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12th IAEE European Energy Conference

Energy challenge and environmental sustainability

September 9-12, 2012 in Venice, Italy
Ca' Foscari University of Venice

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The Conference Objectives

Recent events - such as the conflicts within several North African and Middle East oil and gas-exporting countries, and the nuclear disaster in Japan - have added elements of uncertainty in the already complex evolution of the energy situation in the world and in Europe in particular.
Security of supply, geopolitical aspects and environmental problems are once more at the forefront.
The Conference aims at providing a forum for an analysis of the new developments and a new vision of the future.
No better stage can be imagined for this discussion than the magic and fragile environment of one of the most beautiful cities in the world.

The first plenary sessions of the **12th IAEE European Energy Conference** will therefore be dedicated to the evolution of demand and to the new energy markets less dependent on major commodities.

A debate will follow on how to deal with climate change through better regulation of CO2 emissions and what opportunities Europe can get from these new regulations.
The last sessions of the Conference will deal with energy security in a geopolitical context that is getting more and more complex and difficult in all the main areas of the world .

Besides these main topics the 12th IAEE Conference will also discuss all the issues related to the environmental change and its new perspectives, such as energy efficiency, developing renewable sources, biofuels and sustainable transportation. 8 plenary and 80 concurrent sessions will be organized by the AIEE - together with the International Association for Energy Economics - IAEE in cooperation with Fondazione Eni Enrico Mattei and Ca' Foscari University of Venice.

Fondazione Eni Enrico Mattei

Università Ca'Foscari Venezia

13. Learning by doing: cost reductions for RES (Room "10 A")

Chair: Manfred Weissenbacher

- ELECTRICITY MARKET IMPLICATIONS OF VOLATILE ENERGY TECHNOLOGY INVESTMENT COSTS () (presentation)
  Presenter(s): **Christian Panzer**

- RENEWABLE ELECTRICITY GENERATION IN GERMANY: AN EXTENDED META-ANALYSIS OF LONG-TERM MITIGATION SCENARIOS () (presentation)
  Presenter(s): **Eva Schmid**
  Co-Author(s): Brigitte Knopf and Michael Pahle

- SYSTEM LCOE: WHAT ARE THE COSTS OF VARIABLE RENEWABLES? () (presentation)
  Presenter(s): **Falko Ueckerdt**

- DEMAND SIDE MANAGEMENT WITH HYBRID HEATING PROCESSES: A CONTRIBUTION FOR COST EFFICIENT RENEWABLE ENERGY INTEGRATION (presentation)
  Presenter: **Philipp Riegebauer**

Electricity market implications of volatile energy technology investment costs

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Keywords: Econometric modeling, learning by doing, investment capital, energy technologies, volatile markets

Motivation

The global commitment towards a more sustainable future energy supply portfolio yields several economical and political new challenges. Implemented support schemes of (renewable) energy technologies must be strengthened towards more efficiency and effectiveness. In this context, a necessary precondition for the design of efficient support options is a precise forecast tool of future investment costs in renewable energy technologies (RET). Recent market observations have shown that not solely technological learning effects influence RES technology costs but volatile raw material prices hold an even more significant impact. Hence, this paper discusses the dynamic investment cost development caused by the impact of volatile energy- and raw material prices as well as technological learning. An econometric assessment is carried out, quantifying the impact of energy prices on raw material prices and further on the investment costs of (renewable) energy technologies. Therefore a more precise pathway of future (renewable) energy technology investment costs is derived, allowing for an optimized modeling of the future energy supply portfolio. Thus, on the one hand, political recommendations for electricity technology supports are in-depth assessed. On the other hand, consequences of political support measures determine technical challenges of future electricity markets.

Methodology / practical implementation approach

In a first step selected commodity prices are derived by econometric models considering their main energy input prices, certain time lags and the standard disturbance term. In this process the steel, concrete and silicon price are explained by the development of their main primary energy input prices[1]. In order to ensure consistency to EU scenarios, assumptions on primary energy prices refer to the European Commission published forecast scenarios until 2030. In a second step dynamic investment cost changes of energy technologies are derived from these commodity prices. Therefore a model according to the structure of formula Eq(1) is developed, taking into account the econometric relation to the commodity price impacts and the traditional learning by doing effect based on cumulative production (see Söderholm et al, 2007).

$$INV(t) = \left(\alpha + \vec{\beta}\ \mathrm{CP} + u_t\right) * \left(\frac{x_t}{x_0}\right)^m \qquad \text{Eq(1)}$$

INV(t)	Investment cost of energy technology in the year t
α	Constant
$\vec{\beta}$	Vector of regressors of considered commodity prices
CP	Matrix of considered commodity prices
u_t	Statistical disturbance term
x_t	Cumulative installed capacity in time t
x_0	Initial cumulative installed capacity
m	Learning by doing impact

[1] World demand of commodities, production capacities and local characteristics of different commodities hold an additional impact on their prices. The pure consideration of energy prices rather reflects the commodity production costs.

