

Health & Safety Issues in CCS

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What we will be covering

- Characteristics of CO₂
- Hazard analysis of accidental or intentional CO₂ release
- Design & operational issues for CO₂ service
- A bit about the Energy Institute

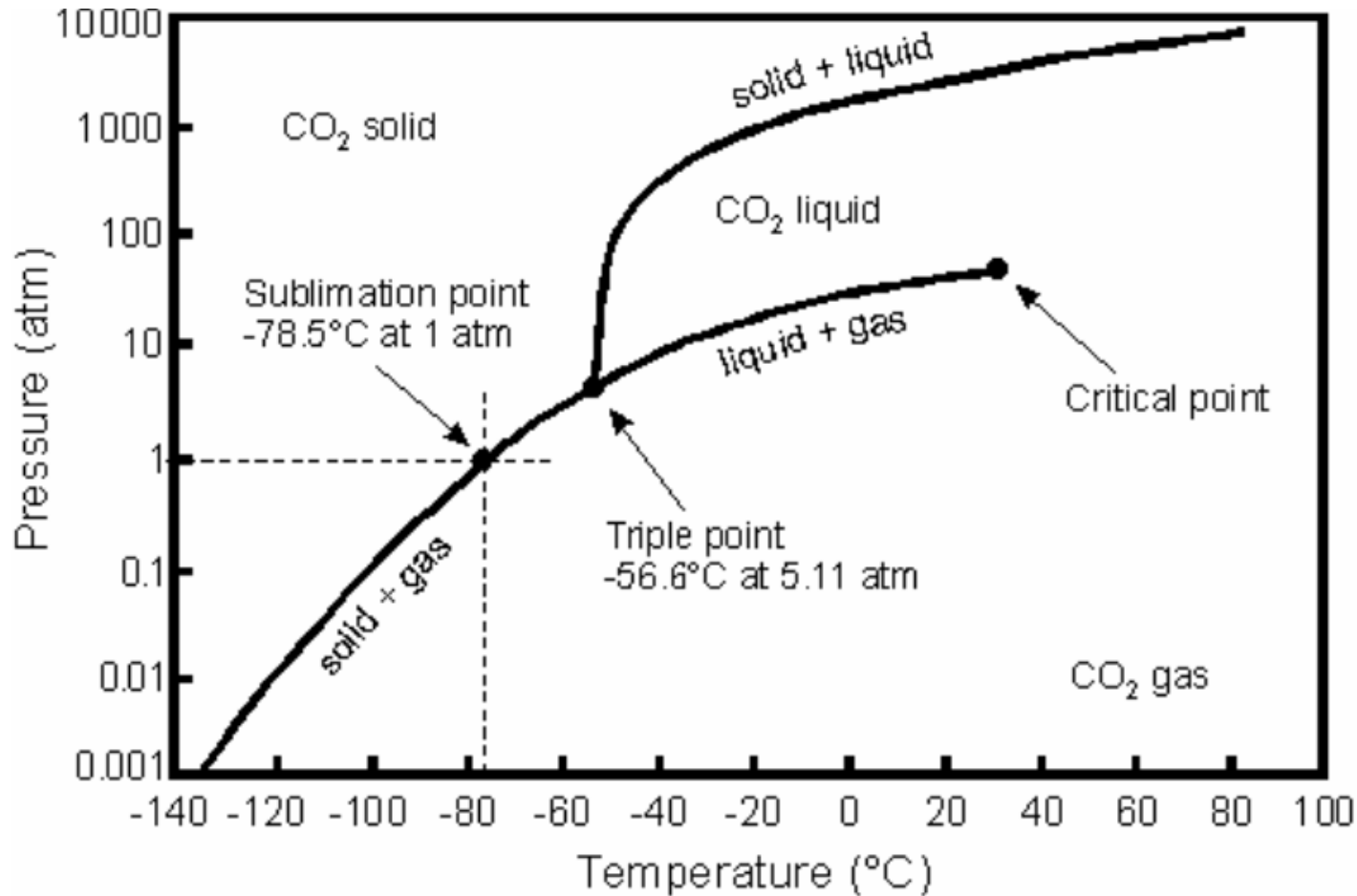
Characteristics of CO₂



Key Characteristics of CO₂

- At ambient conditions, it is a clear odourless gas, slightly denser than air
- Naturally occurring in increasing concentrations
- Released during respiration and combustion processes

