Technology Development Programme

Fuel Cycle Technology Mapping Workshop

FUSION FOR ENERGY

EUROfusion

Converging towards a technology map

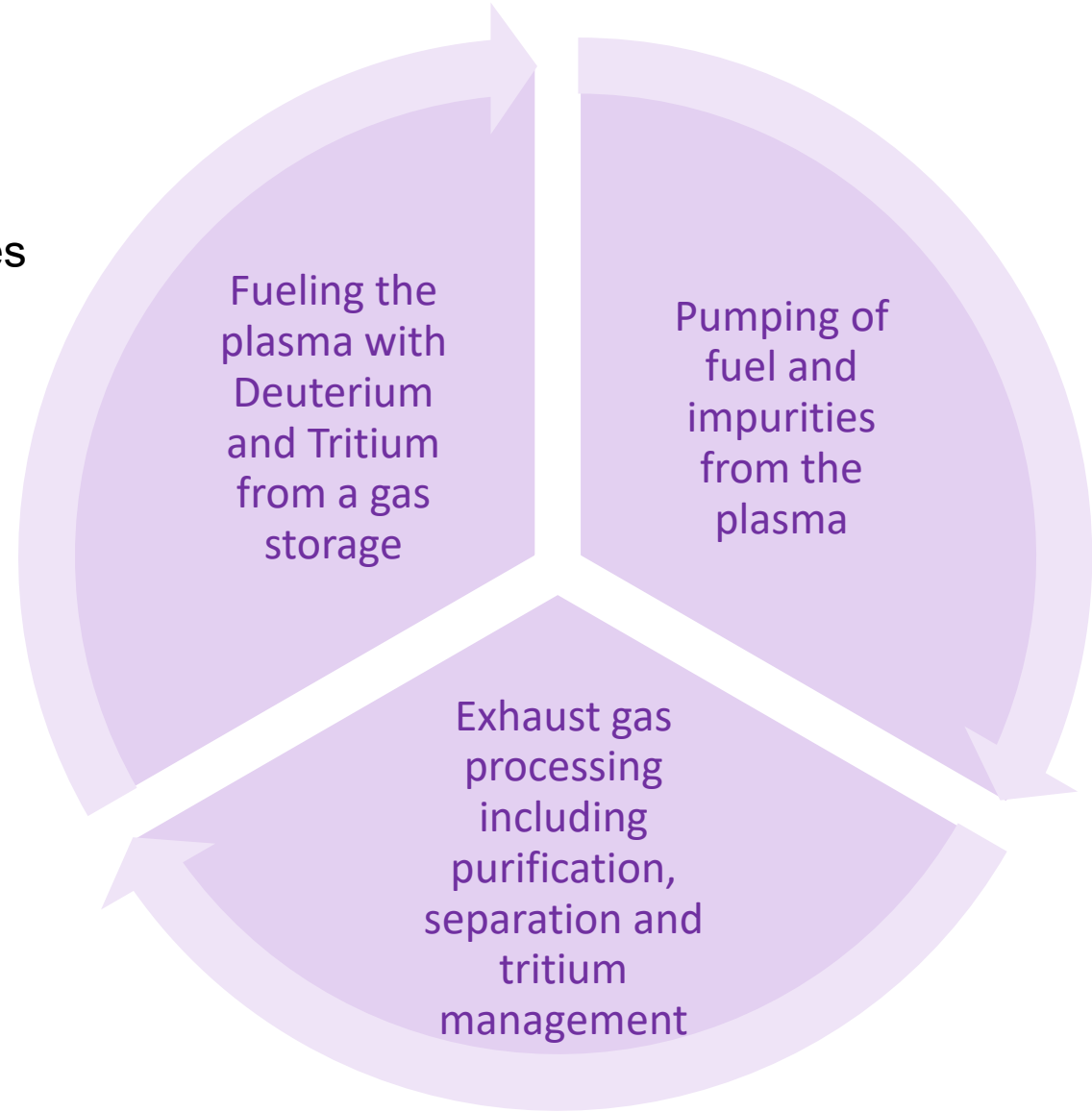
