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National Association of Regulatory Utility Commissioners

2nd Technical Workshop: Gas Market Design and Natural Gas Transmission Grid Codes

Example of Economic Cost Benefit Analysis in Natural Gas Projects

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Basic principles of economic Cost Benefit Analysis (CBA)

Typical economic benefits of gas system projects

Example of economic Cost Benefit Analysis (CBA) in natural gas project

Basic principles of Economic CBA

Economic CBA is an analytical tool for assessing the project's wider costs and benefits to the economy and the society. The underlying concepts to a CBA are:

- Social opportunity costs: the potential gains/ losses to the market, economy and society from not having the investment project under consideration
- Monetisation of economic costs and benefit: CBA evaluates monetary values for the entire positive (benefits) and negative (costs) welfare effects of a project; overall performance is measured by economic indicators, e.g. Economic Net Present Value (ENPV) and the Economic Rate of Return (ERR)
- Incremental approach to cost/ benefit assessment: CBA compares a scenario with the project with a ‘counterfactual‘ baseline scenario without the project
- Social discount rate (SDR): to calculate the present value of future costs and benefits

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Typical Economic Benefits of Gas System Projects

Economic Benefit Description	Indicative Outline Approach to Monetization
Supply source diversification	
A project that enables gas imports from a new supply source diminishes the negative impact of a disruption in existing import sources	The benefit can be calculated on the basis of: (i) annual probability of a specific source disruption (%) (ii) duration of the disruption (days) (iii) the gas volume that is disrupted or the gas volume supplied by the new source (GWh), whichever is lower and (iv) the value of gas to the economy (€/ GWh)
Supply route diversification	
1. A project that enables gas imports from a new supply route (either piped or LNG) diminishes the negative impact of a disruption in existing import routes (NTS entry points)	The benefit can be calculated on the basis of: (i) annual probability of a specific route disruption (%) (ii) duration of the disruption (days) (iii) the gas volume that is disrupted or the gas volume supplied by the new route (GWh), whichever is lower and (iv) the value of gas to the economy (€/ GWh)

Typical Economic Benefits of Gas System Projects

Economic Benefit Description	Indicative Outline Approach to Monetization
Improved security of supply	
2. A gas project in the NTS (pipeline replacement/ new pipeline/ storage etc.) that diminishes the probability of a disruption in the transportation of gas through NTS	The benefit can be calculated on the basis of: (i) reduction in annual probability of NTS disruption (%) (ii) duration of the disruption (days) (iii) the gas volume that is disrupted (GWh) (iv) the value of gas to the economy (€/ GWh)
Reduction in gas supply costs	
A project that enables gas-to- gas competition i.e. gas supply at lower cost (purchase price, transit costs, etc.)	The benefit can be calculated on the basis of: (i) gas supply through the new project (GWh) (ii) difference in gas costs for accommodated demand, before and after the project (€/ GWh)

Typical Economic Benefits of Gas System Projects

Economic Benefit Description	Indicative Outline Approach to Monetization
Reduction in energy costs	
A project that enables gas to substitute other energy sources (coal, oil, etc.)	The benefit can be calculated on the basis of: (i) fuel supply substituted by gas as a result of the project (GWh) (ii) difference in unit costs between gas and the substituted fuel (€/ GWh)
Improved energy efficiency	
A gas project that reduces system losses	The benefit can be calculated on the basis of: (i) efficiency gain (%) (ii) system losses (GWh) (iii) the price of gas (€/ GWh)
Reduction in GHG emissions	
A project that enables substitution of other energy sources (coal, oil, etc.) by gas	The benefit can be calculated on the basis of: (i) fuel supply substituted by gas as a result of the project (GWh) (ii) difference in GHG emissions between gas and the substituted fuel (tons/ GWh) (iii) shadow/ target price of GHG emissions reflecting economic cost of emissions (€/ GWh)

Basic principles of economic Cost Benefit Analysis (CBA)

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Example of Economic CBA
Project Description

- TSO investment project with estimated CAPEX of €100m for construction of 130 kms pipeline, with diameter DN600 and pressure 75 bar;
- The project aims to connect an existing UGS facility, operated by a third party/ SSO, to the country's main consumption centre.
- The UGS facility has been recently upgraded to provide more gas during winter to the main consumption center (storage capacity up from 300 mcm to 750 mcm & withdrawal capacity up from 2 mcm/ day to 5 mcm/ day);
- There is an existing pipeline connection of the UGS to the main consumption centre, which is inadequate to serve incremental demand during winter;

Example of Economic CBA

Financial Analysis

	YR0	YR1	YR2	YR3	YR4	YR5	YR6	YR7	YR8	YR9	YR10	YR20	YR30	YR40
Incremental revenue (€ m)	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
OPEX (€ m)	-	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
CAPEX (€ m)	-100.0	-	-	-	-	-	-	-	-	-	-	-	-	-
Net financial benefits (€ m)	-100.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Discounted cash flows (€ m)	-100.0	1.0	0.9	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.5	0.3	0.2

- TSO incremental cash inflows from the project relate only to **additional entry-exit system charges** for the additional 300 mcm of gas that will be stored during summer and off-taken during winter; Resulting incremental cash inflow for the TSO equates to €2m p.a.
- Incremental **cash outflows** related to the **operation and maintenance** of the new pipeline (assumed at 1% of the pipeline's book value) of €1m p.a.
- Net cash flows are discounted using the Regulator approved WACC (4% p.a.)
- Project is found to be **financially non-viable** with negative NPV of € -80m and a financial rate of return (IRR) of -4%

Example of Economic CBA

Economic Analysis

- If this project is to be assessed only from financial perspective it should not go ahead.
- However, wider economic and social benefits can make a case for the project to go ahead
- In our example, the project is assessed to have a number of significant economic benefits. Integral to the project and key for the realisation of the assumed benefits is the existence of the extended storage facility (300 mcm).
- The approach to monetisation of project-economic benefits and costs is described next.

