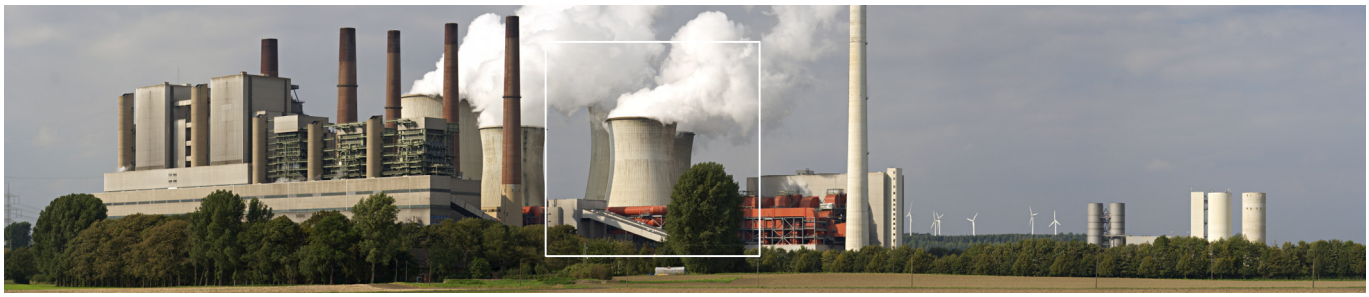
Real Options for the Future Energy Mix

A fair valuation of future investments



In the coming years, both the demand for climate-friendly energy generation and the replacement of aging conventional generation facilities will lead to very large capital investments and planning efforts in the utility sector. With these massive investments ahead, the competitiveness of nearly all electricity utilities depends on meaningful ways of valuing these multi-billion euro investments.

Traditional methods for investment decisions, such as net present value (NPV), are static approaches that do not accommodate flexibility and possible future options. As a result, many investment decisions tend to be undervalued and so are not executed. Real option valuation (ROV) allows a broader perspective on possible future options, giving management a more realistic valuation of future investments and also a method for developing a strategic pathway.

A practical approach developed by Arthur D. Little[1] for the application of ROV gives quick answers to entrepreneurial investment questions. Specifically designed for situations with a high degree of uncertainty, flexibility and active management, this approach models complex market data using advanced financial methods, to provide meaningful results for executives without requiring a specialized mathematical orientation.

Power industry investment environment to 2020

Today's energy market is marked by great uncertainty. The main drivers of the enormous future global investment required in power generation facilities are:

- Increasing global energy demand, mainly in the emerging economies
- Harder-to-access natural resources
- Rising fossil fuel prices
- Higher legislative requirements for climate change mitigation
- Technological innovation
- Replacement of aging facilities
- Increasing shareholder value

As a backdrop to these investment requirements, electricity utilities face a number of challenges, including expensive sourcing and rising pressure from capital markets, as well as privatization, deregulation and antitrust efforts. Meanwhile, emerging technologies, a growing number of environmentally conscious consumers and growing public opinion to combat climate change add pressure to the rising uncertainty.

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1 In cooperation with the Chair of Energy Economics at Dresden University of Technology and with Opexis GmbH

In January 2008, the European Council proposed a binding target that renewable energies must meet 20 percent of the EU's energy requirements by 2020. Also, in 2005, the EU Emissions Trading Scheme was established to create a cap-and-trade market and set a price for industrial carbon emissions. Given these ambitious goals and the accompanying legislation, as well as the decision of the German government to phase out nuclear power (and the reluctance for nuclear new-build in many countries), electricity utilities will have to undertake massive investments in clean technologies for power generation.

The challenge for electricity utilities is to reduce their CO_2 emissions in the most economic and cost effective way. Using traditional evaluation methods, e.g. net present value (NPV), technologies such as wind, biomass and solar tend to be undervalued; valuations do not reflect the flexibility of these technologies compared to conventional power plants, where decisions are irreversible for several decades.

As a result, decision makers in utility companies need a new approach to define the right energy generation mix, given the uncertainty around political frameworks and economic trends and discontinuities.