Matthias Dremel – 06/02/25

Content

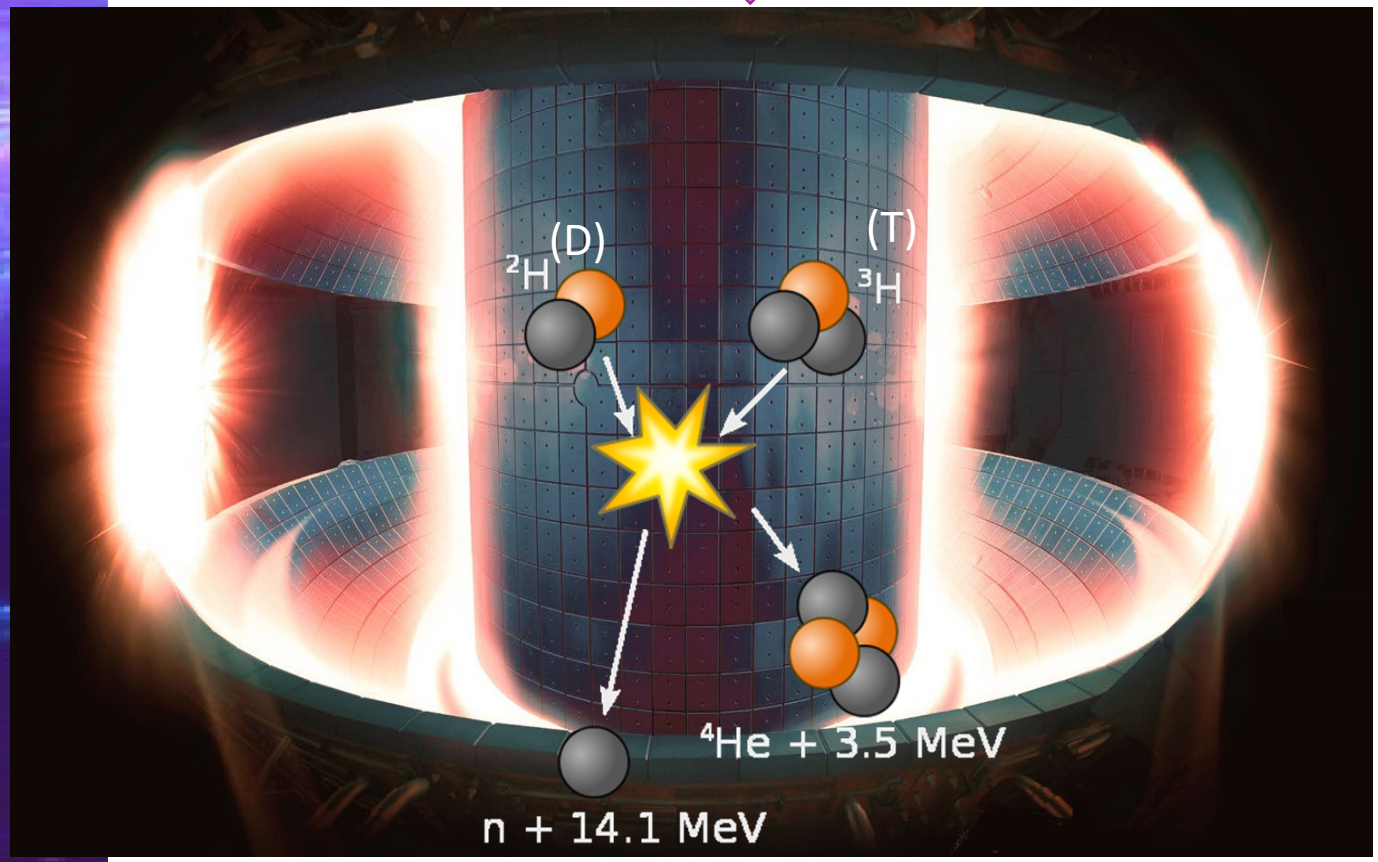
- This workshops Fuel Cycle structure and its drafted technology map
- Groups of Technologies
- What we want to achieve today

