Update on International CCS Standards

Carbon Management Institute

School of Energy Resources
University of Wyoming
Laramie, Wyoming

Prepared for:

14th Annual Carbon Capture, Utilization & Storage Conference

Pittsburgh, PA

Prepared By:

Kipp Coddington

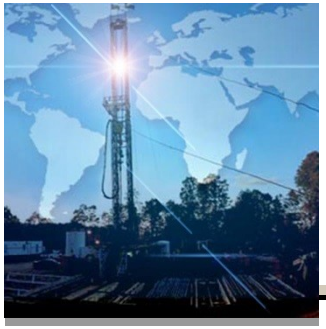
Director, Carbon Management Institute, University of Wyoming; and Convenor, Working Group 6, ISO TC-265 (CO_2 storage via CO_2 -EOR)

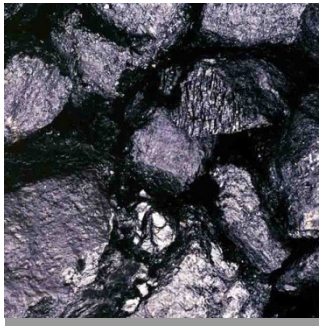
April 30, 2015

1 ISO & Standards

2 TC-265

3 Next Steps

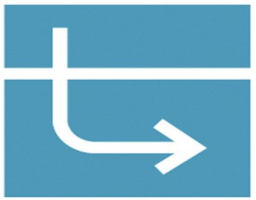




1: ISO & Standards

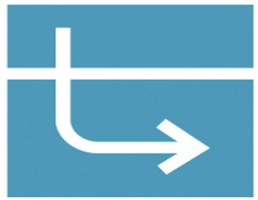
What are Standards?

- Consensus based
- Designed as a rule, guideline or definition
- Revisable and updateable
- Voluntary
- Standards must fit to purpose:
  - Prescriptive based
  - Objectives based
  - Performance based
  - Principles based
  - Hybrids

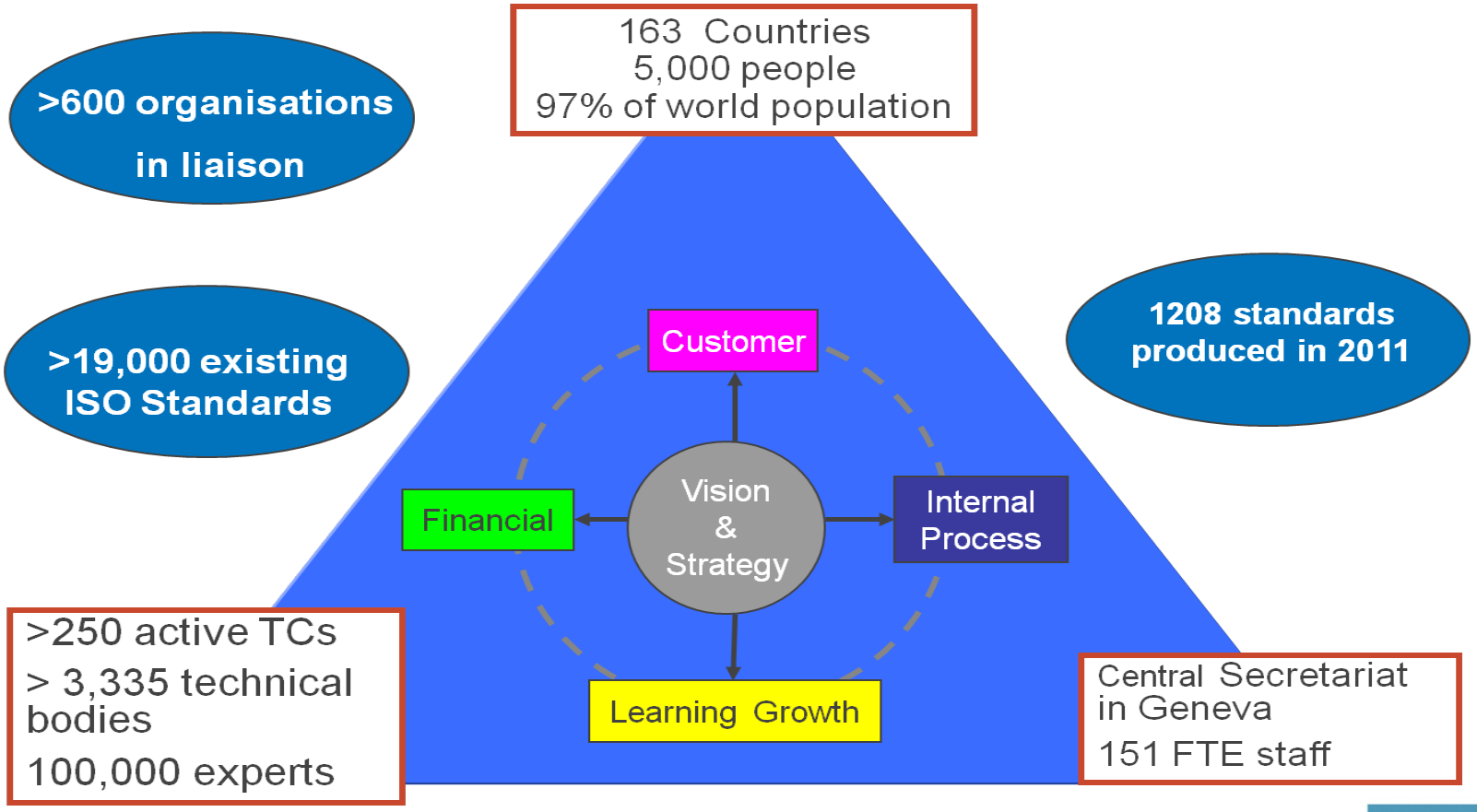


Why Standards?