Generally, the parameters of formula Eq(1) are derived separately. In order to quantify the pure effect[2] of commodity prices on energy technology investment costs an additional econometric model is established. In order to meet the statistical preconditions of econometrics (see Greene, 2012) and increase the quality of the regression analyses a pre-assessment has been carried out, identifying significant time periods of relevant commodity price impacts.

Moreover, future scenarios of renewable energy investment costs are derived based on the developed model in Eq(1). In contrast to the identification of the regressors, where the realized historic observed commodity price information is used, the scenario calculation builds on the derived commodity costs. This allows for an endogenous feedback from energy prices to future investment costs of (renewable) energy technologies, serving as basis for simulation models of investment decisions as well as policy recommendations.

Finally, levelized electricity generation costs of annual new installations of selected technologies are derived. Thus, recommendations on long-term policy support measures of renewable electricity technologies are depicted. Consequently, a future electricity supply portfolio is estimated, pointing out the associated open technical challenges.

Results and conclusions

As the approach has been implemented for several technologies, this abstract exemplarily illustrates the results for the wind onshore and Photovoltaic installations. Figure 1 below depicts the result of the historic and future electricity generation costs of a coal-fired CHP plant, a wind onshore turbine and a Photovoltaic plant taking into account the extended modeling approach of investment costs from formula Eq(1). With respect to historic observations, the impact of increasing raw material prices is noted in 2008 as well as the cost decrease in the depression time period that followed. In terms of future forecasts, in the year 2025 wind onshore generation costs reach the breakeven point to coal fired electricity generation costs, according to this scenario. In contrast Photovoltaic electricity generation costs are expected to decrease in same magnitude as historically observed until 2020. The slower decline in generation costs beyond 2020 is caused by the strong market penetration in that time and the therefore slower doubling of cumulative installations. According to this scenario grid parity of Photovoltaics is achieved around the year 2017 but its generation costs will not decline to the level of conventional plants until 2030.

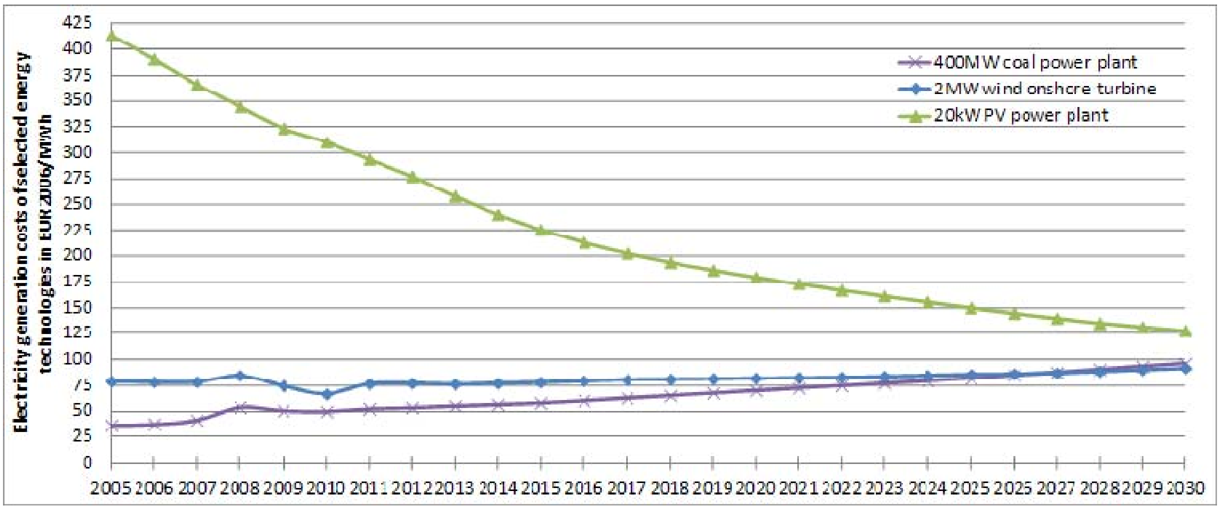

Figure 1 Levelized annual electricity generations costs in EUR2006/MWh, considering the impact of energy and raw material price on investment costs of selected energy technologies. Economic assumptions: (discount rate 6.5 percent, deprecation time 15 years (RES) respectively 30 years (coal) as well as CO2 prices. Source: Own calculation

References

Söderholm, P.; Sundqvist T., 2007. Empirical challenges in the use of learning curves for assessing the economic prospects of renewable energy technologies. Renewable Energy 32(2007), p. 2559-2578

Greene, W.H. (2012). Econometric Analysis – 7 edition. Pearson Education Limited, ISBN 978-0-13-139538-1, UK

[2] Allowing for the pure identification of the commodity prices, historic investments in these specific econometric analyses have in a first step been corrected for GDP, price versus cost and technological learning impacts.