Fuel Cycle technology Breakdown

- Fuelling and Storage,
- Pumping technologies,
- Tritium processing technologies



The fusion fuel cycle in one sketch

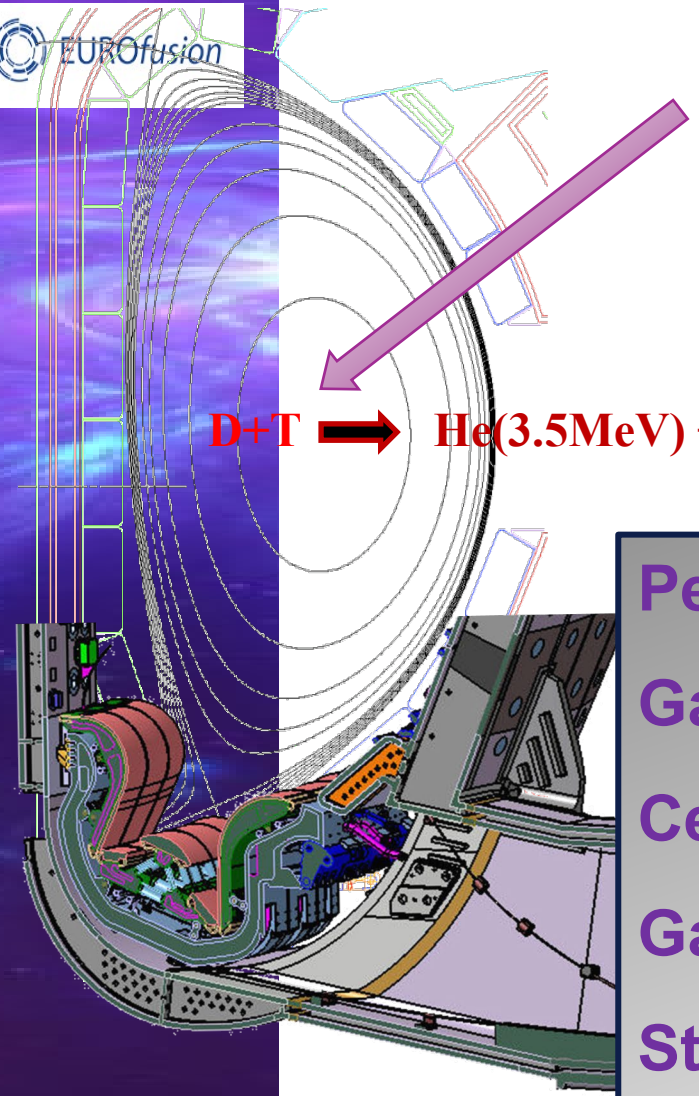


Fueling

Processing

Pumping

Fuelling and Storage technologies

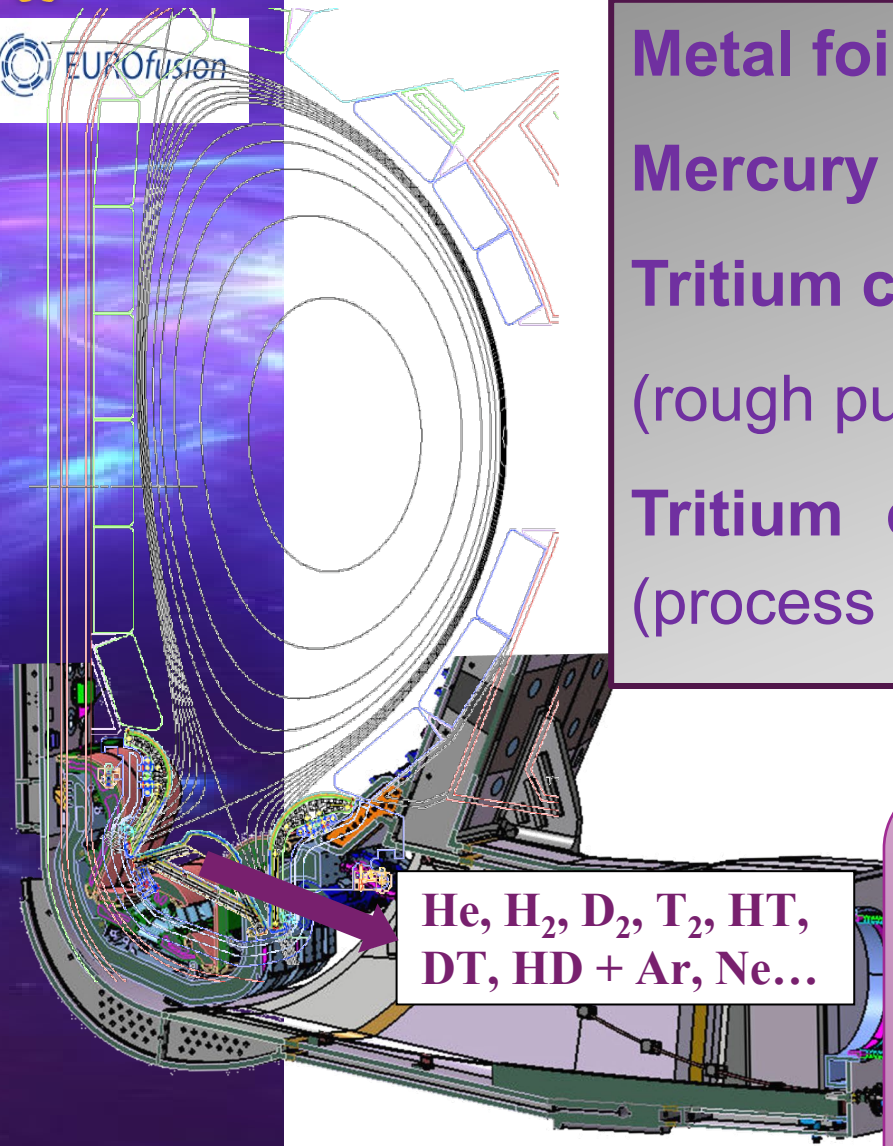


D_2, T_2 Core Fueling

