

**SENATE FOREIGN AFFAIRS, DEFENCE AND TRADE  
REFERENCES COMMITTEE  
ANSWERS TO QUESTIONS ON NOTICE  
CSIRO**

Inquiry into the implications of climate change for Australia's national security  
Tuesday, 20 March 2018

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**REFERENCE:** Hansard page 8 – Senator Fawcett

**QUESTION:**

Hansard extract

**Senator FAWCETT:** Dr James, in your submission, you talk about supporting international adaptation, and one of the areas you talk about is fuels. Again, I come to this area of alternative fuels. I saw the media in the middle of last year on your work around hydrogen and fuel cells. Could you talk to the committee about what work the CSIRO is doing in terms of alternative fuel sources?

**Dr James:** Unfortunately, like Air Vice Marshal Hupfeld, I am not familiar with the area of highly specialised new fuels, particularly the hydrogen one. I cannot speak to that. I would have to take that on notice and provide you with more information.

**ANSWER**

CSIRO is researching a range of alternative fuels, both renewable and fossil fuel-derived. These include:

- Hydrogen
- Ammonia
- Biofuels, including biomass
- Methanol
- Dimethyl ether (DME), a clean burning synthetic fuel

These are not fuel *sources* in the traditional sense, but energy carriers that must be produced from other energy sources. For example:

- natural gas, coal, crude oil, biomass can be converted to syngas, hydrogen, ammonia, methanol, DME or a variety of other chemical products which can be used as energy carriers or as feedstock for other processes
- renewable energy sources such as solar and wind energy can also be used to produce electricity for electrolysis of water to produce hydrogen which can be stored for use when required (for example, using fuel cells to produce power) or for export to remote or international markets.
- There are several alternative chemical compounds which, depending on the market and application, may be suitable for transport of hydrogen to remote or international markets. For example, the recently announced KHI hydrogen supply chain project in Victoria plans to convert brown coal to hydrogen using gasification technology and to export the hydrogen to Japan in the form of liquid hydrogen (<https://industry.gov.au/resource/LowEmissionsFossilFuelTech/Pages/Hydrogen-Energy-Supply-Chain-Pilot-Project.aspx>). Other projects are considering using ammonia as a transport vector. As ammonia is an established commodity product with existing market and handling infrastructure, there are opportunities for this approach to leverage existing

infrastructure to facilitate new energy markets based on ammonia as a hydrogen energy carrier.

- Where excess renewable energy is available, CO<sub>2</sub> can be used as a feedstock for production of methane, methanol, DME or other chemical forms which may be considered as suitable energy carriers in relevant process systems.

When considering how these fuels are used to transport energy, they vary in efficiency, based on the processes and feed stocks used for their preparation, the transportation infrastructure and intended end use. This concept is explored in more detail, for ammonia, in this paper:

<https://pubs.acs.org/doi/pdf/10.1021/acssuschemeng.7b02219> .

CSIRO research is focused on improving these efficiencies in order to promote the use of alternative fuels to complement a range of other energy technologies. We are also exploring pathways to facilitate export of Australia's abundant renewable energy resources for use in transport, power and industry sectors around the world. For example, CSIRO is developing a suite of technologies to produce hydrogen and separate pure hydrogen from mixed gas streams that may potentially pave the way for a new hydrogen export market.