Key Characteristics of CO₂



CO₂ has useful characteristics

- With compression, will behave like a liquid for the likely range of temperatures and pressures in CCS projects
 - CO₂ can be compressed and pumped to a storage site with good volume characteristics
 - Supercritical phase unlikely due to temperature and pressure ranges in CCS
 - Good solvent for organic materials

CO₂ has some hazards

- Asphyxiant at high concentrations
- Pressure and expansion ratio – venting to a gas from liquid results in large volumes
- Low temperature effects
- Incompatibility with some materials

So how bad is CO₂?

	CO ₂	H ₂ S	SO ₂
5 minute exposure limit	15,000 ppm	15 ppm	5 ppm
8 hour exposure limit	5,000 ppm	10 ppm	2 ppm

Note: various different exposure limits quoted for CO₂ with ones above being most conservative. Other exposure limits quoted are 50,000ppm (5%) and 20,000ppm (2%)

So how bad is CO₂?

	CO ₂	H ₂	H ₂ S	SO ₂	CH ₄
Flammability (lower limit) %	No	4	4	No	4-6
Flammability (upper limit) %	No	76	44	No	13- 17

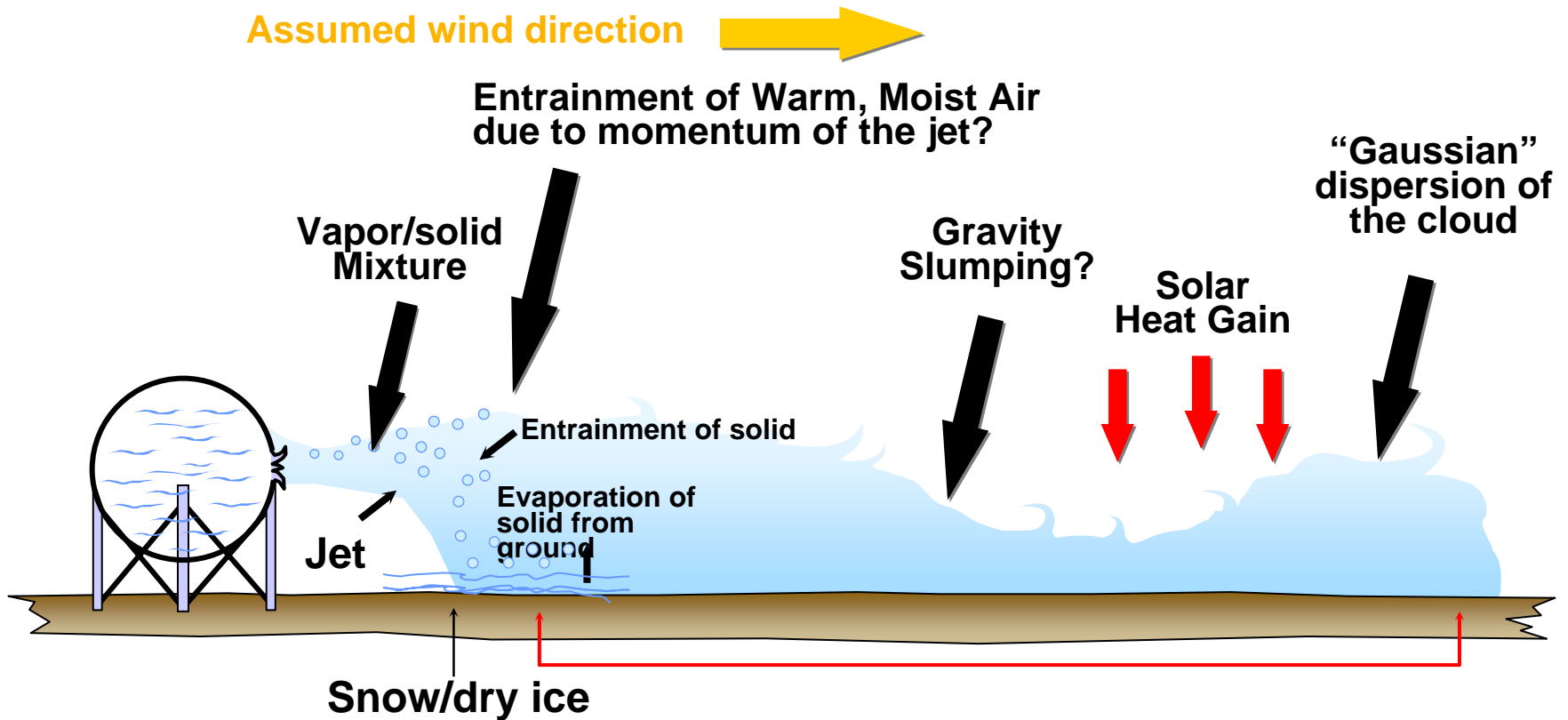
Hazard Analysis



Hazard analysis key component of project design

- Allows risks to be assessed, understood and designed out where appropriate
 - How far CO₂ will travel and at what concentrations is fundamental to evaluating the risks
 - Current dispersion models not designed for CO₂ without modifying the source terms. All dispersion models will model CO₂ if source terms are modified appropriately
 - New guidance document giving detailed advice on how to model the dispersion