- Because they are not laws…
  - *Standards & regulations can work together*
- Not Mandated
- Typically initiated by industry…
  - *And therefore better received and used by industry because they are part of the process*
- Demonstrate regulatory compliance
- Streamline the regulatory process
- Harmonize across jurisdictions



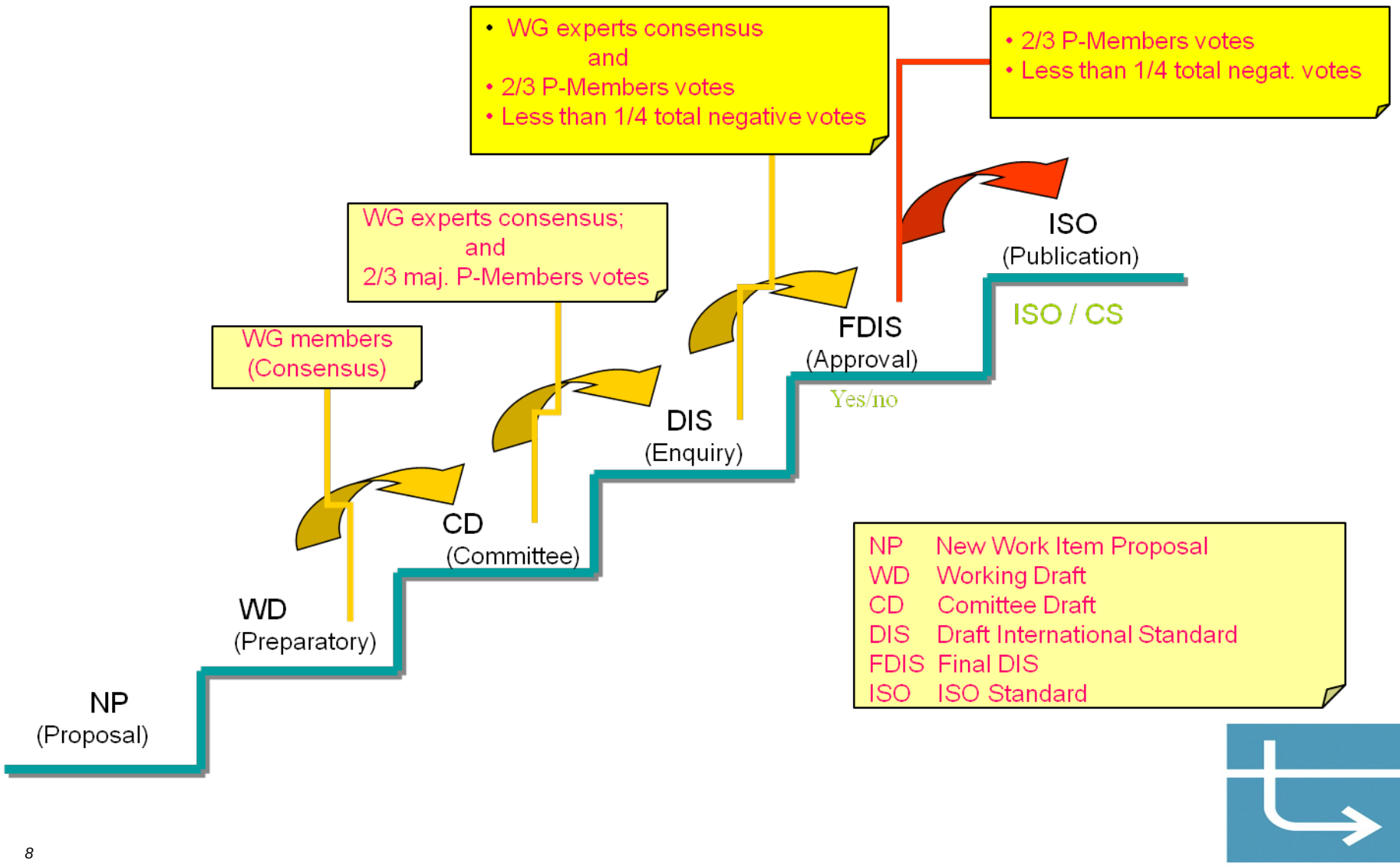
ISO = A Global System

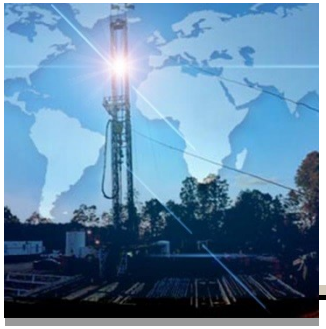


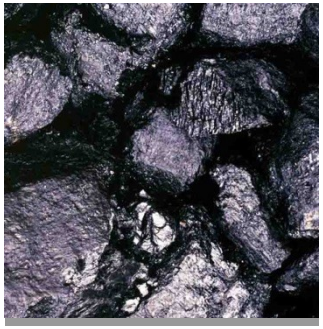
ISO Standards Development

- *ISO does not write standards*
- *Technical Committees write standards*
- *P-Member countries approve standards*
- *Nations adopt ISO standards*
- *ISO does not influence the technical content*

