Hydrogen and fuel cell R&D at TU Delft

Kas Hemmes

29 November 2007

Projects

- VG2 project
- TUD-TBM funded ‘ACTS’-projects
- TNW projects (applied sciences)
- 3mE (mechanical engineering: process and energy department)
- Industrial design projects
- Other more energy related projects like dealing with uncertainty in energy transitions, combined heat & power and EWI-DENLAB

TUD-TBM funded 'ACTS'-projects **1**

Interaction between
A) hydrogen system development paths (PhD Vacancy) and
B) public acceptance of hydrogen: an integrated approach.

Key words:

A) Hydrogen transition paths; gaming;

B) public acceptance modeling, stated preference approach; stated choice method; multinomial logic model; Bayesian belief networks

Objective: This project intends to perform an integrated analysis of alternative hydrogen development pathways, taking into account public acceptance of such pathways, and reactions of key stakeholders in the energy system to public acceptance. In addition, the influence of social networks and of information provision on public acceptance will be studied. This will result in improved insight into the socio-technical dynamics of hydrogen development, and provide a basis for policy recommendations in a transition towards a hydrogen economy.

TUD-TBM funded 'ACTS'-projects 2

Options for hydrogen-related market development and their potential: A study of the present and desirable future institutional economic context for the transition towards a more sustainable society with hydrogen in a decentralized energy system.

Key words: A) Institutional economics; technical governance,
B) policy lock-ins; hidden subsidies

Objective: Our aim is to investigate the degree to which the current institutional and socio-economic regime favours the use of specific energy carriers resulting in lock-in effects. Further, we analyse the ways in which the current energy system may be modified in order to facilitate a more dominant role for hydrogen.

TUD-TBM funded 'ACTS'-projects 3

Hydrogen, paths of transition and geopolitics: between conflict and cooperation

Keywords: hydrogen transition paths, geopolitical consequences, structure of international energy markets, international regimes, comparative analysis, energy dependence

Objectives:

This project will, establish a framework to analyze how geopolitical factors, like international patterns of economic and political rivalry and cooperation and resource dependency, influence the evolution of energy systems.

- this framework will be applied to examine alternative paths of transition towards a hydrogen-based economy.
- analyze how potential variations in the broader geopolitical world may be of influence in the way in which these transitions may occur, including the viability of the transition strategies and technological and supply options involved.
- draw conclusions in support of the development of national strategies, including the involvement in the international (EU) framework, for policymaking and industry and research cooperation.

Questions:

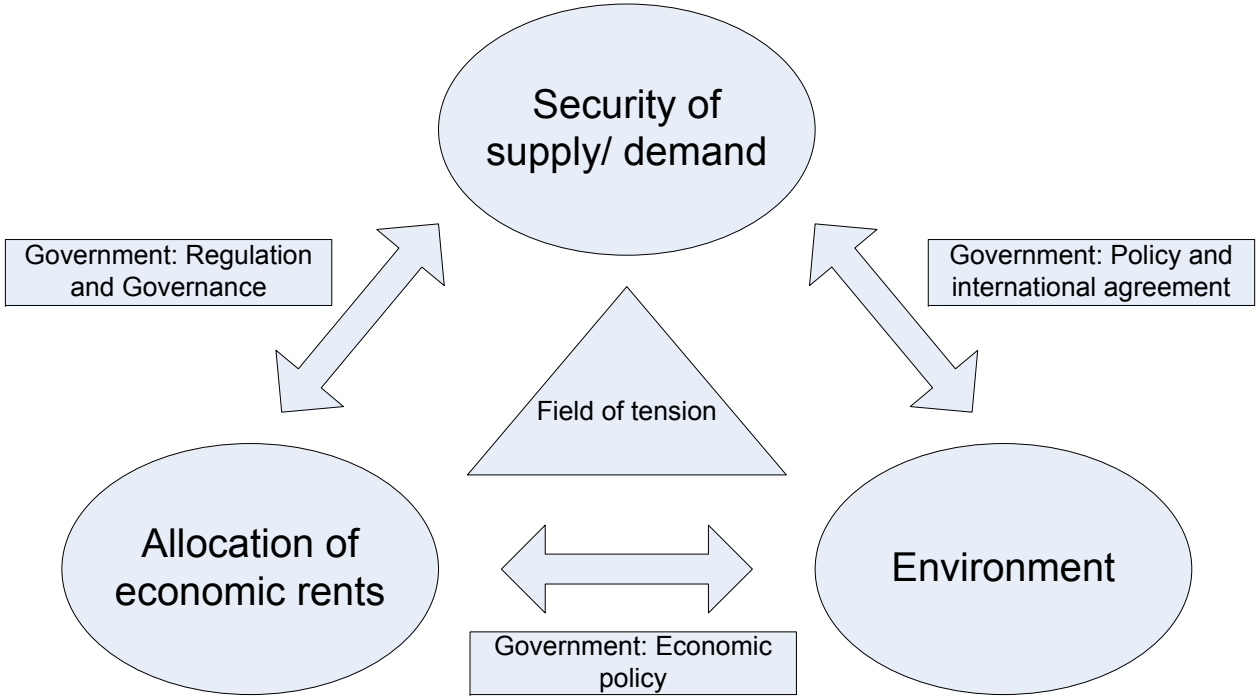
Is geopolitics a driver or impediment for the hydrogen economy?

1. What are the main geopolitical implications and relationships in the development of (new) energy systems?
2. What kind of strategies are applied to address these implications?
3. What kind of geopolitical implications arise from several modes of hydrogen consumption and production?