How CO₂ disperses

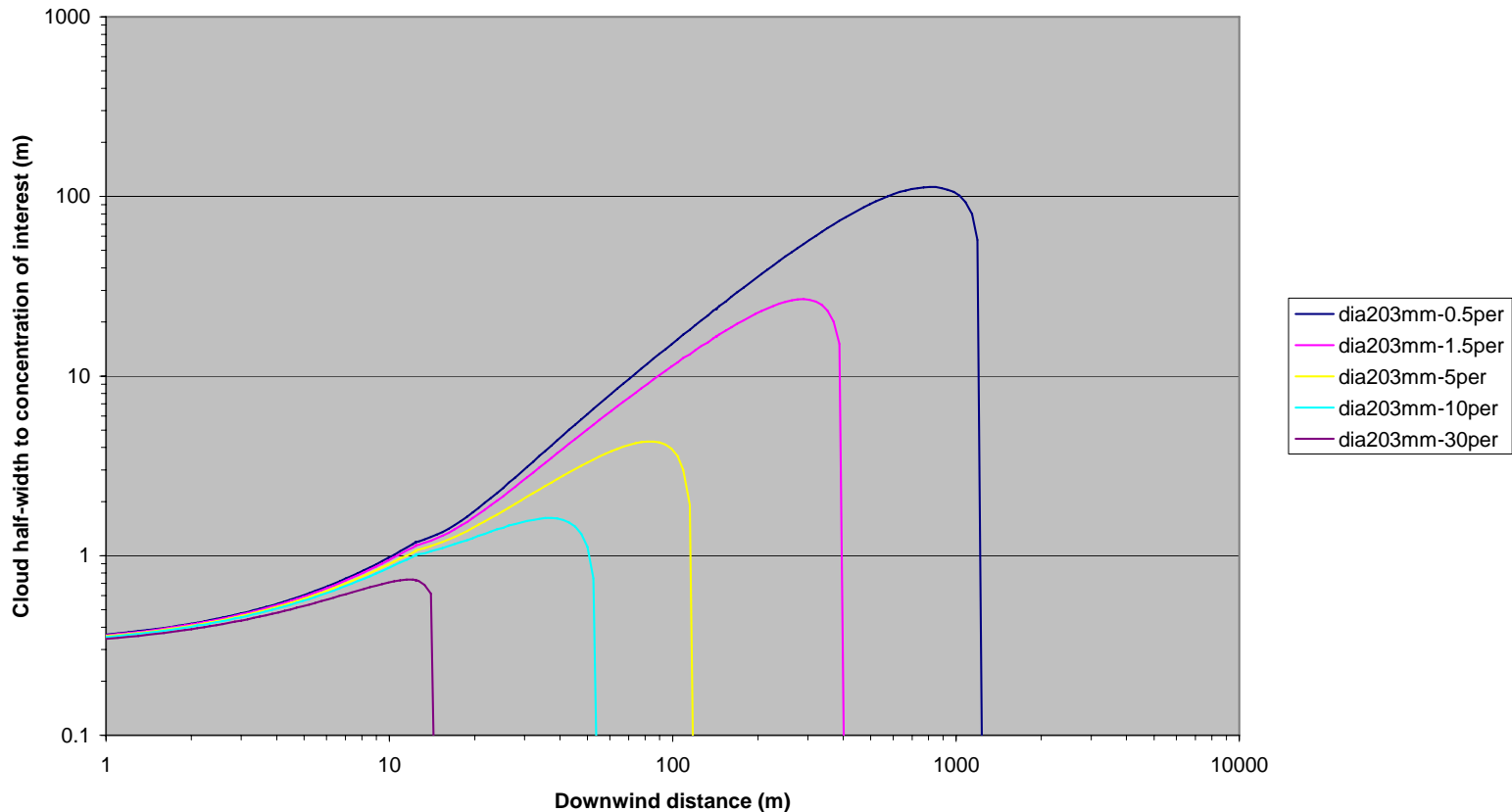


What does the guidance do?

- Guide to dispersion modelling
- Detailed instructions on how to use existing commercial models for CO₂
- Worked examples using HSE SLOT/SLOD data converted into toxic load data
- Allows users to develop submissions to H&S authorities

An example diagram in guidance document

Cloud half-width to concentration of interest



Design & Operational Issues



Design and Operational Issues

- 2nd guide looks at basic design and operational considerations making use of industrial gases experience
 - Detailed guide to CO₂ and its hazards
 - Design guide for onshore plant
 - Design guide for onshore pipelines
- Aimed at project engineers, managers, plant operators and procurement specialists

Guide covers issues such as:

- Plant layout
- Relief valves
- Valves and seals
- Material compatibility
- Blowdown and depressurisation of plant
- Leak detection in confined spaces