ISO Standards Process







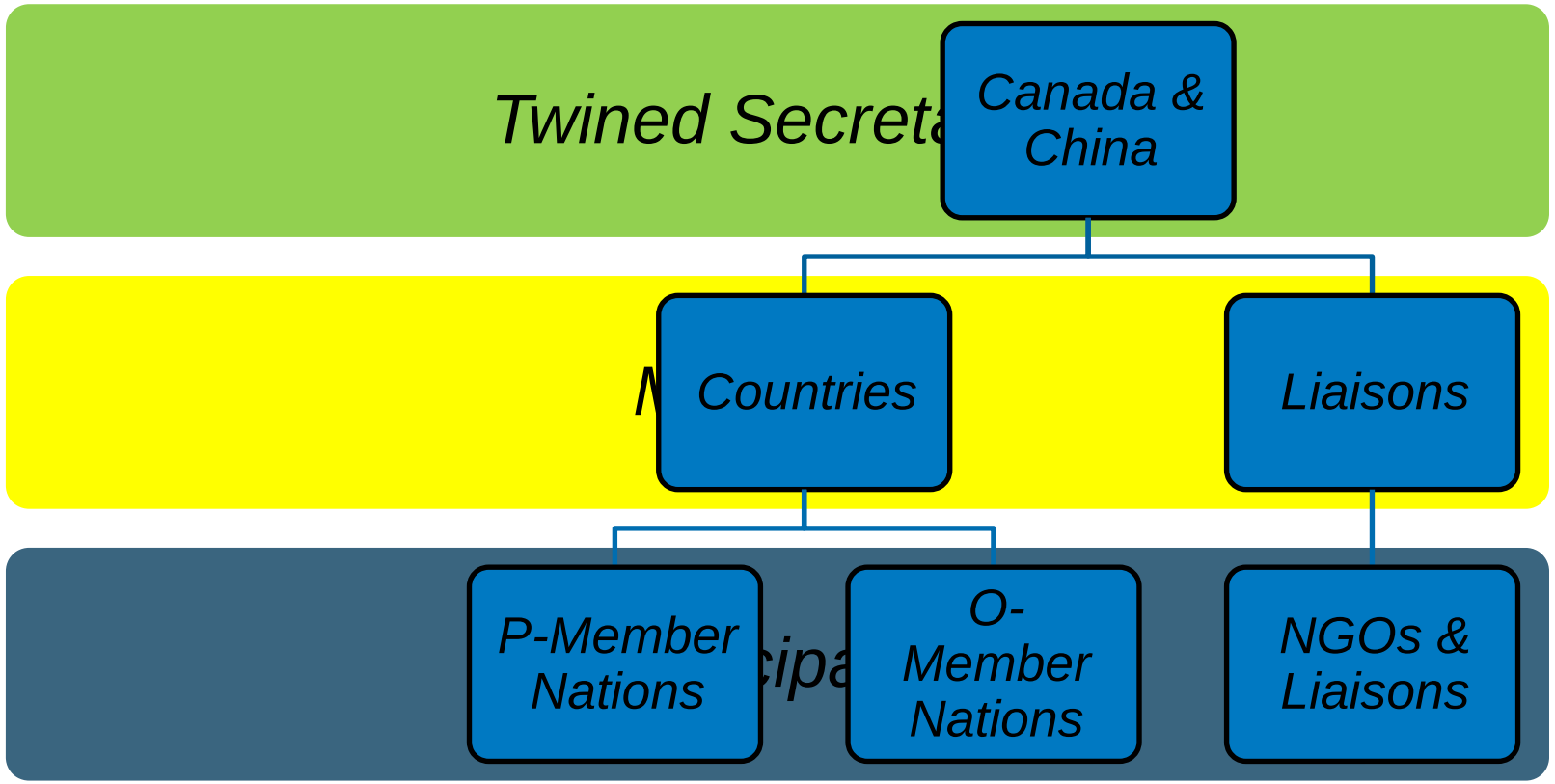
2: ISO TC 265

Carbon Dioxide Capture, Transportation, and Geological Storage

Title & Designation:

Standardization of design, construction, operation, and environmental planning and management, risk management, quantification, monitoring and verification, and related activities in the field of carbon dioxide capture, transportation, and geological storage (CCS).

ISO TC 265 – CCS Organization



ISO TC 265 – P-Members

Participating Countries:

Australia
Canada
China
France
Germany
India
Italy
Japan
S. Korea
Malaysia
Netherlands
Norway
Saudi Arabia
South Africa
Spain
Sweden
Switzerland
United Kingdom
United States

- ✓ *Voting Members*
- ✓ *Guaranteed International Expert Participation on all WGs*

