Energy Delta Institute
Energy Business School

Algemene informatie – economics/finance

Deze artikelen zijn door EDI geschreven in het kader van het EDIAAL programma

Costs versus economics

Key concepts

Although basic cost calculations have been the starting point for comparisons this is by no means the only criterion. Other criteria include the speed of response to demand changes, and temporal and spatial production profiles.

Because electricity is very costly to store, wholesale prices can vary by a factor of 10 or more within a day. As a result time variation in production, and the operator's control over that variation, greatly affects the value of power produced. Generation resources over which an operator has greater temporal control, and thus are able to respond to demand changes, are considered "dispatchable," while those that vary significantly due to exogenous factors are considered "intermittent."

Dispatchability

Among conventional gas and coal plants, there are constraints on how quickly a plant's output level can be increased or decreased ("ramping rates"), how long the plant must remain off once it has been shut down, and how frequently it must be shut down for planned or unplanned maintenance, as well as the cost of starting the plant. Gas-fired peaker plants, for instance, have low fuel efficiency, but are very flexible, with rapid ramping capability and low start-up costs. Hydro-electric generation is also highly valued for its ability to adjust output very quickly. If the optimal "dispatch" of a plant implies that it will run disproportionately at times when electricity is of particularly high value – as is the case with gas-fired peaker generation and most hydropower generation – then any levelized cost comparison must be adjusted for the enhanced value of power produced.

Intermittency

Generation resources that depend on the local weather – such as wind and solar – are intermittent and therefore the least dispatchable. Such generation is almost entirely out of the control of the plant operator. Power from intermittent resources must be evaluated in terms of the time at which it is produced.

Solar power is produced only during daylight hours and tends to peak in the middle of the day. In many southern areas, especially those with high penetration rates of air-conditioning units, this is close to coincident with the highest electricity demand. Thus, the average economic value of generation from solar is greater than if it produced the same quantity of power averaged over all hours of the day. In cooler climates peak demand is in the evening, not coinciding with the peak in solar power production. However, the economic value of solar energy will still be relatively high as power demand will be above average during the day due to industrial and commercial demand. Wind power often has the opposite generation pattern, in most locations producing more power at night and at times of lower demand and prices(1). Wind power produced at night will receive a lower price as demand is low and thus has a lower economic value.

Back-up requirements

With renewable energy sources, not only the moment of (peak) production affects the economic value, but also its intermittent nature. The effect of intermittency on economic value depends on the degree to which intermittency requires additional generation reserves, or increases the risk of a supply shortage that causes blackouts or brownouts. While a grid can easily handle very small shares of intermittent resources, system costs will increase more than proportionally if intermittent resources constitute a significant share of generation. At levels greater than 20 percent, as has been achieved in some locations in Europe, this becomes a problem(2).

References

1. Power generation is blowing in the wind. DOE/Lawrence Livermore National Laboratory. ScienceDaily, 25 Jan. 2012 <http://www.sciencedaily.com/releases/2012/01/120117161623.htm>

2. The Private and Public Economics of Renewable Electricity Generation. Severin Borenstein. Energy Institute at Haas.

2011 <http://ei.haas.berkeley.edu/pdf/working_papers/WP221.pdf>

This article is sponsored by the EDIaal program

EDIAAL is an Energy Delta Institute programme that aims to gather, edit and make available independent knowledge on the role of gas in the transition to a low carbon economy. The EDIAAL project is partly made possible by a subsidy granted by The Northern Netherlands Provinces (SNN), Koers Noord. EDIAAL is co-financed by the European Union, European Fund for Regional Development and The Ministry of Economic Affairs, Agriculture and Innovation, Peaks in the Delta.

in co-operation with:

Cost comparison of natural gas and renewable energy

Key concepts

Calculating and comparing costs for different power generation technologies is a difficult process. It is often done by calculating the Levelized Cost of Electricity (LCOE) for different generation technologies. The LCOE attempts to calculate the average electricity price needed over the full lifetime of an installation to come to a break-even for a new-build project. However, LCOE calculations are very sensitive to differences in assumptions, for instance concerning fuel prices or discount rates, and may change yearly due to unexpected developments. For this article the LCOEs for OECD countries as calculated by the IEA are used(1), and other related costs are taken from the same source. The costs have been recalculated to Euros using an exchange rate of $0.68 for one euro (as used by the original source). One of the most important assumptions in calculating the LCOE is the discount rate; for this article only the 10% discount rate is used, as this best fits the range of discount rates used in reality.

