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"LONG-TERM ENERGY TRENDS – WHERE WILL WE BE IN 2050?"

4TH ENERDAY CONFERENCE ON ENERGY ECONOMICS AND TECHNOLOGY, TU DRESDEN

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The fourth gathering of the popular ENERDAY Conference was a one day event guided by the giddy-sounding theme of "LONG-TERM ENERGY TRENDS – WHERE WILL WE BE IN 2050?" The event attracted over 90 European experts in energy policy, energy technology and energy economics from academia, regulators, consultancies, and the energy industry itself. The event took place under the umbrella of TU Dresden's Energy Competence Centre (Energy 21++) and was hosted by Prof. Christian von Hirschhausen. Pre- and post-conference meals, as well as an excellent tour of Dresden the following day, provided ample opportunities for networking in what proved to be a relaxed, broad-ranging and engaging event.

The conference itself was organized into three keynote speeches and four sets of concurrent sessions (usually three running at any one time). The 11 concurrent sessions were: Energy System 2050 (1) & (2), Electricity (1) & (2), Energy Technology, Renewables, Renewables and Network Integration, Oil & Coal, Natural Gas, Regulation and Investment and Supply Security. This summary is based on the key note addresses and attendance and participation at the Regulation and Investment, Supply Security, Renewables, and Electricity (2) sessions.

1. Where will we be in 2050?

By way of introduction it was noted that making meaningful insights about the energy systems in 2050 would be difficult. This point was emphasized by the large differences in 2050 scenarios, perhaps most clearly epitomized the contrasting visions generated by the modeling of Franz Trieb (DLR/German Aerospace Center – A keynote address) and François Cattier (EDF). The latter was perhaps the most *status quo* model since it was reliant largely on existing generating technologies (existing renewables and an expanded use of nuclear power) and which foresaw the development of carbon capture technologies and the implementation of a single price for carbon (with a tax). The former started from an assessment of the potential of renewable sources versus current and projected demand, leading to a energy mix dominated by renewables which is backed up by some fossil fuel generation when needed and where High Voltage DC (HVDC) lines bringing North African concentrating solar power to Europe.

Even if the future does not contain DC lines bringing North African concentrating solar power to Europe, Franz Trieb's vision of the future did emphasize one of the other opening remarks; namely, that over the forty or so years to 2050 the energy system is likely to look radically different to todays. It is human nature that we tend to overestimate the short-term impact of technology but underestimate it in the long-run. The comparison with mobile telephony was made; there was a lot of hype and disappointment associated with the early days of 3G but over a forty year time horizon it is unquestionable that remarkable advances have been

achieved, with today's mobile phone devices and networks providing access to functionality and services that would have seemed unimaginable to most people in the late 1960s.

Interestingly both Franz Trieb and François Cattier's vision of the future came under criticism from a security of supply perspective, thus emphasizing the complexities of energy policy. Attempts to solve one goal (the environmental question) throw up undesirable consequences in another goal (security). In the case of Franz Trieb modeling concerns were raised about becoming dependent on North Africa for electricity supply. These concerns were put in context given the nonproliferation concerns attached to François Cattier's modeling which saw nuclear know-how expand from around 30 to some 70 states worldwide, with most of that growth occurring in developing countries.

On a more congruous note it was interesting to observe that all the 2050 modeling efforts that I observed (Franz Trieb, François Cattier and Alban Kitous, ENERDATA) concluded that large carbon reductions would be possible by 2050. Some paths may be more radical than others and offer greater benefits but undoubtedly they are more disruptive and may face greater risks. Further, all three models of 2050 envisaged a large role for renewables, but with wide variations. Franz Trieb saw renewables providing the lion's share of generation, for François Cattier this was around a third, while Alban Kitous' modeling foresaw RES deployment leading to a quarter of carbon savings (cumulative between 2000 and 2100). Further, both Alban Kitous and François Cattier saw a large role for energy efficiency. Finally, Alban Kitous' modeling was highly dependent on the development and use of CCS and on assumptions about biomass.