D+T ➡ He(3.5MeV) + n(14MeV

- Pellets fabrication for solid injection fuelling
- Gas-gun acceleration mechanism for solid injection fuelling
- Centrifugal acceleration for solid injection fuelling
- Gas distribution & control
- Storage of hydrogen isotopes

Pumping Technologies

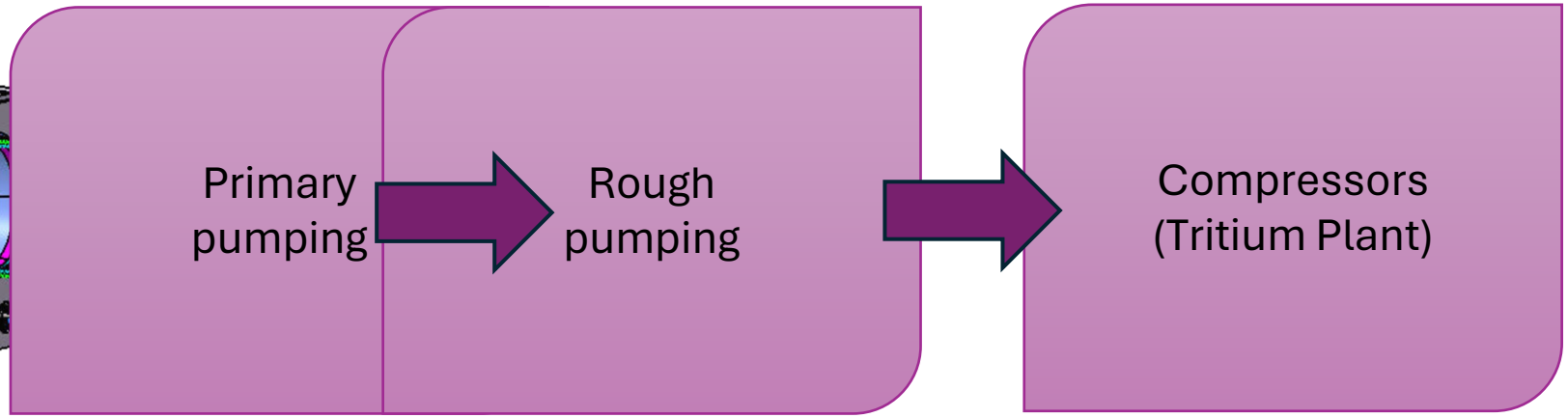


Metal foil pump (primary pump)