Gas-fired generating technologies

Investment costs of gas-fired plants are significantly lower than those of coal-fired and nuclear power plants. For basic gas turbines investment costs range between 350 and 500 €/kWe, while for combined cycle gas turbines (CCGTs) costs range between 520 and 1000 €/kWe. Gas-fired power plants are built rapidly and, in most cases, expenditures are spread over just two to three years. The O&M costs of gas-fired power plants are also significantly lower than those of coal-fired or nuclear power plants. However, fuel costs are significantly higher than for coal-fired or nuclear plants due to relatively high gas prices (except for the US where natural gas spot prices are at a historical low because of the shale gas boom).

The levelized costs of gas-fired plants in OECD countries range between 52 €/MWh and 82 €/MWh. Here, fuel costs are the major contributor representing 67% of total levelized generation cost. Investment costs amount to 16%, while operation and maintenance (O&M) and carbon costs(2) contribute around 5% and 11% respectively to total LCOE. Consequently, gas prices are the driving factor in the estimated costs of gas-generated electricity.

Renewable energy technologies

In general, all renewable energy technologies tend to have high upfront construction costs, and low O&M costs. Renewable energy sources have the biggest advantage with respect to the fuel costs as their 'fuel' is supplied by nature and is free of charge. However, they do tend to be sensitive for load factor variations and geographical differences.

Figure 1 summarizes the costs discussed above and adds those of coal for comparison.

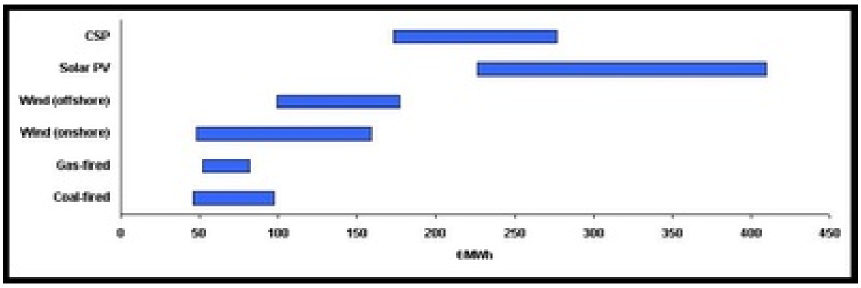

Figure 1: LCOE for a selected range of technologies installed in 2010 (€/MWh)(3)

Where local conditions are favourable, hydropower and wind are becoming increasingly competitive with coal and gas for power generation, and this trend will shape the electricity sector in the years to come. Their precise cost competitiveness depends on the local characteristics of each particular market and their associated cost of financing, as well as CO_2 and fossil fuel prices. The lower the cost of financing, the better the performance of capital-intensive, low-carbon technologies such as nuclear or wind; at higher rates, coal and gas will be more competitive. There is no technology that has a clear overall advantage globally or even regionally. Each one of these technologies has potentially decisive strengths and weaknesses that are not always reflected in the costs. At this moment, due to the increased use of natural gas in North America, coal is relatively cheap and natural gas-fired generation has difficulties remaining profitable outside of North America.

References

1. Projected Costs of Generating Electricity: 2010 Edition. International Energy Agency (IEA)/OECD Nuclear Energy Agency (NEA). OECD Publishing, 2010 <http://www.iea.org/Textbase/npsum/ElecCost2010SUM.pdf>

2. Carbon costs were calculated at a carbon price of 20 €/ton CO2

3. Projected Costs of Generating Electricity: 2010 Edition. International Energy Agency (IEA)/OECD Nuclear Energy Agency (NEA). OECD Publishing, 2010 <http://www.iea.org/Textbase/npsum/ElecCost2010SUM.pdf>

This article is sponsored by the EDIaal program

EDIAAL is an Energy Delta Institute programme that aims to gather, edit and make available independent knowledge on the role of gas in the transition to a low carbon economy. The EDIAAL project is partly made possible by a subsidy granted by The Northern Netherlands Provinces (SNN), Koers Noord. EDIAAL is co-financed by the European Union, European Fund for Regional Development and The Ministry of Economic Affairs, Agriculture and Innovation, Peaks in the Delta.

in co-operation with:

Business models based on new financing schemes

Key concepts

There are business opportunities in making use of new and innovative financing schemes. High upfront costs are a major barrier for increased deployment of RES. Innovative financing schemes may therefore create business cases if the financing schemes help to overcome the barrier of high upfront costs. Financing schemes can be offered by different organizations, including local governments. They generally take over the initial investments and are paid through periodic payments.