ISO TC 265 – O-Members

<u>Observing Countries:</u>

Argentina
Brazil
Czech Rep.
Egypt
Finland
Iran
New Zealand
Serbia
Sri Lanka

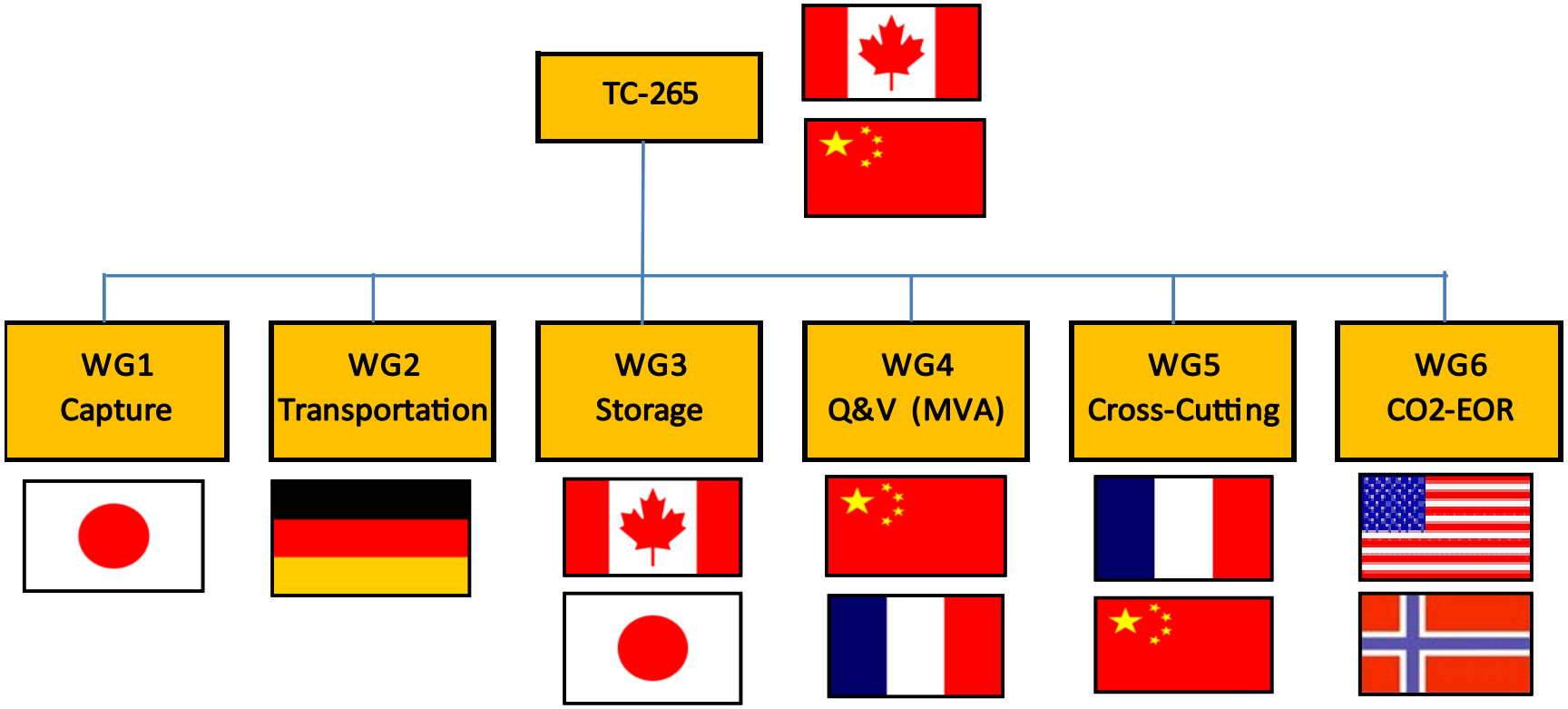
- ✓ *Non-voting Members*
- ✓ *May request International Expert Participation on all WGs*
- ✓ *May upgrade to P-Member at any time*

ISO TC 265 – Liaisons

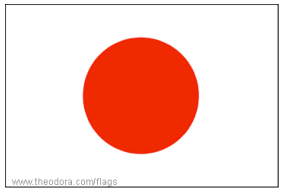
- *ISO TC207 Environmental Management*
- *ISO TC67 Petroleum and Natural Gas*
- *CEN/TC 234 Gas Infrastructure*
- *Carbon Sequestration Leadership Forum (CSLF)*
- *European Industrial Gases Association (EIGA)*
- *Global CCS Institute (GCCSI)*
- *International Energy Association (IEA)*
- *IEAGHG*
- *CO2 GeoNet*
- *World Resources Institute (WRI)*

- ✓ *Non-voting Members*
- ✓ *Guaranteed International Expert Participation on all WGs*

TC-265 Working Groups



WG1: Capture

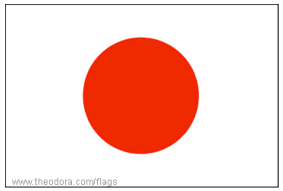


Technical Report (TR):

- Pre-, post-, & oxyfuel combustion capture
- Industrial processes
- Separation, purification
- Dehydration, compression and pumping
- Liquefaction, installation, operation, maintenance
- Quality of CO_2 streams
- Monitoring, management systems
- Plant retrofitting