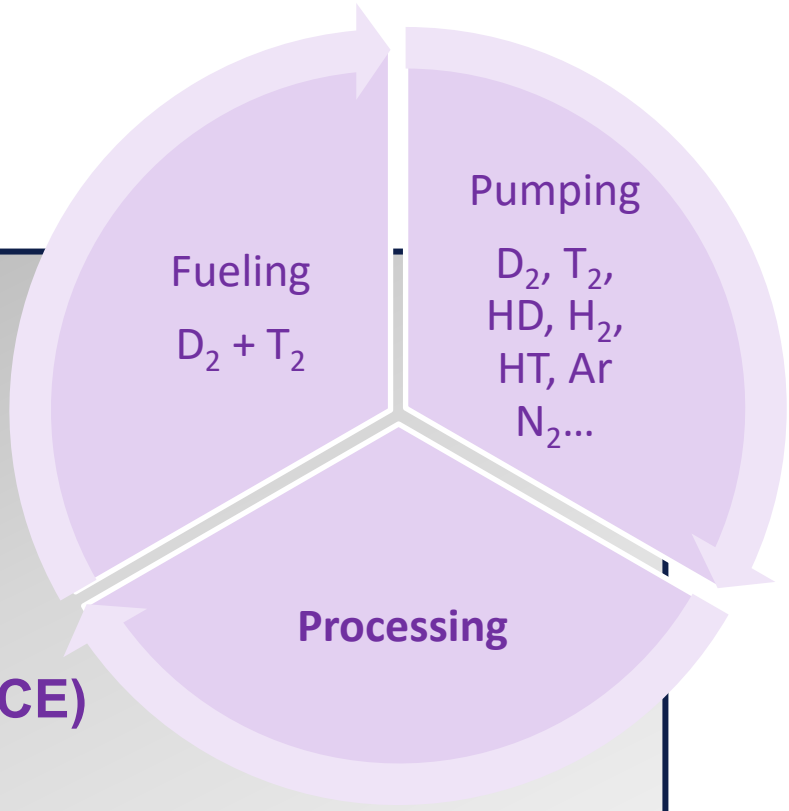
Mercury Diffusion Pumps (primary pumping)

Tritium compatible mechanical displacement pumps (rough pumping)

Tritium compatible compressors for exhaust processing (process gas transfer)



Membranes and Packing processing



- Membranes
- Vapor Phase Catalytic Exchange (VPCE)
- Liquid Phase Catalytic Exchange (LPCE)
- Water detritiation by distillation
- Combined Electrolysis and Catalytic Exchange (CECE)
- Electrolysis Cell for tritiated water
- Air/Gas detritiation technologies
- Column Packings
- Temperature/Pressure Swing Adsorption (TSA)

Tritium process management

- Continuous gas flow meters
- Instruments to measure hydrogen isotope concentrations
- Tritium detectors
- Tritium permeation barriers
- Simulation Software:
  - Adsorption/Desorption modelling for Tritium management
  - Diffusion mechanisms for divertor pumping
  - Helium coolant detritiation and its load dynamics
  - Fuel Cycle Simulator

Cryogenic Processing

Cryogenic Distillation (Separation and Purification of the hydrogen isotopes)

Cryogenic Adsorption pumps for divertor pumping (primary pumping)

Temperature Staged cryogenic condensation and adsorption pumps (primary pumping)

Cryogenic Viscous Compressor (CVC) for fusion exhaust pumping (rough pumping)

Parallel round table discussions

Fuelling and Storage

Cryogenic Processing

Pumping

Tritium Management

Membranes and packing processing

Parallel round table discussions

Fuelling and Storage

Chair: Christian Day (Kyoto Fusioneering Europe)

Panel:

