Sprayer
ISO 5682 – Sprayer performance
ISO/TS 11356 – Spray parameters
ISO 11783-10 – ISOBUS communication
NOAA – Weather
ASTM – Adjuvants
AgGateway – 'OK to Spray'
AgGateway – Regulatory Reporting
AgGateway
ASABE

Supporting Standards



Questions?

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Valcore Consulting, LLC