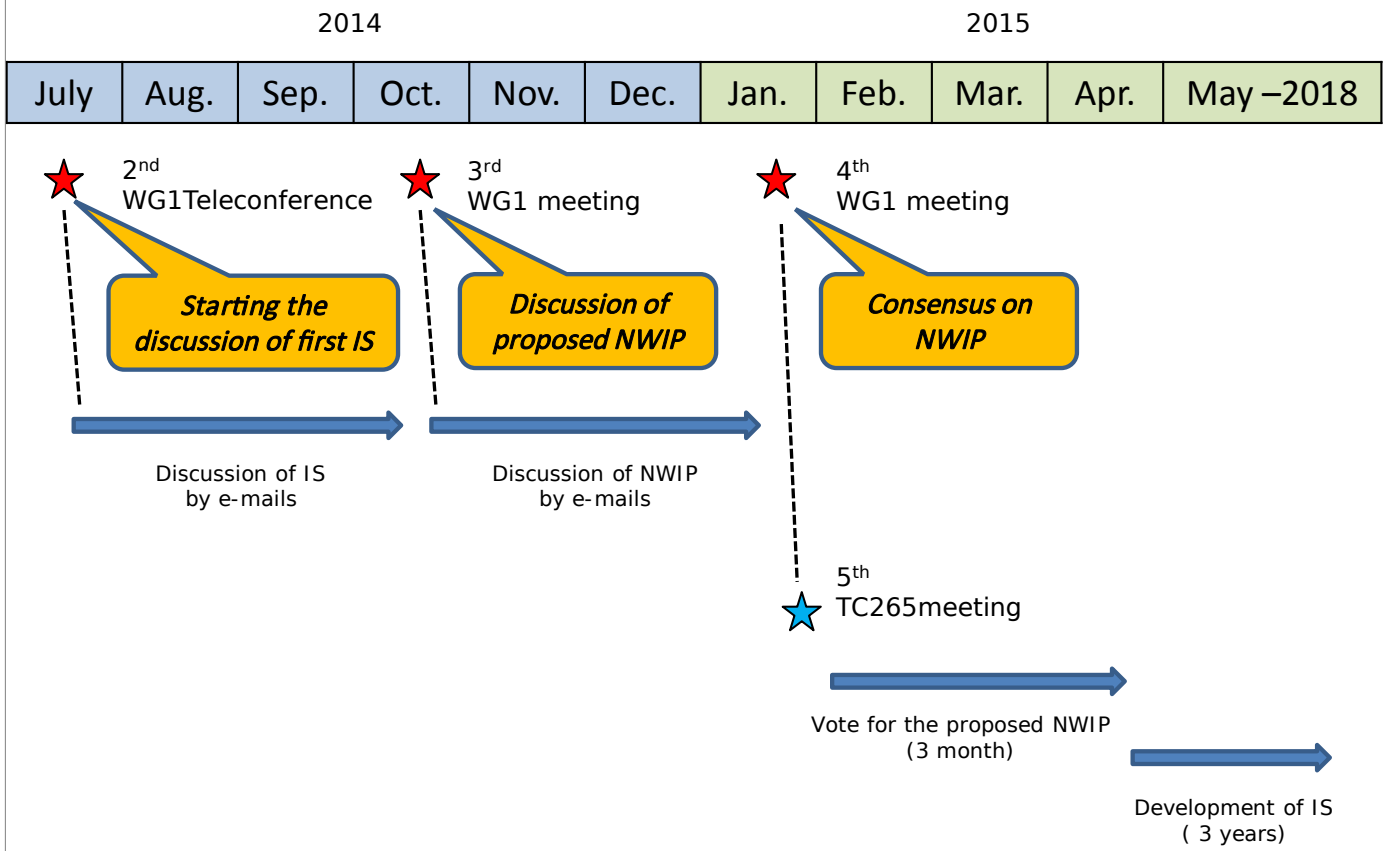
- ✓ *4 US Members*
- ✓ *All have lead author roles*

WG1: Capture



ISO/TC 265/WG1 N053

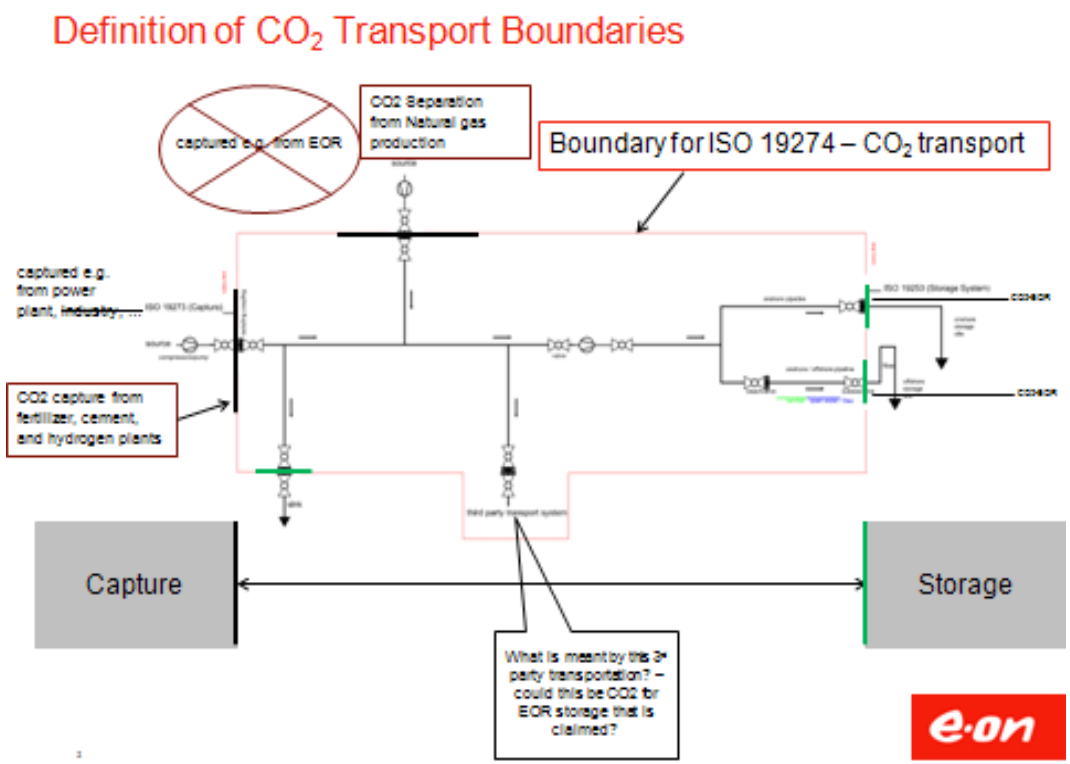
Proposed schedule for the first IS



ISO/TC 265 the 2nd WG1 Teleconference, 2014-07-17

WG2: Transportation

Pipeline transportation systems boundaries:



