**Those of you of an Australian persuasion might recognise this guy.**

**He’s called Dr Alan Finkel, and he holds the position of Chief Scientist for Australia.**

**I imagine that probably means he’s got his hands quite full right now discussing strategies for a safe long-term exit from lock down.**

**But he also plays an important role in advising on the science around his country’s transition to sustainable energy.**

**In November 2019, The Australian Government released its National Hydrogen Strategy, and in a statement released on 23rd December Dr Finkel said.**

**“We truly are at the dawn of a new industry that can contribute to jobs, export income, energy storage, and, vitally, global emissions reduction.”**

**And just a couple of weeks ago, a 300-million-dollar project was announced for Western Australia, bringing large-scale hydrogen production, powered by wind and solar, to that region.**

**Sounds great doesn’t it. But like all energy technologies, hydrogen has its advantages and disadvantages, not least of which is the possibility of fossil fuel companies muscling in on the action and cheating on carbon emission regulations in an effort to lower prices and gain unfair market advantage.**

**So, is Australia really ready to lead the world in such a disruptive energy technology, and have they set a clear path to navigate the pitfalls?**

**Hello and welcome to Just Have a Think,**

**We’ve looked at hydrogen in a couple of earlier videos on this channel, and you can jump back to look at one of them by clicking up there somewhere.**

**Hydrogen extracted from hydrocarbons, in a process called steam reforming, is already widely used to produce ammonia for nitrogen fertilisers and for the production of other chemicals.**

**Oil refineries add hydrogen to heavier oil to produce transport fuels, and methanol can be produced as a by- product of separating hydrogen out from fossil fuel.**

**All those processes produce carbon dioxide, so it’s fair to say that historically, hydrogen has never been regarded as a low carbon contributor to the energy transition.**

**But that legacy industry HAS resulted in a lot of experience of how to handle hydrogen, which is after all a highly explosive, and quite corrosive element.**

**Hydrogen pipelines have been operating without incident over hundreds of miles in many countries for decades, and there’s also a very long and safe track record of transporting hydrogen by road haulage in specialised vehicles.**

**Hydrogen offers many potential benefits both as a direct fuel and as an energy carrier for long term storage.**

**It looks increasingly unlikely to surpass Battery Electricity for domestic vehicles, but it’s proving to be a great solution for larger commercial vehicles like trucks, ships, trains, and even aeroplanes.**

**The only by product of a hydrogen fuel cell is water.**

**Compressed hydrogen canisters can be shipped easily by road and rail, and where the geography allows, it may be possible to store enormous quantities of hydrogen in salt caverns, providing almost instantly available energy to boost and stabilise grid electricity during the long winter months when solar and wind power are least effective.**

**So how do we get hydrogen without the CO2 emission problem?**

**Well, scientists and governments have been discussing the possibility of producing hydrogen via electrolysis using renewable energy since the early nineteen seventies, but until recently the costs have been prohibitive.**

**As Dr Frankel explained in a recent paper called ‘Hydrogen for Australia’s Future’, the key drivers behind the interest in hydrogen are a one hundred-fold reduction in the price of solar electricity in the past four decades, coupled with Japan’s commitment to be a long-term, large-scale customer for hydrogen produced through low-emissions methods.**

**Frankel says**

**“Japan currently imports 94% of its energy in the form of fossil fuels. To reduce its emissions, government and industry have put ambitious hydrogen uptake targets at the heart of a comprehensive energy transition plan,”**

**But he also warns his fellow Aussies**

**“We’re not alone in this race. Norway, Brunei and Saudi Arabia are all boosting their credentials as future hydrogen suppliers.”**

**He says, “This is the time for Australia to stake its claim as supplier of choice not just to Japan, but to other nations like South Korea, hungry for a twenty-first century fuel,”**

**And let’s not forget too that other countries like the United Kingdom, Germany and the United States are also actively pursuing Hydrogen as a significant addition to their low or zero emissions energy policies.**

**And of course, our global economies and industries are currently driven by more or less untamed capitalism, which means all those countries will be working hard to achieve market dominance.**

**So why does Australia think it might have the edge?**

**Well, in an August 2018 report published by the Australian Renewable Energy Agency, their CEO, Ivor Frischknecht, tells us**

If Australia can tap into our abundant wind and solar resources to produce hydrogen using renewable energy, we could export hydrogen at large scale,

**The report points out that Australia has a significant advantage for exporting to Japan and across Asia due to what Frischknecht says are its ideal location, excellent renewable energy resources, well established energy trading relationships and experience in large scale energy infrastructure construction.**

**And crucially, as well as providing a boost to the Aussie economy, a new hydrogen industry would provide a much-needed lifeline to many regional communities, because hydrogen production facilities are likely to be located close to the supply of renewable energy, particularly large-scale solar farms in more remote areas.**

**The ARENA report finds that Australian hydrogen exports could potentially contribute $1.7 billion to the economy every year and provide nearly three thousand jobs by 2030.**

**And that’s where this new 300-million-dollar project comes in.**

**It’s called The Arrowsmith Hydrogen Project, and it’ll be built in a place called Dongara, a small town about 320km north of Perth.**

In an interview with the online site ‘RenewEconomy’, a spokesperson for Infinite Blue Energy said

the facility will produce about 25 tonnes of green hydrogen every day via electrolysis of water powered entirely by renewable energy supplied from about 85 Mega Watts of solar power, supplemented by 75 Mega Watts of wind generation capacity.