Questions 2

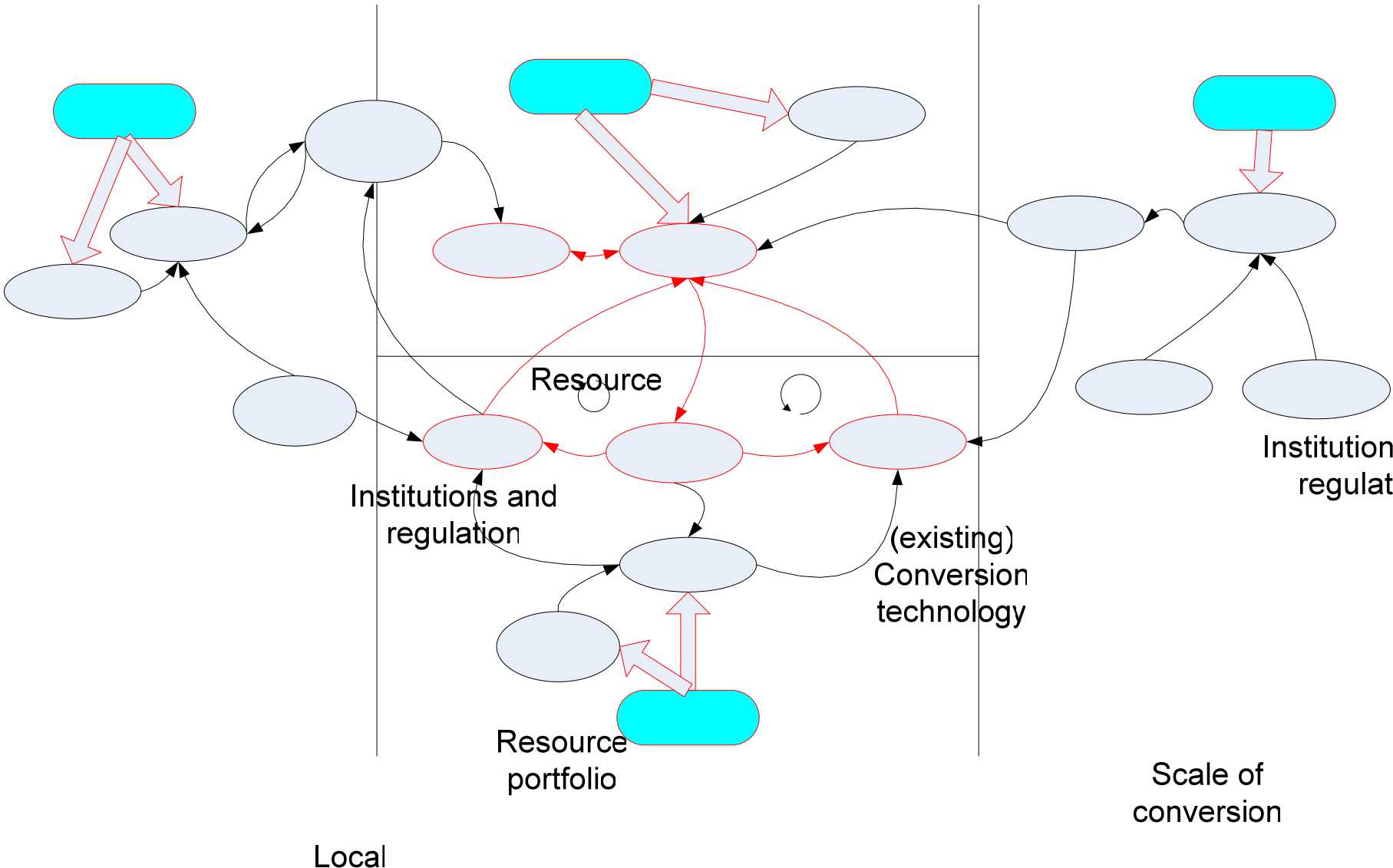
4. What strategies could countries apply to address these implications based on the insights retrieved in question 3?
5. How does this roughly compare with the different alternatives of energy carriers including the fossil based?
6. What would this mean, from a geopolitical perspective, for the position of hydrogen as the new energy carrier of the future?

Analytical framework 1.1: Energy Geopolitics



Source: Eden et al 1981; Correljé 1994; Correljé & Van der Linde 2006

Analytical framework 3: Value chain, geography, and institutions



TUD-TBM funded ‘ACTS’-projects + VG2

Cees van Beers
Adriana Diaz
Alexander de Haan
Nicole Huijts
Rolf Kunneke
Erika Neef
Wouter Pieterse
Wil Thissen
Margot Weijnen

Aad Correlje
John Groenewegen
Kas Hemmes
Alfred Kleinknecht
Eric Molin
Anish Patil
Daniel Scholten
Maria Trombetta
Leslie Zacharia

Secr: Klara Paardenkooper-Suli

TNW-Applied science

Joop Schoonman, Cor Peters et al.:

- Hydrogen clusters stored in Hydrates

Similar to methane hydrates H2 can form hydrates under special circumstances.

- Membrane reactors in Energy system (GCEP project ism ECN en Stanford) a.o. ceramic g-Al_2O_3 membranes.

For example steam methane reforming can be enhanced by selectively removing H_2 through a membrane in a membrane reactor. Pd metal membranes suffer from poisoning by CO and S, carbon deposition and low H_2 permeability

3mE (mechanical engineering: process and energy department)

Ad Verkooijen, Nico Woudstra, P.V. Aravind et al.:

- Biomass gasification and fuel cells (SOFC) (Aravind PhD 26 nov. 2007)
- ~ 5 PhD student on Fuel Cell related system studies

Industrial design projects

Han Brezet, Sacha Silvester, Hanna Hellman et al.:

- Hanna Hellman
- Hybrid H2-scooter (Crijn Bouman)
- Integration of Fuel Cells in (consumer) products (Bas Flipsen)