✓ *2 US Members*

- *Pipelines not currently covered by existing ISO/TC-67 standards*
- *Health, safety and environment (HSE) aspects specific to transport*
- *Monitoring of CO_2*

WG2: Transportation

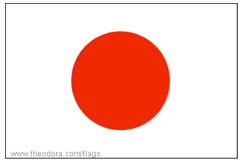
427 comments:

- Australia 34 comments
- Canada 27 comments
- China 42 comments
- France 9 comments
- Germany 5 comments
- Japan 16 comments
- Norway 19 comments
- UK 212 comments
- USA 63 comments

ISO International Organization for Standardization

ISO/CD 27913
CO_2-Transportation

WG3: Storage



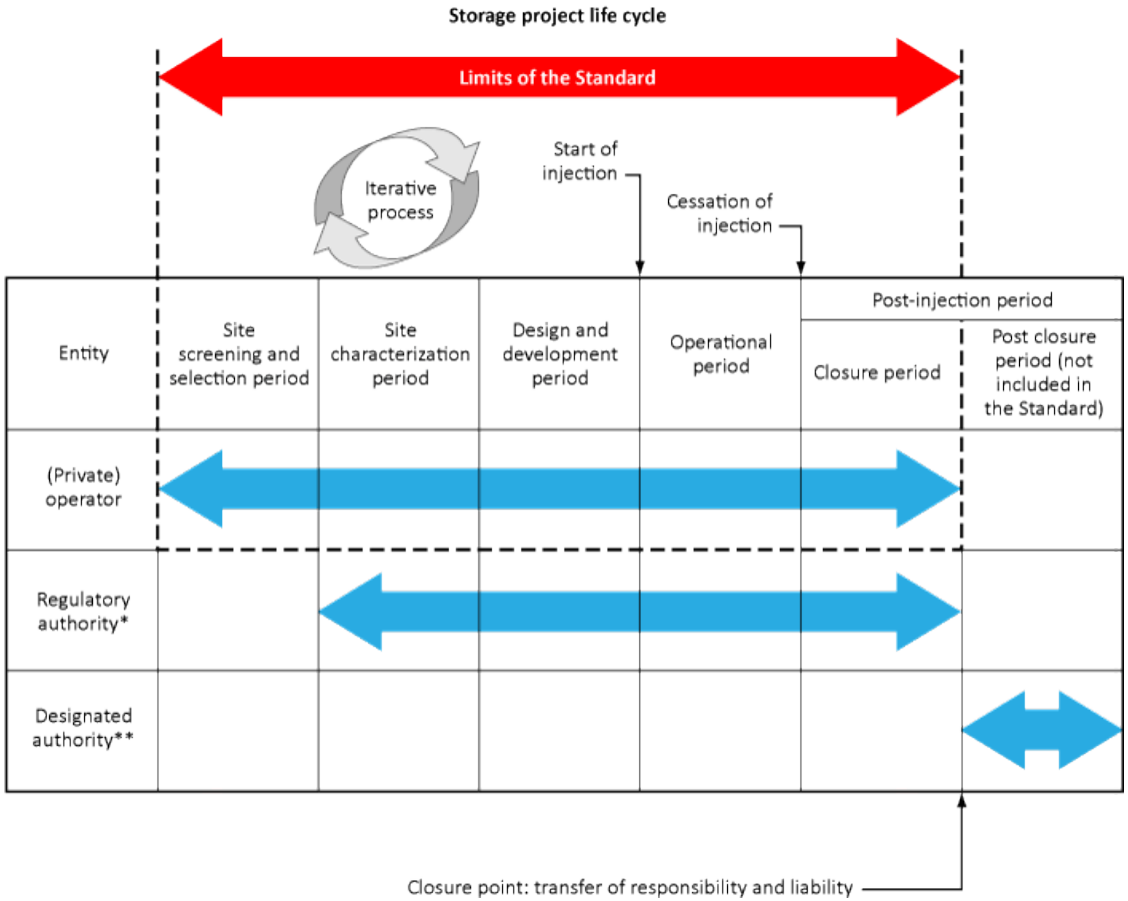
Geological storage of carbon dioxide; Canada (Onshore) Japan (Offshore):

- Z-741-12 as seed document
- Site selection
- Site characterization
- Risk assessment & risk management
- Well construction
- Closure
- Post-closure

- ✓ *8 US Members*
- ✓ *Many have lead or co-lead author roles*

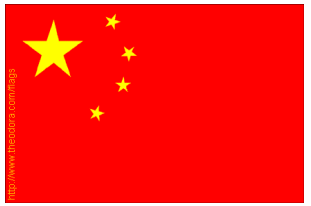
WG3: Storage

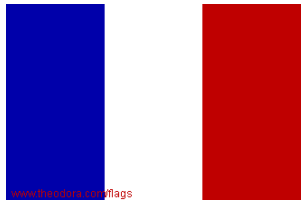
- 750 comments from the Technical Committee



WG4: Quantification & Verification

Quantification & Verification Methodology (TR): Led by China, with support from France:





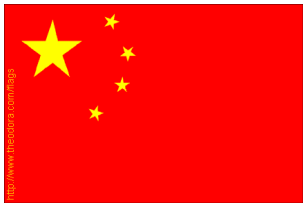
- Project boundary & leakage
- CO_2 quantification
- Monitoring and reporting
- Third party verification
- Life Cycle Analysis