**And, as this** [**report published by the Australian Renewable Energy Agency last week**](https://reneweconomy.com.au/on-site-solar-is-key-to-cost-competitive-renewable-hydrogen-32730/)**, points out, that on-site supply of wind and solar is the key to lowering the cost of renewable hydrogen production at Australian facilities.**

**Works on the project are expected to commence by the middle of the year, with first production planned for the final quarter of 2022.**

**Ultimately, Infinite Blue Energy hopes to see the integration of large-scale electricity storage and generation using hydrogen, that could offer 24/7 supplies of power.**

**The company already has plans for a follow up project that’ll have the capacity to produce as much as 75 tonnes of renewable hydrogen a day, and ultimately they hope to have many similar projects established across Western Australia.**

**The country’s highly respected Commonwealth Scientific and Industrial Research Organisation, or CSIRO, has produced a National Hydrogen Roadmap which expects the demand for renewable hydrogen imports by Asian nations to reach 3.8 million tonnes by 2030.**

**It’s thought that between 10 and 20% of Japanese and Korean hydrogen demand could be met by Australian exports, with a mid-case forecast of 500,000 tonnes per annum by 2030 and this report from Bloomberg’s New Energy Finance Group calculates that**

renewable hydrogen could be produced for between $0.70 and a $1.60 per kilo in most parts of the world before 2050.

**That makes it**

competitive with natural gas in many parts of the world, and cheaper than producing hydrogen from natural gas or coal with carbon capture and storage.

**As industry and press, quite understandably focus their attention on reducing CO2 emissions, a key challenge for standard hydrogen electrolysis is sometimes overlooked though.**

**And that’s the fact that it requires enormous quantities of purified water to work properly.**

**Water scarcity is a major problem in places like Australia and California, where green hydrogen electrolysis is being so enthusiastically pursued.**

**So, innovations like this one from Stanford University could be transformational. That team appears to have overcome the issue of anode corrosion from the chloride in saltwater, increasing the effective working time of the anode from about 12 hours to more than a thousand hours.**

**That means that in future, the water required for hydrogen electrolysis could be drawn directly from our oceans.**

**That’s a technology we’ll take a closer look at later in the year.**

**Despite all that though, IRENA still published this infographic illustrating how they see the near, and medium, term transitional future of hydrogen production remaining a combination of green hydrogen and hydrogen derived from hydrocarbons with carbon capture and storage.**

**So how can we be sure that CO2 emissions will really be reduced by adding hydrogen into our energy mix?**

**Let’s go back to Australia’s Chief Scientist, Alan Finkel to give us a steer on that one. He says**

if hydrogen is produced from either coal or natural gas, using best practice CCS, then the amount of carbon dioxide generated is very small (less than 0.8 kg of carbon dioxide emitted per kg of hydrogen produced).

But, [ ] since carbon dioxide is left behind as a residual part of the hydrogen production process, there is no additional step, and little added cost, for its extraction.

And, [ ] because the gas mixture at the output of the process is at much higher pressure than flue gases, the extraction of the carbon dioxide is more energy efficient and it is easier to store.

**Finkel assures his readers that energy importing countries have been explicit that their interest is in ‘clean’ hydrogen.**

**And he says that thanks to Geoscience Australia’s online ‘CCS Assessment Tool’, there are numerous known suitable CCS reservoirs across the country.**

**Australia is developing a credible ‘Certificate of Origin’ scheme, Finkel explains – ensuring the clean credentials of every kilogram of hydrogen bought and sold can be verified, providing an effective mechanism to deter dishonest practices.**

**Finkel concludes that the idea of fossil fuel companies promising to implement CCS for their hydrogen production facilities, only to later renege on their commitment, is unfounded.**

**I’ll let you draw your own conclusions from those comments, but it’s not hard to see why some environmental groups worry that relying on Carbon Capture and Storage provides a potential loophole that the fossil fuel producers could exploit.**

**CCS has not so far been a success story in the United States for example. There are very few full-scale working examples of CCS technologies, and the only ones that are economically viable are those that use CCS to force CO2 under pressure into untapped underground seams to get at previously inaccessible oil reserves in a process known as Enhanced Oil Recovery.**

**Those companies enjoy the grotesque bonus of government subsidy for implementing an apparently low carbon technology while growing their profits from the extra oil the captured CO2 gas allows them to extract.**

**Nothing is straightforward in the wonderful world of energy resources, as I’ve said on many occasions.**

**There’s no doubt that energy storage is the key to a successful transition to a sustainable future, but if creating that storage also creates secondary, almost hidden carbon dioxide emissions then we will have failed to move away from our collective delusion that we can stay on a business as usual trajectory and still have any hope of survival as a species much past the end of this century.**

**Human beings are remarkably innovative though, and new carbon free ways to store energy are being developed all over the world.**

**2020 is shaping up to be a pivotal year for these technologies and we’ll be taking a look at many of them in more detail as we go through 2020**

**That’s it for this week though.**

**A massive thank you as always to the channel’s supporters over at Patreon who make these programs possible, and I must just give a shout out to the folks who joined the Patreon team since last week, with pledges of ten dollars or more a month.**

**They are**

**Ian Lowry**

**David Fife**

**Kevin Sharpe**

**Paul Spanton**

**Mark Hector**

**Phil Krug**

**Mark Muir**

**Graham Luell**

**William Knox**

**Daniel Pichimeier**

**Bill Plepmeyer**

**And**

**Philippe Roussel**

**A big thank you to all those folks and to everyone else who joined since last time.**

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**As always, thanks very much for watching,**

**Have a great week and remember to just have a think**

**See you next week.**