Practical advice on design and operational issues

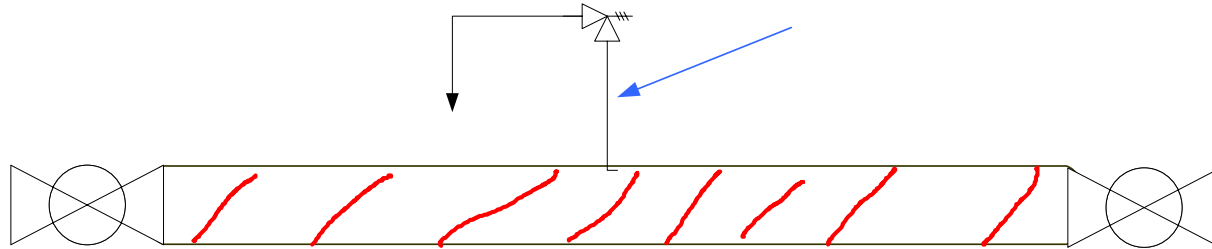


Figure 1: Thermal relief valve

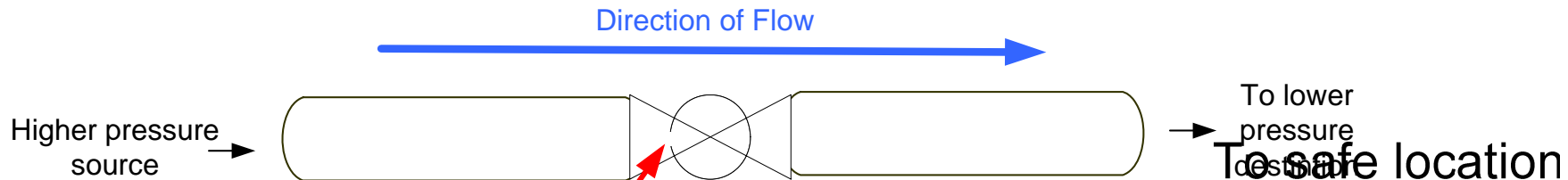


Figure 2: Ball Valve design

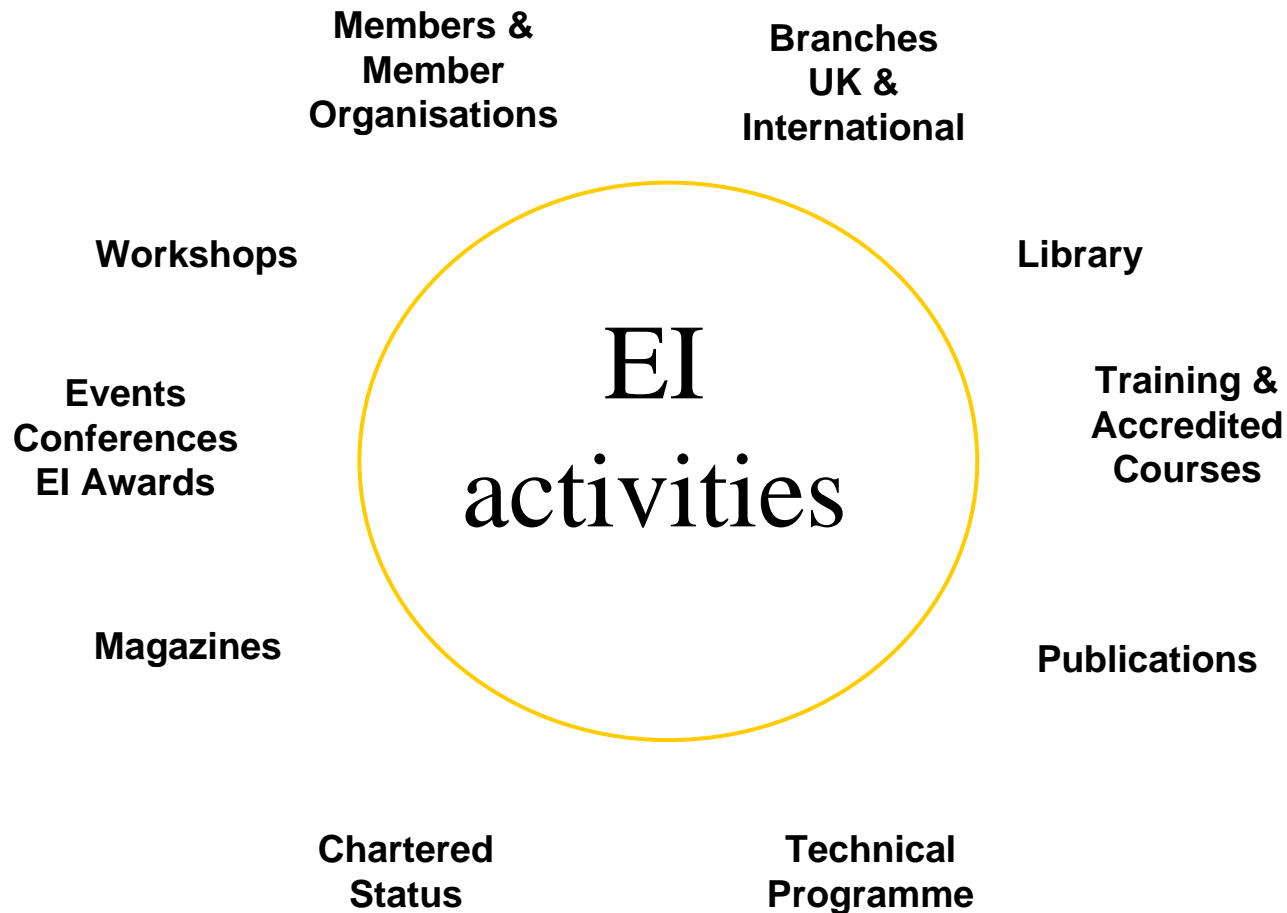
About the Energy Institute



Who is the Energy Institute?

- Formed in 2003 from Institute of Petroleum & Institute of Energy merger
- 14,000 individual members and around 300 company members
- Licensed to offer
 - chartered energy engineer,
 - chartered petroleum engineer,
 - chartered environmentalist and
 - chartered energy manager

What do we do?



Dedicated energy technical research programme

- Carry out £1m of research a year on business critical issues in energy sector
 - CCS
 - Environment
 - Safety including process safety
 - Health & Hygiene
 - Petroleum distribution
 - Hydrocarbon management
 - Standard test methods for petroleum products
- Independently audits demonstrate £50 benefits to technical programme members per £1 spent

We are stand B29 – Free drinks on stand from 3.30

- Speak to me on stand after this session and pre-register for our new guidance documents
- Queries regarding CCS technical work
 - Isabelle McKenzie, CCS Technical Manager
 - Isabelle.mckenzie@equilibriumenergy.co.uk
- Queries regarding wider EI technical work
 - Martin Maeso, Technical Director
 - Mmaeso@energyinst.org.uk

Energy Institute

Working with energy professionals, serving the
global energy community

- www.energyinst.org.uk