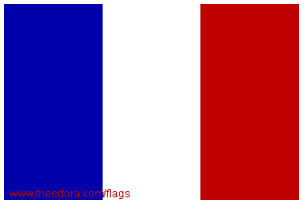
✓ *4 US Members*

Professor Bo Peng, CUPB, CHAIR
Ms Mei LIU , CNIS, Secretariat

WG4: Quantification & Verification

Country	Number of member (2014, last plenary)	Current membership
Australia	1	1
Canada	2	4
China	4	4
France	1	4
Germany	2	2
Japan	6	6
Korea	1	2
Norway	2	2
Spain	2	2
Sweden		1
UK	1	2
US	4	5
Liaison	1	2
Total	27	37





Professor Bo Peng, CUPB, CHAIR
Ms Mei LIU , CNIS, Secretariat

WG5: Crosscutting Issues



Definitions & Vocabulary; Led by France, with support from China:

- Terminology
- Definitions
- System Integration
- Public Participation & Engagement
- Mixing of gas streams from different sources

- ✓ *7 US Members*
- ✓ *Many have lead or co-lead author roles*

WG5: Crosscutting Issues

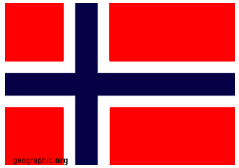


Example of harmonizing cross-cutting terms among WGs: CO_2 stream

- **WG5**: *a stream consisting overwhelmingly of carbon dioxide*
- **WG2:** stream consisting overwhelmingly of carbon dioxide *with a limited fraction of other chemical substances*
- **WG3**: a stream of carbon dioxide *that has been captured from an emission source (e.g., a fossil fuel power plant) and meets applicable regulatory requirements for CO_2 storage*

  Note: It may include any incidental associated substances derived from the source materials or the capture process, added as a result of commingling for transportation, added to the stream to enable or improve the injection process and/or trace substances added to assist in CO_2 migration detection.

WG6: CO2-EOR



Carbon Dioxide Storage using EOR; led by USA, with support from Norway:

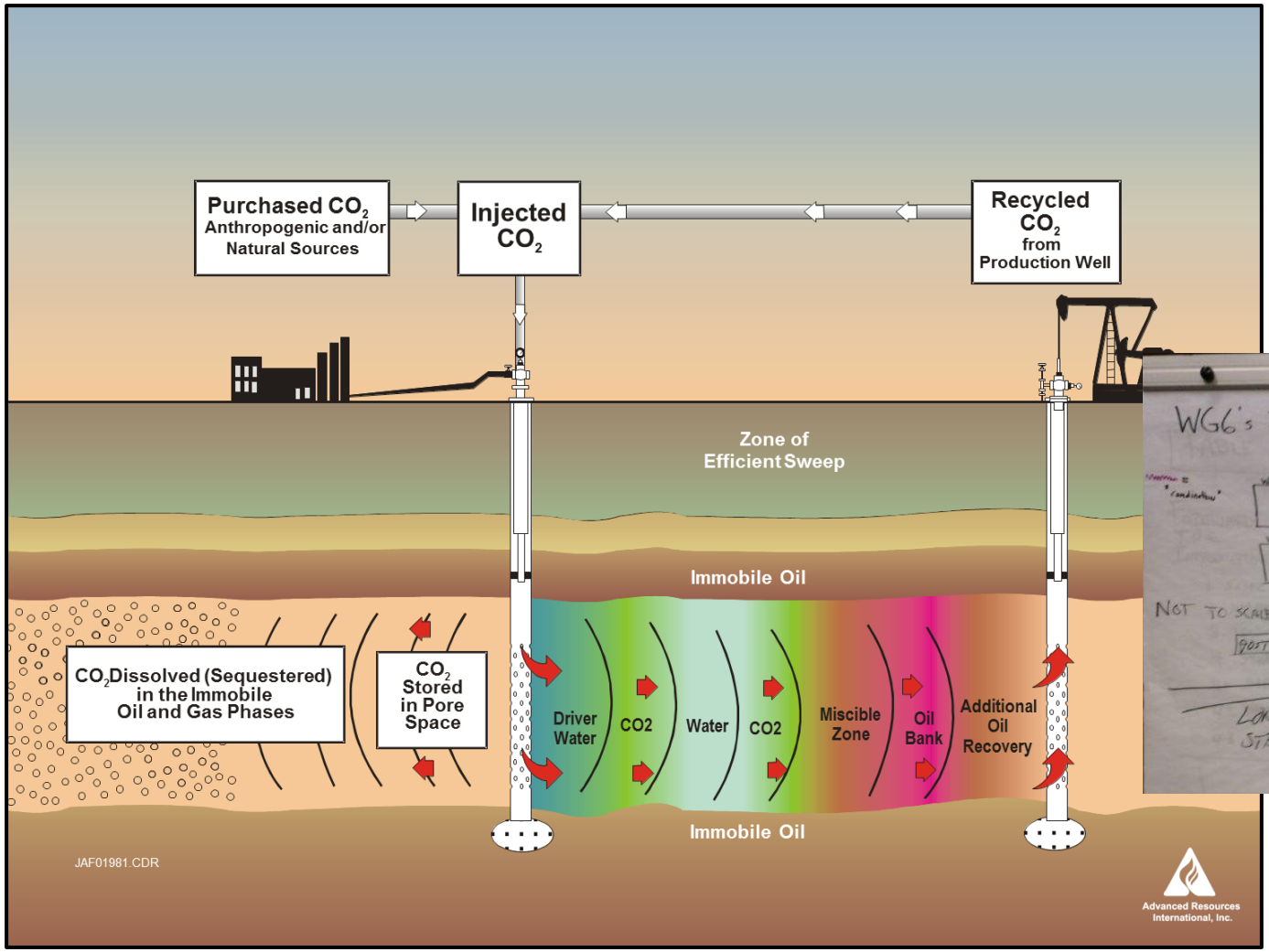
- *Low-pressure subsurface oil field operating environments*
- *Reservoir & pore space management*
- *Manage known lateral stratigraphic traps in the target formation*
- *Coordination with WGs1-5*