Four steps to identify and determine option values

Arthur D. Little has developed a four-step approach that leads to a fair evaluation of energy generation investments. This new approach enables top management to break out of the more rigid corporate systems that were suited to the less volatile industry environments of the past, to strategically discuss different investment alternatives in a structured way.

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First, a base case scenario is defined using the NPV method. In the second step, scenarios are built that describe potential future environments in terms of political and economic frameworks.

Within these scenarios, different options for investment decisions such as 'invest in wind generation' or 'expand coal power plant capacities' are modeled. This modeling is based on parameters that require a fundamental understanding of the relevant parameters within the utility industry.

When a complete set of different options has been modelled, the fourth step is to carry out a real option valuation (ROV) using complex financial and statistical modeling which takes into account the uncertainty of the real world. As a result, not only is the value of different investment strategies derived, but also the likelihood of each option becoming reality and its single value. (See figure 1).

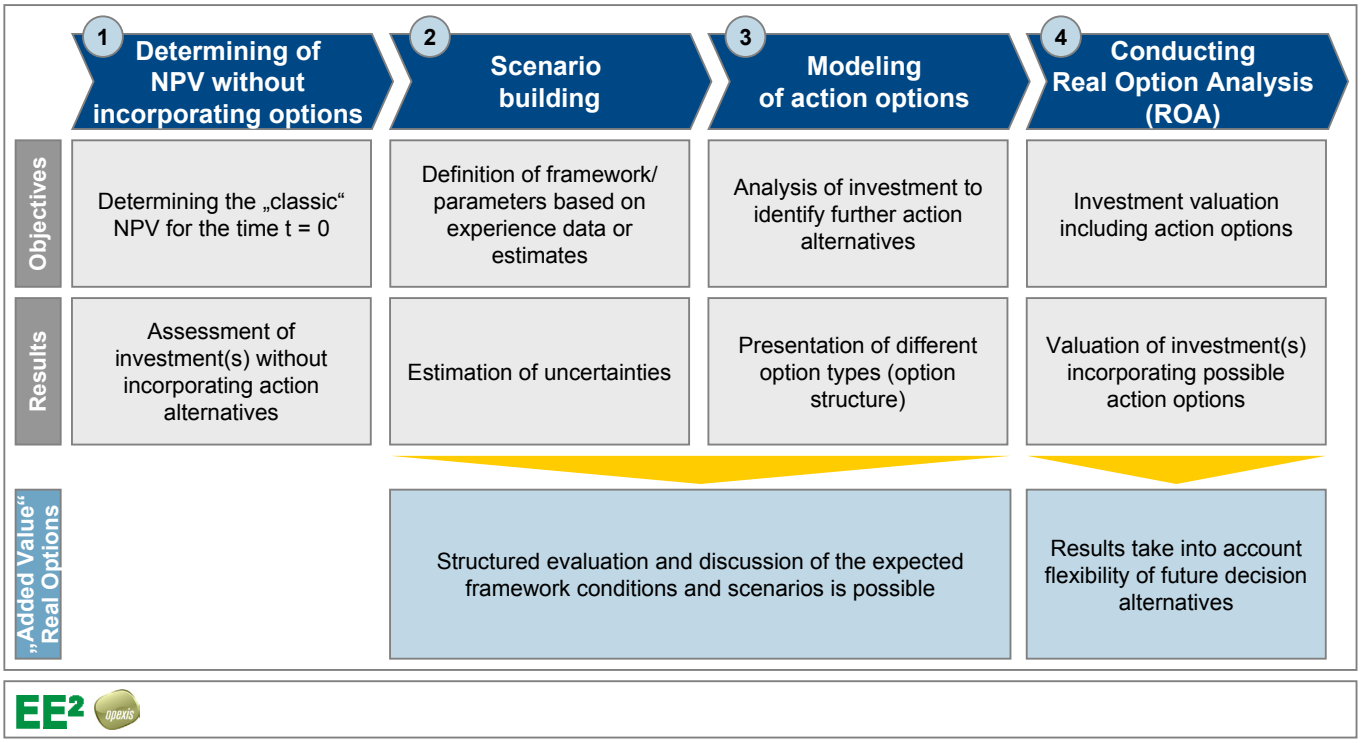

Figure 1: Real Option Valuation methodology – Step-by-step approach

The Net Present Value trap

The profitability of CO_2-related investments depends on highly volatile parameters. Conventional methods of valuation (e.g. NPV, discounted cash flow (DCF), and scenario analysis) can lead to misleading values if certain key factors are not taken into account since they cannot properly capture some of the major characteristics of such investments – notably, their uncertainty, flexibility and irreversibility.