Property Assessed Clean Energy (PACE) financing

PACE financing is a mechanism set up by a municipal government by which property owners finance RES and EE measures via an additional tax assessment on their property. The property owners repay the 'assessment' over a period of 15 to 20 years through an increase in their property tax bills. When the property changes ownership, the remaining debt is transferred with the property to the new owner. The legal possibilities in the Netherlands for this type of business model are currently being investigated by the municipality of Groningen under a Green Deal with the Dutch government.

On-bill financing

Utilities provide financing (i.e. a loan) for RES and EE measures. The building owners (or building users) repay the loans via a surcharge on their utility bills. For the utilities, this will not only offer a possible profit on the loan, but also a more sustainable image and better customer relations.

Leasing of renewable energy equipment

Leasing enables a building owner to use a renewable energy installation without having to buy it. The installation is owned or invested in by another party, like a bank or an ESCO. Leasing can be a central component of the business model of an ESCO or of a company that introduces a new technology to the market.

Energy Saving Obligations

Energy Saving Obligations are a policy instrument that obliges energy companies to realise energy savings at the level of end users. It stimulates business models based on financial incentives offered by energy suppliers to building owners, renters or energy service companies(1).

References
1. L. Würtenberger, J.W. Bleyl, M. Menkveld , P. Vethman , X. van Tilburg (2012). "Business models for renewable energy in the built environment". Energy research Centre of the Netherlands.

This article is sponsored by the EDIaal program

EDIAAL is an Energy Delta Institute programme that aims to gather, edit and make available independent knowledge on the role of gas in the transition to a low carbon economy. The EDIAAL project is partly made possible by a subsidy granted by The Northern Netherlands Provinces (SNN), Koers Noord. EDIAAL is co-financed by the European Union, European Fund for Regional Development and The Ministry of Economic Affairs, Agriculture and Innovation, Peaks in the Delta.

in co-operation with:

ENERGY DELTA INSTITUTE
ENERGY BUSINESS SCHOOL

SNN

Ministerie van Economische Zaken, Landbouw en Innovatie

Costs and economics of natural gas and renewables

Key concepts

Costs and economics are of importance in almost every discussion concerning the selection of an energy source. Both natural gas and renewable energy are seen among the best options for the future, although most often not from a cost perspective. In this article the costs and economics of natural gas and renewables in the electricity market will be discussed and compared.

Cost comparison

Calculating and comparing costs for different power generation technologies is a difficult process. It is often done by calculating the Levelized Cost of Electricity (LCOE) for different generation technologies. The LCOE attempts to calculate the average electricity price needed over the full lifetime of an installation to come to a break-even for a new-build project. However, LCOE calculations are very sensitive to differences in assumptions, for instance concerning fuel prices or discount rates, and may change yearly due to unexpected developments.

Costs versus economics

Although basic cost calculations have been the starting point for comparisons this is by no means the only criterion. Other criteria include the speed of response to demand changes, and temporal and spatial production profiles. Because electricity is very costly to store, wholesale prices can vary by a factor of 10 or more within a day. As a result time variation in production, and the operator's control over that variation, greatly affects the value of power produced. Generation resources over which an operator has greater temporal control, and thus are able to respond to demand changes, are considered "dispatchable," while those that vary significantly due to exogenous factors are considered "intermittent."

The value of distributed generation

Renewable energy – especially solar and small-scale wind – is often a 'distributed' generation asset, feeding electricity in at the distribution level instead of the transport level. The economics of any kind of distributed generation is partly dependent on how power delivered to the grid is valued, and the valuation of distributed generation is a topic of much debate.

Future expectations

Both natural gas and renewables are often cited as the energy sources of the future, and often a combination of the two is seen as the optimal solution for the coming decades. Competition between natural gas and renewable energy is complex due to the interplay of evolving economic and political factors; for example, many countries are committed to expanding their renewable energy portfolios regardless of the price of natural gas and other fossil fuels.