2. Session on Regulation and Investment

This session covered presentation on take-or-pay contracts (Bert Willems, Tilburg), the role of regulation in fostering innovation in electricity distribution (Machiel Mulder, Netherlands Competition Authority) and the modeling the diffusion of CCS (Johannes Herold, TU Dresden). Bert Willems presented a theoretical case for banning take-or-pay contracts on the basis that they do not provide for risk sharing. However, practitioners in the audience felt this general position did not reflect the heterogeneity of contracts in existence, with observations noting that most contracts included clauses that did indeed result in risk sharing.

Machiel Mulder's contribution noted that the current regulatory regime for electricity distribution focused on efficiency did not leave enough room for innovation. In particular he argued that it acted as a disincentive to distributed generation (since DG's did not pay for transport costs, hence DSO's had few incentives facilitate DG) and he argued for a regulatory regime that permitted sufficient scope for high risk/uncertainty R&D. The congruence of these conclusion with the more radical 2050 scenarios should not be overlooked even if participants struggled to see what exact form the innovation required would take. As noted in earlier discussions of 2050 scenarios, such foresight is not possible yet it does seem to provide a *prima facie* case against making these changes/investments. Again with interesting links to the 2050 scenarios, Johannes Herold's diffusion model of CCS deployment highlighted that take-up of CCS technologies was highly dependent on (1) learning externalities and (2) stringent 'flanking policies' policies (such as the phase out of nuclear).

3. Session on Supply Security

A keynote (Thomas Kleefuß, RWE Transgas Net) and one concurrent session addressed security of supply, representing a broad range on views and approached to the subject of supply security. Thomas Kleefuß sought to draw security of supply lessons from the Russian-Ukrainian crisis in 2009, showing how investment in its infrastructure that allowed bi-directionality of gas flows had meant that RWE was able to supply all its customers in the Czech Republic and supply considerable volumes to Slovakia from its northern business (principally Norway) when Russian gas supplies through Ukraine were cut off. The example, he argued, not only shows the need for relevant investments in bi-directionality and storage but also highlighted the need for 'strong' energy companies that can be relied upon to implement European-wide SOS policies. In the concurrent session there were two presentations. Jaap C. Jansen (Energy Research Center of the Netherlands) described how energy security indexes could be used to measure the various components of security of supply so as to try to provide a comprehensive indicator of 'energy services security'. Christoph Gatzen (Frontier Economics) presented a model that explored the best use for salt caverns as energy storage devices

between three alternatives; carbon storage (CCS), gas storage and compressed air storage for electricity generation. His modelling lead to the conclusions that depending on circumstances the last two options were the most attractive, while their use for CCS was not recommended since caverns are too small and too valuable compared to expected carbon storage volumes to justify this use.

4. Session Renewables

There were three presentations in this session. Daniel Gudopp (Lahmeyer International) provided a review of Concentration Solar Power from a technological and commercial perspective and concluded that CSP has the potential for utility scale energy generation that was adaptable to a market context. This said, discussion centered on technical challenges such as coping with sand storms and high-water usage in desert locations, where some of the biggest CSP resources lie. Markus Reichel (Dreberis Dresden) explored the effects of different RES investment support schemes (Feed-in-Tariffs vs. quotas) on investment risk and therefore on the cost of capital. His analysis led to the conclusion that FIT implied lower risk and therefore a lower cost of capital. By way of contrast countries with quotas would have to have higher energy prices to offset the additional risk investors felt they were fencing and for these same reasons the cost of capital would be higher in this context. The final presentation, my own, explored whether the patterns of induced diffusion (i.e. when a policy intervention pushes the take-up of a technology) were different to the 's' shapes observed conventionally.

5. Session Electricity (2)

Due to prolonged discussions following my presentation I only caught two presentations in this session; by François Cattier (discussed earlier) and by Christian Growitsch (WIK Bad Honnef). The latter explored the efficiency of the German electricity wholesale markets using formal statistical methods (Co-integration Test and Vector Error Correction Models) and concluded that though there were no significant arbitrage opportunities the wholesale spot market remains illiquid and inefficient. The authors suggest that a larger proportion of wholesale electricity should be traded via power exchanges to facilitate liquidity, stability and efficiency.

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