In general, investment decisions in power generation are usually characterized as being large and irreversible with high sunk costs. As with CO_2 opportunities, these investment decisions are made under a cloud of uncertainty in a highly volatile market. The roots of this volatility are prices (e.g. for electricity sales), costs (e.g. procurement and generation), legislation (e.g. future Emissions Trading Schemes) and political trends that are difficult to predict as well as erratic consumer behavior, disruptive technologies and competition.

One particular area of uncertainty is the price of carbon which will have a significant impact on costs. As the price is market driven, there is inherent uncertainty; however it is not clear what a global carbon market will look like and how it will develop post 2012. Real Option Valuation allows these uncertainties to be modelled in different scenarios and included in the decision making process.

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Flexibility is necessary in order to properly react to these uncertainties and actively manage a utility's generation portfolio. Being flexible adds value to a project. Rigid predictions, which are a central assumption of static evaluation models such as NPV, do not allow alternatives to the project that might arise later to be factored into the present value.

However, to generate the base case for future developments, the classical NPV approach is necessary and appropriate. (See figure 2).

NPV is the most commonly used valuation and decision method for investment projects, measuring the excess or shortfall of cash flows in present value terms. The NPV can be seen as the statistical value of an investment, giving information about the minimum return without incorporating any flexibility.

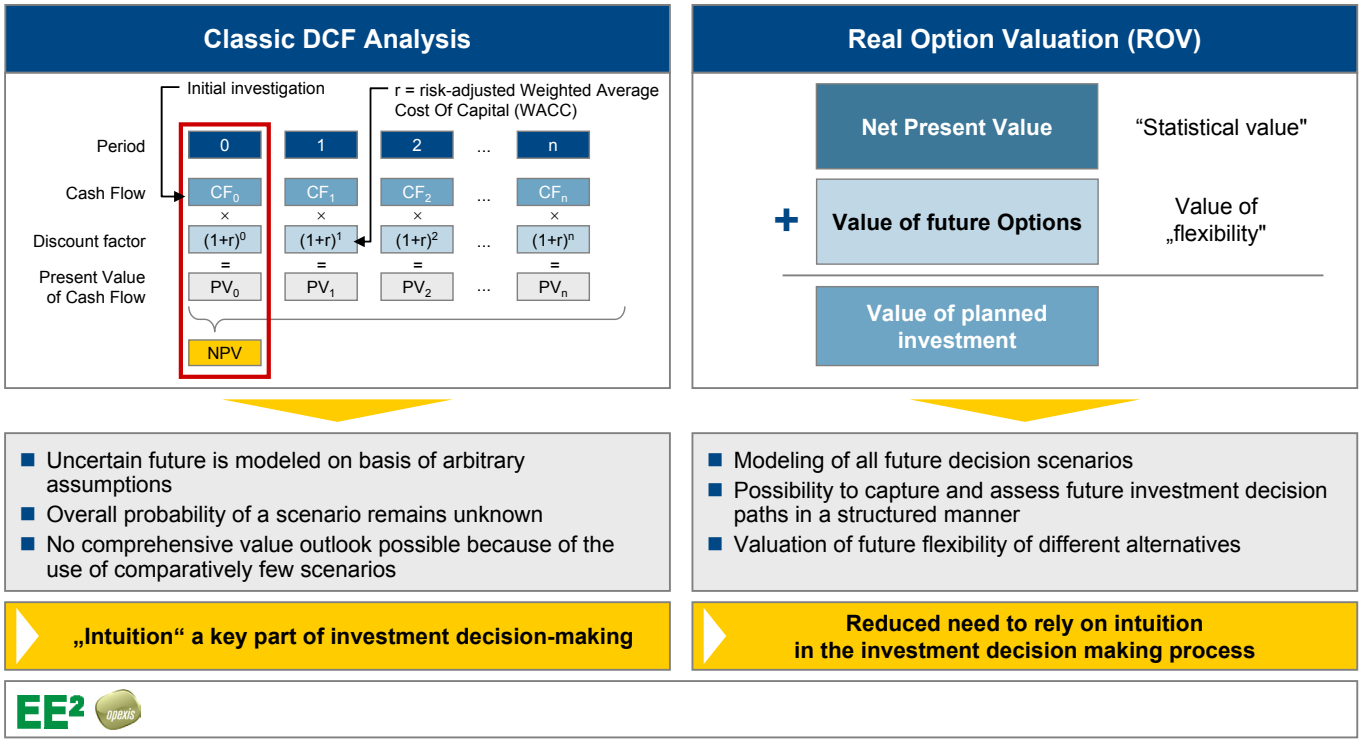

Figure 2: Real Option Valuation methodology – Comparison of ROV and classic discounted cash flow methods

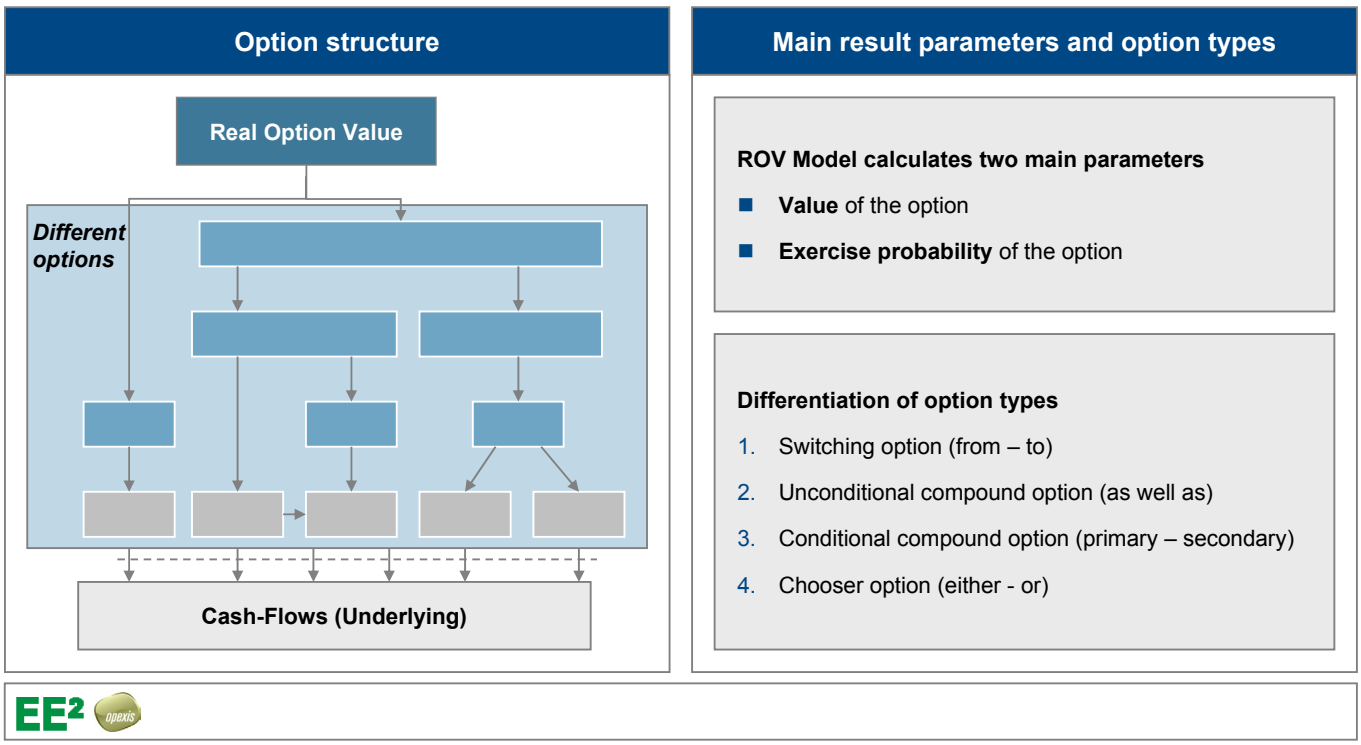

Figure 3: Real Option Valuation methodology – Main result parameters and option types

Strategic aspects of Real Option Valuation

The ROV approach gives a more realistic view of the value of investment projects. However, the process involved creates a challenge in terms of strategic discussions within the firm. Whereas modeling an investment with NPV merely means clarifying how much value a sole investment is creating, the real option approach implies a structured debate about the company's perspective on the future. (See figure 3).