Conclusion

It can be concluded that natural gas and renewable energy are both competitive in today's market, although not always from a pure costs perspective. Natural gas is on average still the most expensive form of fossil energy when looking at running costs, but when commodity and CO2 prices are in its favor, it may be cost competitive with coal. Renewable energy is still more expensive than fossil energy but can rely on the support of governments all over the world and offers advantages with respect to the environment and as a hedge from volatile fossil fuel prices. Also, the costs of renewable energy technologies keep trending downward while fossil fuel-based power costs are expected to rise in the long term, either because of rising fuel prices or tighter pollution regulations. This means that, for the future, renewable energy can become cost competitive with every other source of energy while natural gas may serve as the most cost effective source of back-up power in the medium term.

This article is sponsored by the EDIaal program

EDIAAL is an Energy Delta Institute programme that aims to gather, edit and make available independent knowledge on the role of gas in the transition to a low carbon economy. The EDIAAL project is partly made possible by a subsidy granted by The Northern Netherlands Provinces (SNN), Koers Noord. EDIAAL is co-financed by the European Union, European Fund for Regional Development and The Ministry of Economic Affairs, Agriculture and Innovation, Peaks in the Delta.

in co-operation with:

Expectations for the future

Key concepts

Both natural gas and renewables are often cited as the energy sources of the future, and often a combination of the two is seen as the optimal solution for the coming decades. Competition between natural gas and renewable energy is complex due to the interplay of evolving economic and political factors; for example, many countries are committed to expanding their renewable energy portfolios regardless of the price of natural gas and other fossil fuels. Germany already derives about 20 percent of its electricity from renewables, and Japan, struggling to recover from last year's devastating tsunami and nuclear plant meltdown, is now debating renewable electricity targets of 25 to 35 percent by the year 2030.

Natural gas prices

Natural gas prices are expected to remain close to their current levels on average or rise in the future due to diminishing production from current fields, increasingly more difficult and more expensive to develop new fields, geopolitical tensions with respect to market design, and an increasingly tighter LNG market due to rising Asian demand. The discovery and production of unconventional (shale) gas might put downward pressure on gas prices, but so far the development of shale gas in Europe is going slow, and will require a benevolent regulatory regime. Obviously, any long-term rise in natural gas prices will affect the cost of gas-fired power significantly.

Renewable energy costs

While natural gas prices exhibit at most a stabilizing trend over the next few years, renewable energy technology is becoming more cost-competitive. The capital and installation costs of solar photovoltaic systems dropped by more than 50% from 2007 to 2011, wind and hydropower systems are already competitive in some markets, and promising technologies such as fuel cells and biogas are on the horizon. In 2011, for the first time, solar photovoltaic power was the top source of new electricity generation capacity in Europe, beating natural gas and wind combined(1).

Distributed generation

Furthermore, distributed renewable installations like solar panels on factory roofs compete against retail power rates, and thus, are less threatened by wholesale natural gas prices. And large utility-scale solar and wind projects that are subject to fixed-price energy contracts, and pass costs on to consumers in base rates, are potentially less susceptible to natural gas price fluctuations(2).

References

1. Global Market Outlook for Photovoltaics Until 2016. European Photovoltaic Industry Association (EPIA). 2012 < http://files.epia.org/files/Global-Market-Outlook-2016.pdf>

2. Dash for gas could damage renewables drive. Renewable Energy Magazine. 27 July 2012. <http://www.renewableenergymagazine.com/article/dash-for-gas-could-damage-renewables-drive>

This article is sponsored by the EDIaal program

EDIAAL is an Energy Delta Institute programme that aims to gather, edit and make available independent knowledge on the role of gas in the transition to a low carbon economy. The EDIAAL project is partly made possible by a subsidy granted by The Northern Netherlands Provinces (SNN), Koers Noord. EDIAAL is co-financed by the European Union, European Fund for Regional Development and The Ministry of Economic Affairs, Agriculture and Innovation, Peaks in the Delta.

in co-operation with:

Energy Delta Institute
Energy Business School

SNN

Ministerie van Economische Zaken, Landbouw en Innovatie