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Example of Economic CBA

Monetisation of project economic benefits and costs	€ m
1. Reduction in gas purchasing prices	16.0
1a. Reduction in gas purchasing prices during summer months • Availability of extended storage facility enables gas to be purchased and stored during summer months and transported to customers during winter months. Summer gas purchases (off-peak) (May to September) have lower price compared to winter purchases. This cost saving is a benefit for the project. • Prices for summer gas purchases assumed to be 10% lower than average yearly gas prices, and forecasted gas purchase price for 2018 is €200/000m^3. Incremental saving in first year of project operation (2018), is €20/000m^3. For a gas quantity of 300 mcm, this amounts to €6.0 m.	6.0
1b. Reduction in gas purchasing prices for the all months except summer • …	10.0

Example of Economic CBA

Monetisation of project economic benefits and costs	€ m
1. Reduction in gas purchasing prices	16.0
1a. Reduction in gas purchasing prices during summer months • …	6.0
1b. Reduction in gas purchasing prices for the all months except summer • Gas purchases, other than those purchased during the summer would be approx. 1,000 mcm. • Spreading these gas purchases throughout the year (as a result of summer purchases) enables cost saving over current prices, as load factor of supplier is flattened and this leads to price discount to the buyer. These savings (over the 7 months of the year outside the above referenced 5 summer months) are 5% of the price paid for purchases. • Based on gas purchase price of €200/000 m3, the incremental saving from gas purchases would be €10.0/000 m3. For gas quantity of 1,000 mcm, this amounts to €10.0 m.	10.0

Example of Economic CBA

Monetisation of project economic benefits and costs	€ m
2. Reduction in gas transportation costs	13.6
2a. Reduced gas transportation costs – through import pipeline • More even distribution of gas purchases throughout the year, and thus 'flatter' loads of the import pipeline will result in cost reductions vis a vis current transportation cost of gas imports (€30/000 m^3) for 1,300 mcm • The project would enable transportation costs for the 300 mcm during summer to be €10/000m^3 and €20/000 m^3 for the remainder of 1,000 mcm • The weighted average cost of transportation will be around €18/000m3. Thus, incremental savings for transportation amount to €12/000 m^3, and for the 1,300 mcm a total of €15.6 m.	15.6
2b. Increased gas transportation costs – through national system • …	(2.0)

Example of Economic CBA

Monetisation of project economic benefits and costs	€ m
2. Reduction in gas transportation costs	13.6
2a. Reduced gas transportation costs – through import pipeline • …	15.6
2b. Increased gas transportation costs – through national system • A shipper would have to bear additional transportation charges for transportation in the national system as a result of additional entry-exit system charges (capacity) • These are levied by the TSO for the 300 mcm of gas that are transported to storage during the summer and off-taken during the winter compared to the current situation, where this gas would enter into the transmission system and exit directly to domestic consumption. • Resulting incremental costs for shippers are €2.0 m p.a. This is a cost that has to be deducted from the project benefits.	(2.0)

Example of Economic CBA

Monetisation of project economic benefits and costs	€ m
3. Increased cost of storage	
• The above project benefits are conditional upon the availability of the extended storage facilities. • Investment in extension of the storage will be implemented by the storage operator and not the TSO. Nevertheless, incremental economic cost of the extended storage facilities should be taken into account. A proxy to this cost is the fee to be charged by the operator • It is expected that the charges for use of the extended storage will amount to €50/000 m^3 and thus the total incremental costs would amount to €15.0 m p.a.	(15.0)

Example of Economic CBA

Monetisation of project economic benefits and costs	€ m
4. Benefit from avoided disruption	
• The project has a benefit in terms of limiting the economic cost from a potential disruption in the major supply source due to the availability of the extended storage facility. • The probability of a disruption is assumed to be once every 50 years, thus 2% p.a. The minimum days of disruption, in line with EU Regulation 994/2010, are assumed to be 7 days. The incremental gas that could be supplied during a disruption, by virtue of having the additional storage, is 20.0 GWh/day. • A simplified approach to the value of gas to the economy is derived by dividing national GDP by the total annual energy consumption. This produces a value of energy in the economy of €0.3 m/GWh. • By combining all of the above, the annual benefit of avoiding disruption costs throughout the project amounts to approx. €0.8 m p.a.	0.8

Example of Economic CBA
Economic Analysis

- Taking into account the above economic benefits and costs, the project's **ENPV is €148 m with an ERR of 14%.**
- Included in the calculations are the financial costs of the project:
  - CAPEX of €100 m
  - OPEX of €1.0 m p.a.

Note: The same values for CAPEX and opex are used in both economic and financial analyses, as it is assumed that market conditions and prices are not different from the shadow prices.