Defining future options and structuring the options available provides a systematic way to analyse and quantify possible future strategies. The idea that all future actions and developments can be treated as real options, some of them depending on each other, some others uncoupled, gives new insights to top management. Uncertain developments that will be more evident in the future, and which are outside the control of management (e.g. fuel prices), can be included in a general strategy.

In Arthur D. Little's approach, structuring the options involves naming all the different options available and categorizing them under different option types. Every option is defined with underlying information such as its risks and its impact on capital expenditure. Even if, during valuation, an option emerges as being worthless and therefore not worth carrying out, the associated gathering of information and discussion has helped top management to have a deeper understanding of the market and its positioning relative to the competition.

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Case study –
Power plant portfolio development in Germany

To give an example of the impact of ROV on strategy as well as on the value of investments, we have created a 'synthetic utility' with the following energy generation output in the year 2008:

- Hard coal (as well as lignite) and natural gas are equivalent to around 70 per cent of the total energy mix
- Nuclear power is reflected in 20 per cent of the generation portfolio
- 10 per cent are generated by other energy sources

Between 2008 and 2020, the synthetic utility has to react to a number of diverse and dramatic changes. Regulatory requirements set by the government call for a phase out of nuclear power generation. Furthermore climate change regulation will be critical in any future expansion of coal power (and form the basis for the decision to make plants Carbon Capture Storage ready). Therefore renewable sources should increase to around 20 percent in the year 2020, with an emphasis on increasing the share of wind power, as it is the only renewable source that gives the necessary generation capacity.

To model a base case scenario, several complex assumptions have to be made about the different energy sources with respect to efficiency, full load hours, size and other parameters of a plant.

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Based on these figures the synthetic utility calculates a 'base case scenario NPV' that includes the downsizing of nuclear power as well as investment into other energy sources (wind and fossil energy) to maintain the energy output of the synthetic utility constant. This yields an NPV of the synthetic utility's generation investments of €19,950 million.

This figure indicates that the changes in the power generation mix still lead to a positive NPV. However, possible future changes in the energy mix or a 'waiting option' for changes in the regulatory environment are not valued.

To overcome these obstacles an option structure chart with possible future scenarios is developed. In addition to the base case that includes the downsizing of nuclear power (comparable to the NPV valuation just described), the following main options for the future energy mix are defined:

- 'Expansion in offshore wind energy'
- 'Expansion in hard coal'
- 'Expansion in natural gas'

All options are defined by their relevant underlying data, such as capex and opex and their volatilities, and then included in the ROV.

The resulting ROV gives a significantly higher value for the investment strategy – by €2,520 million. Clear recommendations for strategic decisions for the synthetic utility can be derived from the outcome of the real option analysis:

- Regardless of volatilities and costs right now, investment into wind and fossil fuels has to be made immediately as it is unprofitable to wait
- There is a clear preference for hard coal power generation over natural gas

The higher valuation derived from the real option approach is caused by including 'switching' and 'chooser' options, allowing the utility to change, enlarge or newly build energy generation sources. In comparison, the NPV method's static approach merely values the worth of an investment opportunity, neglecting the idea of delaying or changing investments in the future.

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Creating new value in utility investment decision making

The concept of Real Option Valuation exhibits some major advantages compared to traditional valuation technics.

In common valuation approaches the choices are 'invest' or 'do not invest'; no option of delaying the investment exists. By using Real Option Valuation, the value of keeping an opportunity open is taken into account. Uncertainties in parameters outside management's control are recognized and incorporated. Strategic investment decision making is structured, comprehensive and conclusive.

To find out more about how Real Option Valuation could add value in your utility investment decision making, please contact your local Arthur D. Little office.

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