De mogelijke rol van Waterstof binnen de Energietransitie

“een introductie op Waterstof ”

Dr. Ir. Jan-jaap Aué

Directeur EnTranCe, Centre of Expertise Energy
Lector toepassing van waterstof in de energietransitie

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“Yes, my friends, I believe that water will one day be employed as fuel, that hydrogen and oxygen which constitute it, used singly or together, will furnish an inexhaustible source of heat and light”

Jules Vernes 1874 Mysterious Island
1839 Grove Fuel Cell
1860 Lenoir Hydrogen Car

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Hydrogen

source: US dep. of Energy

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source: NASA
So Why Hydrogen?

- There is enough renewable energy potential *not at the right spot on the right time*;
- Storage of renewable energy is key;
- Intermittency of renewable production needs buffering in the network;
- Mobility needs clean energy-carriers;
- Usage of existing assets and infrastructure;
- Power 2 products;
- New jobs
Why now?

- Decrease of renewable production prices, renewable investments surpass fossilde;
- Speed of development in electric mobility;
- Fukishima;
- Decreasing the Dutch natural gas production;
- E-Grid capacity issues (intermittency / buffering)
Announced wind & solar PV average auction prices by commissioning date

Wind & Solar Action Prices.

Source: IEA Renewables 2017
This area is sufficient to produce HYDROGEN from solarPV to cover the entire primary energy demand of EU28 (incl. UK)

Assumptions: (current technology)
- Solar PV efficiency 16%
- Electrolyses efficiency 75%
- Current EU PRIMARY energy demand

Source: Martien Visser @hanze
Opportunities

- (Clean) mobility / public transport;
- High Temperature demand industry;
- E-Grid capacity issues (intermittency / buffering);
- Heat demand housing;
Powertrain map in future mobility

Vehicle size vs. Driving distance

- HVs & PHVs with internal combustion engine
- FCHVs
- EVs
- Passenger cars
- Route buses
- Heavy-duty trucks
- Delivery trucks
- FCHV(BUS)
- FCHV
- Gasoline, diesel, bio-fuels, compressed natural gas, gas to liquids, coal to liquids, etc.

Fuel: Electricity, Hydrogen

TOYOTA

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Gasunie en het klimaatakkoord

Wat stroomt er in de toekomst door onze leidingen?

Gasunie 2030 plans 15GW H2 Backbone
Pilots needed?

• Gain experience and competencies;
• Make mistakes;
• Create demand;
• Create awareness;

• Be prepared for criticism: look who’s the sender;
AkzoNobel and Gasunie jointly scaling up the conversion of sustainable electricity into green hydrogen

- 20 megawatt water electrolyser, the largest in Europe
- Producing 3 kiloton (30 million m³) of green hydrogen
- Enough to fuel 300 buses, or enough for 1 bus to drive around the world more than 1100 times
- Up-scaling is essential for the transition to a hydrogen economy

**Chemical industry**
- Replacing hydrogen produced by fossil fuels
- As building block for everyday products

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Nijstad-Oost

Gezinswoningen voor de Hoogeveener

Verbeteren van verbinding tussen Erflanden en Nijstad

Vergroten van de samenhang in het gebied

Energiemotor?
An Opportunity for the Netherlands?

- Urgency, due to the Earthquake issues;
- Knowledge and skills in the existing labor market;
- An existing Hydrogen market;
- Geographic location and available space;
- New Jobs;
Challenges

Technology Trigger

Peak of Inflated Expectations

Plateau of Productivity

Slope of Enlightenment

Trough of Disillusionment

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(Many) Challenges

- Supply of green Electricity
- Down- and upscaling;
- Reduction of costs;
- Supply or demand?
- Reputation;
- Regulation;

Source: US dep Energy
Dr. Ir. Jan-jaap Aué
Dean EnTranCe, Centre of Expertise Energy
*Lector toepassing van waterstof in de energietransitie*
j.aue@pl.hanze.nl
Integrale ketenkosten [€/kg H₂]

Source CE Delft Waterstofroutes 2018

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Percentage NL hernieuwbare energie per dag sinds 2014

Entrance database

- Alle hernieuwbare energie
- alleen solarPV & wind

Source: Martien Visser @hanze
Integrale ketenkosten [€/kg H₂]

Source CE Delft Waterstofroutes 2018
Percentage NL hernieuwbare energie per dag sinds 2014

Source: Martien Visser @hanze
Investments in energy

Source: IEA data, World Energy Investment 2017

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