International Energy Agency

The promise of fusion - innovation and the role of industry

a strategic discussion and webinar led by the

Fusion Power Co-ordinating Committee (FPCC)

25 January 2017 14h-18h00

to be held at the OECD headquarters
2 rue André Pascal, 75016 Paris

iea Energy Technology Network
Fusion Power Co-ordinating Committee

International Energy Agency (IEA)

The IEA is an autonomous agency established in November 1974. Its mandate is two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply and to advise member countries on sound energy policy. The IEA carries out a comprehensive programme of energy co-operation among 28 advanced economies[1], each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency aims to:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations, and other stakeholders.

Since the 1980s, the IEA has continued to build good working relationships with countries beyond its membership, in particular major energy consuming, producing and transit countries. Countries with which the IEA seeks enhanced engagement, or key Partner countries (Brazil, China, India, Indonesia, Mexico, Russia and South Africa). Co-operation with these and other partner countries cover a wide range of activities, from joint workshops to in-depth surveys of specific energy sectors or data exchange. Combined, the IEA co-operates with more than 69 countries worldwide.

IEA Energy Technology Network

The IEA Energy Technology Network is an ever-expanding, co-operative group of more than 6,000 experts that support and encourage global technology collaboration. At the head of this vast network is the Committee on Energy Research and Technology (CERT).

Committee on Energy Research and Technology

Comprised of senior experts from IEA member governments, the Committee on Energy Research and Technology (CERT) considers effective energy technology and policies to improve energy security, encourage environmental protection and maintain economic growth. Under the guidance of the IEA Governing Board, the CERT oversees the technology forecasting, analyses and the research, development, demonstration and deployment (RDD&D) strategies of the IEA Secretariat, notably through its flagship publication, *Energy Technology Perspectives*, and the series of energy technology roadmaps. The CERT also provides guidance to its working parties and experts' groups to examine topics that address current energy technology, or technology policy, issues. The CERT is supported in its work through four topical working parties, including the Fusion Power Co-ordinating Committee.

Fusion Power Co-ordinating Committee (FPCC)

The objective of the FPCC is to enhance fusion RDD&D activities with a strategic approach to realising fusion energy in both IEA member countries and key partner countries. The FPCC accomplishes this objective by promoting, initiating and co-ordinating international co-operative experiments of the IEA member countries participating in the FPCC, the partner country representatives, the FPCC Steady State Operations Coordination Group (SSOCG), and the participants in the eight Technology Collaboration Programmes (TCPs).

[1] Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea (Republic of), Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States; The European Commission also participates in the work of the IEA.

Rationale

Introduction

This strategic session, the third in a series, is the primary means for the FPCC to gain insights into the remaining challenges towards realisation of fusion as an energy source in support of DEMO, the strategic objective of the FPCC for the period 2015-2017. This strategic session enables public and private sector stakeholders to share experiences and lessons learned. Key messages from the discussions will be synthesized for the IEA Committee on Energy Research and Technology.

The promise of fusion

Fusion energy is the focus of much research worldwide, both in national laboratories as well as innovative approaches funded by the private sector. While progress is being made on the scientific, technical and materials towards the realization of fusion power daily, maintaining the momentum of research funding to reach the DEMO phase remains a considerable challenge. Therefore now is the time to increase efforts.

At the 21st meeting of the UNFCCC Conference of the Parties (COP21), 20 countries pledged to double their public funding for R&D under a new effort - Mission Innovation (MI). At COP22 the MI members announced several innovation challenges relating to energy technologies, including materials. The objective of the Clean Energy Materials Challenge is to accelerate the exploration, discovery and use of new high-performance, low-cost clean energy materials - a significant barrier to achieving the promise of fusion.

Innovation and the role of industry

In recent years a variety of fusion devices has been discussed, planned, under development (proof of concept) or in operation. While funded by private investors, they build on the expertise of scientists from national laboratories who gained experience with existing experimental devices.

The recent fusion devices have two things in common. First, they include one or more innovative concepts (departures from the fusion science state of the art) to the main barriers of fusion viability, such as fuels, materials, means of confinement, or the shape or size of the device. Second, they are designed as profit making companies, a contrast to public research carried out in university laboratories (one company is actually a spin-off from a university research laboratory).

These concepts could potentially contribute significantly to advancing the state of the art of fusion science. Yet while the recent concepts were able to build on publicly funded research to date, it remains to be seen whether existing fusion experiments – or ITER – will be able to benefit from these advances. And increasing the role for industry is important particularly as ITER moves to assembly.

Is fusion the same as other technologies or does it require a new paradigm to bridge the “valley of death” from laboratory to market? If there is private sector investment then the promise of fusion is alive and there will be a race among approaches to cross the finish line first.

While fusion technology is viewed as a long-term investment, there can also be impacts in the shorter term. Technology transfer (spin-offs) from fusion research is possible, and industry’s role in moving an innovative new application to market is needed. Learning from other major research efforts such as space can provide valuable insights.

Outcomes expected

Given the broad range of activities and the significant investments made by both publicly funded experiments and innovative, start-up experiments, more clarity is needed on the achievements to date of fusion science and the remaining challenges. Taken together, this information could provide valuable insights for policy makers and fusion programme managers.