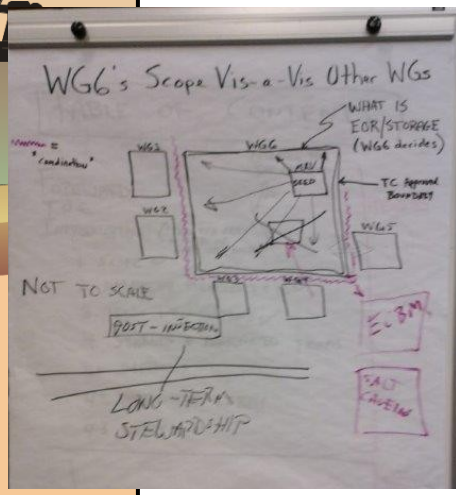
- ✓ *14 US Members*
- ✓ *1 - Norway*
- ✓ *5 - Canada*
- ✓ *2 - Japan*
- ✓ *2 - IEA*
- ✓ *24 Total Members*

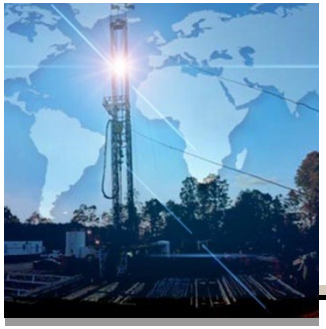
Expected:

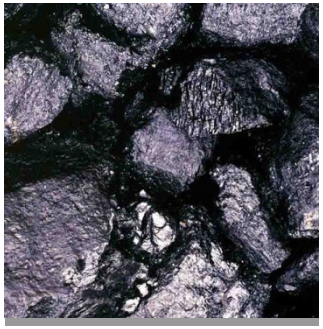
- *China*
- *France*
- *UK*
- *Liaisons*

WG6: CO2-EOR


Purchased CO_2
Anthropogenic and/or
Natural Sources
Injected
CO_2
Recycled
CO_2
from
Production Well
Zone of
Efficient Sweep
Immobile Oil
CO_2 Dissolved (Sequestered)
in the Immobile
Oil and Gas Phases
CO_2
Stored
in Pore
Space
Driver
Water
CO2
Water
CO2
Miscible
Zone
Oil
Bank
Additional
Oil
Recovery
Immobile Oil
JAF01981.CDR
Advanced Resources
International, Inc.


WG6's Scope Vis-a-Vis Other WGs
WHAT IS
EOR/STORAGE
(WG6 decides)
WG6
WG5
NOT TO SCALE
POST-INJECTION
LONG-TERM
STEWARDSHIP





3: Next Steps

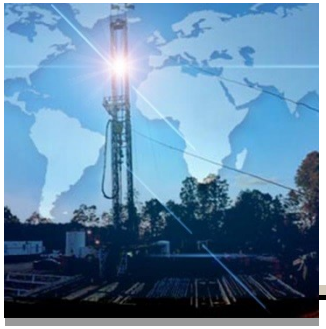
Next Steps…

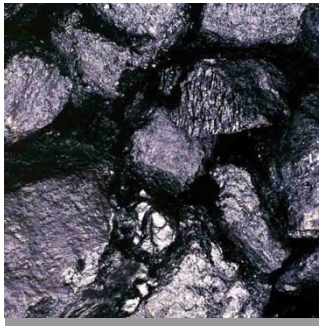
- CO_2-EOR Meetings Houston, late June 2015
- 6th Plenary Meeting in September – Oslo, Norway
- Expanding membership - Saudi Arabia
- Participate in UNFCCC – COP21 in Paris
- Expect draft standards in the coming months, years

Thank you

Carbon Management Institute

University of Wyoming





Backup & Supporting Slide

US TAG Membership

Members		Role & International WG	Affiliation
Carpenter	Steven	Chair, WG2 & WG6	Advanced Resources
Batum	Melissa		BOEM
Coddington	Kipp	WG3 & WG6	NACCSA
Comello	Stephen	WG5	Stanford
Duguid	Andrew	WG3 & WG6	Schlumberger
Ekmann	Jim	WG1	Leonardo Tech
Esposito	Richard	WG3 & WG6	Southern Company
Feldman	Arnie	WG1 & WG5	JJD Environmental
Forbes	Sarah	WG5	WRI
Frailey	Scott	WG3 & WG6	Illinois GS
Greenberg	Sallie	WG5	Illinois GS
Herzog	Howard	WG1	MIT
Hill	Bruce	WG6	CATF
Hovorka	Sue	WG6	UT-BEG
Hnottavange-Telleen	Ken	WG5	Schlumberger
Jenvey	Nigel	WG6	BP
Koperna	George	WG6	Advanced Resources
Marston	Phil	WG5 & WG6	Marston Law
Mohaghegh	Shahab	WG4 & WG6	WVU
Pashin	Jack	WG3	OSU
Ripepi	Nino	WG4	VT
Sams	Kimberly	WG3	SSEB
Schnacke	Greg	WG2 & WG6	Denbury
Surface	Michael	WG1	Dominion
Thomas	Burt	WG4	USGS
Van Voorhees	Bob	WG3 & WG5 & WG6	USCCSA
Wade	Sarah	WG4 & WG6	Wade, LLC
Woods	Mark	WG1	Booz Allen Hamilton