Sandor Zoletnik (Hun-Ren Centre for Energy Research, Hungary)

Bernhard Ploeckl (Max-Planck-Institute, Germany)

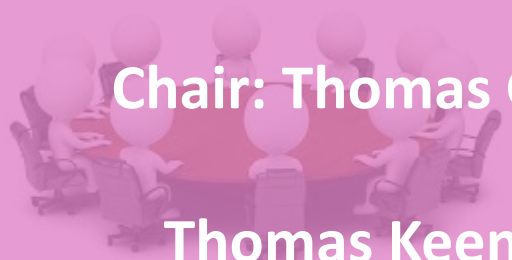
Jean Manzagol (CEA, France)

Facilitator: Andrew Lynch (ATG Europe)

Parallel round table discussions

Fueling and Storage

Cryogenic Processing



Pumping

Chair: Thomas Giegerich (KIT, Germany)

Panel:

Thomas Keenan (ITER Organization)

Thomas Haertl (EUROfusion)

Silvio Giors (ITER Organization)

Facilitator: Guim Pallas (F4E)

Tritium Management

Membranes and packing processing

Parallel round table discussions

Fuelling and Storage

Chair: Alessia Santucci (ENEA, Italy)

Panel:

Robert Michling (ITER Organization)

Daniel Baquerisse (Alsymex, France)

Josep Benet (F4E)

Facilitator: Marc Simon

Cryogenic Processing

Pumping

Tritium Management

Membranes and packing processing

Parallel round table discussions

Fuelling and Storage

Chair: Ian Bonnett (ITER Organization)

Cryogenic Processing

Panel:

Pumping

Elodie Bernard (CEA, France)

Giovanni Piazza (F4E)

Jonas Caspar Schwenzer (Kyoto Fusioneering Europe)

Facilitator: Javier Abal (F4E)

Membranes and packing processing

Tritium Management

Parallel round table discussions

Cryogenic Processing

Fuelling and Storage

Pumping

Tritium Management

Membranes and packing processing

Chair: Matthias Dremel (F4E)

Panel:

Sebastian Brad (ICSI, Romania)

Lyn McWilliam (UKAEA, UK)

Francois Millet (CEA, France)

Facilitator: Grigory Kouzmenko (F4E)

What we want to achieve today!

Is the map complete?

Making sure we have a exhaustive list of technologies that will be evaluated during the workshop in March

Is the map detailed enough?

Do we need to split proposed technologies? Do we need a specific sub-technology development that covers several technologies?

The five technology groups are created for todays workshop, but for the evaluation some technologies will require regrouping.

What level of detail we expect?

We do not want to discuss today the merits of the technologies and we do not ask to have details on maturity. We will have 2 x 3 hours session in the March meeting.

How to?

Via teams you can connect to one of the parallel sessions and change in between them!
By raising your hand in the parallel session, you can directly/verbally make proposals or ask questions.

Via slido you can connect to each to the parallel sessions and switch in between them.
In slido you can write down proposals/questions that are seen by the panel.
The panel will discuss the suggestions.

To connect to slido you can scan the code below by your phone, and you will be linked to the slido website for this event. You can also connect by a browser to slido.com and connect with the tag number.

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slido.com
#2169 335

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- 14:00-14:10: Welcome and introductory remarks (Chema Zarzalejos, Enrique Garcia)
- 14:10-14:20: The technology mapping process - Javier Serrano
- 14:25- 14:40: Fusion fuel cycle: critical system requirements - Alessia Santucci
- 14:40-14:55: From ITER to fusion power plants: designing the fusion fuel cycle of the future - Ian Bonnett
- 14:55-15:10: Speed networking opportunity between participants (random pairing)
- 15:10-15:30: Converging towards a technology map - Matthias Dremel
- 15:30-15:45: Break
- 15:45-16:30: Round tables: Joint review of the technology breakdown (Parallel sessions)
- 16:30-16:45: What's next ? Towards a fuel cycle roadmap - Marc Simon
- 16:45-17:00- Feedback and wrap-up - Chema Zarzalejos
- 17:00-17:30: buffer