IEA Fusion Power Co-ordinating Committee (FPCC)

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25 January 2017, 14h00 – 17h30

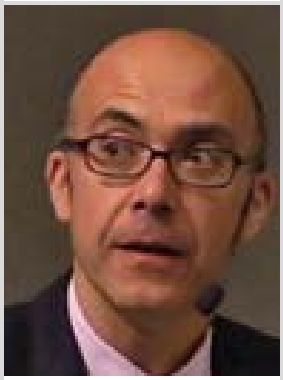
FINAL AGENDA

TIME	ITEM
14:00	**Introductory remarks** *Thomas Vanek, Chair, Fusion Power Co-ordinating Committee* *Senior Policy Advisor, Office of Fusion Science (US)*
14:15	**Integrating industry into early stage plans** *Dr. Tony Donné, Programme Manager, EUROFusion*
14:45	**Achieving industry buy-in** *Dr Leonardo Biagioni, Head of Procurement, Fusion for Energy*
15:15	**Innovative fusion concepts – General Fusion** *Dr. Michel Laberge, Founder and Chief Scientist, General Fusion*
15:45	**Break**
16:00	**The spherical tokamak route to fusion power** *Dr. David R. Kingham, Chief Executive, Tokamak Energy*
16:30	**Creating markets for fusion spin-offs** *Matthew Edwards, Space Business Education and ESA Broker in the UK, Science and Technology Facilities Council (STFC) (on behalf of the European Space Agency)*
17:00	**Roundtable Discussion** *Moderator: Mr. Thomas Vanek, FPCC Chair*
17:45	**Wrap-up and closing remarks** *Thomas Vanek, Chair, Fusion Power Co-ordinating Committee*
18:00	Meeting close

SPEAKERS

Mr. Thomas Vanek, Chair of the FPCC, is the Senior Policy Advisor for the Office of Fusion Energy Sciences at the U.S. Department of Energy. Mr. Vanek has focused on fusion research during his government career and on ITER since 2002, serving on the ITER Council, ITER Council Preparatory Working Group and ITER Management Advisory Committee. In 2006 Mr. Vanek received the Secretary of Energy Exceptional Service Award. Previously Mr. Vanek served as Senior Advisor in the U.S. Department of Energy, Office of Science and as the U.S. House of Representatives Science Committee. He holds a Bachelors' Degree in Public Affairs (Bachelors) from the George Washington University and a Masters' Degree in International Affairs from Georgetown University.

Dr. Tony Donné, Programme Manager, Eurofusion, and professor at Eindhoven University of Technology (Netherlands). His main duty is to coordinate fusion research in Europe. From 2009-2014 Prof. Donné was head of the fusion physics department of the Dutch Institute for Fundamental Energy Research (formerly FOM-Rijnhuizen), as well as director of the Dutch-Russian Centre-of-Excellence on Fusion Physics and Technology. From 1997-2008 he was stationed at the Forschungszentrum Jülich in Germany. He has been involved in ITER-related diagnostics for over 25 years and has served as a member of several ITER and European Fusion Committees. Prof. Donné holds a PhD in physics, Free University of Amsterdam.



Dr. Leonardo Biagioni, Head, Procurement, Fusion for Energy, manages a cross-functional service composed of about 50 engineers, procurers, lawyers, economists and support staff serving the Agency's multiple locations in Europe (Spain, France, Germany). The service is in charge of all supply chain activities for the Agency, including suppliers' selection, contract follow-up, industrial policy implementation and supply chain analysis and strategy. Before joining F4E he worked in the aeronautical, defence and space sectors in both private and public organizations, in several European countries and the United States. Dr Biagioni earned MS and PhD in Aerospace Engineering from the University of Pisa (Italy), as well as post-graduate degrees in Applied Mathematics (Scuola Normale Superiore) and Business Administration (UPenn/Wharton and IESE).

Dr. Michel Laberge, Founder and Chief Scientist, General Fusion, Inc., founded General Fusion in 2002 to investigate magnetized target fusion (MTF) as an approach to fusion that may lead to a viable power plant. Working in partnership with universities and national laboratories, the company is conducting researching on large-scale MTF plasma targets and the liner compression of magnetized plasmas. Dr. Laberge is a physicist with widespread practical experience in plasma physics and modern plasma diagnostic techniques. Prior to establishing General Fusion, he spent nine years at Creo Products in Vancouver as a senior physicist and principal engineer. His roles included inventor, designer, and scientific project leader on projects that resulted in more than $1 billion worth of product sales. Dr. Laberge holds a B.Sc. and M.Sc. in physics from Laval University, and a Ph.D in physics from the University of British Columbia.

Dr. David Kingham, Tokamak Energy, is the Chief Executive Officer of Tokamak Energy Ltd, a privately funded company that aims to accelerate the development of fusion energy. The company is developing compact, high magnetic field, tokamaks and is building on the world leading expertise in fusion, spherical tokamaks and high field superconducting magnets in the UK. Tokamak Energy was recognised as a Technology Pioneer of the World Economic Forum in 2015. Dr Kingham founded Tokamak Energy with two pioneering fusion scientists, Dr Mikhail Gryaznevich and Alan Sykes in 2010. Previously Dr Kingham was Managing Director of Oxford Innovation Ltd. He has a PhD in Physics from the Cavendish Laboratory, Cambridge.

Matthew Edwards, Relationship Manager – Space Business Incubation, Science and Technology Facilities Council (STFC), joined the UK Science & Technology Facilities Council in 2012 and is the national broker for the European Space Agency (ESA) Technology Transfer Network and Technical Officer for the ESA Business Incubation Centre at Harwell. These both involve supporting the UK space industry find applications for its technology back on Earth. During this time he also managed the Fusion Technology Transfer Action (FUTTA) project within the UK. Here, technology transfer opportunities were sought for technologies that have been developed within the EUROfusion framework of nuclear fusion research. Matthew holds a double Masters in Astrophysics and has a practical astronomy background.

Presentations and proceedings of the meeting are available at
www.iea.org/workshops/http://www.iea.org/workshops/the-promise-of-fusion---innovation-and-the-role-of-industry.html

For further information about the Fusion Power Co-ordinating committee, see
www.iea.org/aboutus/standinggroupsandcommittees/cert/fpcc/