

USE OF MODERN PORTFOLIO THEORY TO OPTIMIZE THE POWER GENERATION MIX AT THE COMPANY LEVEL: IMPACT OF INVESTMENTS IN NEW RENEWABLE ENERGY TECHNOLOGIES

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OVERVIEW

E.ON is one of the largest energy companies in Europe, having strong market position in the power and downstream gas markets not only in Germany and Central Europe but also in the United Kingdom, Northern Europe, Russia, Italy, Spain, and the US. In all these market units, E.ON owns and operates very diverse power generation portfolios. Relying on well diversified power generation mixes that are based on a range of fuels, such as gas, wind, coal, oil, or biomass, is an effective strategy for ensuring security of supply. The construction of power portfolios is a process where energy utilities have to take into account a number of factors and goals, including the following: minimizing the impact on the environment, keeping the cost of generation as low as possible and, from a power supplier's point of view, achieving the best profit for a given risk level. To reach these goals they research and develop new technologies which could better meet the needs of their consumers and to adjust to changes in the energy industry.

The intense changes in worldwide energy industry are the results of a number of factors, such as the increase in energy demand, growing industrialization processes, and resources limitations. Many countries and energy providers are obligated to reconstruct their power generation mix and to develop new possibilities for producing energy. One reason is that their existing power plants are often old, not very energy-efficient and not very eco-friendly (e.g. featuring high CO₂ emissions). Moreover, present energy utilities are heavily involved to develop CO₂-free or CO₂-low technologies. Worldwide activities connected with climate change mitigation and shifting energy production towards renewable energy sources determine a direction of change for all energy suppliers and also requiring adjustments of consumers' behavior. E.ON plans changes and aims the expansion and development of new strategies as well, which include the following goals:

- reduction of specific CO₂ emissions by at least 50% by 2030;
- generation of 18% of energy from renewable sources by 2015;
- generation of 50% of energy from carbon-free renewable and nuclear energy sources by 2030 and the other 50% from low-carbon emission generation.

E.ON wants to achieve these goals, among other measures, through the modernization of the existing power plant stock and by means of new investments. The investment plan foresees that some €60 billion shall be invested between 2007 and 2010. Unfortunately, difficulties and instabilities on the economic and financial market recently caused some reductions in the actual investment spending. Nevertheless, a major part of the investment strategy remains unmodified and affects different markets to different extents.

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2 METHOD

Since electricity market liberalization commenced, energy planners and providers have had to modify their allocation strategies and to use a robust analytical framework to conceive optimal risk diversification. The practice and many theoretical studies show that the analytical tool borrowed from the financial literature – such as mean-variance portfolio (MVP) theory – is, also for power generation sector, a consistent framework. According to this methodology the optimal combination of assets (power plants or power technologies) is one which has the smallest attainable portfolio risk for a given level of expected return, or the largest expected return for a give level of risk.

In our analysis, we use this two-dimensional optimization framework that regards, on the one hand, expected returns on investment and, on the other hand, the investment risks attached and the possibilities for risk diversification in direction of an optimal, or efficient, portfolio composition. In the decision-making process, electric utilities construct their generation mix considering financial risk, technical and societal aspects, and also the expected return on investment. Regarding all these factors we use, on the one hand, annual returns and, on the other hand, the Net Present Value (NPV) of power generation assets as a measure of project evaluation, in order to construct return-risk-optimized power generation mixes for the market units analyzed.

3 RESULTS AND CONCLUSIONS

In our study we aim at investigating the impact of new investments, especially in renewable energy technologies, on the efficiency of the power generation mix of E.ON in Germany, Sweden and United Kingdom.

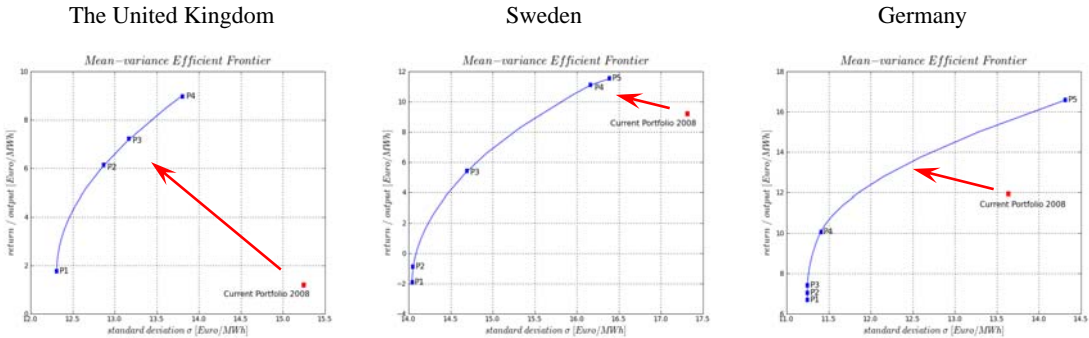


Fig. 1. Efficient frontier and E.ON portfolio (year 2008) in considering market units – analysis based on annual return (own calculations)

This comparative analysis is based on actual information about all existing and planned technologies in these three market units of E.ON. The expected results of our analysis should provide some evidence on which investments could improve existing power generation mixes and how the position of the efficient frontier will change when new projects are added to the existing portfolio. On the other hand, the results obtained are the next step in our ongoing project where we consider the application of portfolio analysis to the electricity sector (not only the classical Markowitz approach but also alternative methods and dynamic aspects).