Bridging barriers for multi-party investments in energy efficiency – A real options based approach for common utility systems design and evaluation

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Collaborative Chemistry **Case Study**



A case study of vision-driven multi-party collaboration







The studied case: A chemical industry cluster



Why is this cluster so interesting to analyze?









"Swedens single largest industrial energy efficiency potential"

 Total Site Analysis (TSA) and retrofit analysis has been used to identify possibilities for energy savings through internal heat exchange within the cluster

Hackl, R., Andersson, E., Harvey, S., 2011. Targeting for energy efficiency and improved energy collaboration between different companies using total site analysis (TSA). Energy 36, 4609-4615.

Hackl, R., Harvey, S., 2014. Implementing energy efficiency measure in industrial clusters – A design approach for site-wide heat recovery systems, 17th Conference on Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction – PRES 2014. Accepted for presentation, Prague, Czech Republic.

- Theoretical energy saving potentitial: 120 MW (equals approx. 100% of heat produced in boilers based on purshased fuels)
- "Techno-economic" potential: 67 MW
- The investment consists of a common utility system and requires new/modified heat exchangers, heat, steam and fuel pipes







Well this all sounds good.. BUT...

- Compared to energy efficiency investments identified for single companies, similar investments identified for clusters hold an inherent complexity; they assume joint investments and/or multi-party collaboration
 - Require agreement on a common investment path including its intertemporal distribution
 - Complicating factors e.g. conflicting interests among the actors, lack of mandate, different risk appetite, access to funding and competing investments/other priorities

The complexity due to many participating companies and the demand for simultaneous action can be a significant barrier for implementation of joint investments in energy efficiency!







How to overcome these barriers?

- Use an evaluation method which structures the investment so it reduces the exposure to these kinds of complicating e.g. through...
 - reduction of the number of participating companies and/or
 - splitting the investment in several sequential "investment packages" that can be implemented stepwise according to their attractiveness at the time.







Regular evaluation/investment analysis methods are not enough! Especially not for a cluster-investment

- As stated in the key-note presentations Payback Period is not a suitable method for energy efficiency investments
- Net Present Value is a better method, yet not suitable for a joint investment
- Real Options Analysis (ROA) is a tool that can be used for helping managers to evaluate different investment options. However, previous research almost exclusively concerns single companies/ actors and not the increased complexity of joint investments







Real options analysis (ROA)

- Real Options Analysis (ROA) is a flexible method that can be used for evaluating long-term, complex investments which are influenced by different types of market uncertainties
- In the ROA framework, structuring of the investment and identification of options is an essential part
- ROA forces stakeholders to be explicit regarding assumptions and projections for the problem formulation
- A key feature of ROA is the ability to incorporate flexibility in order to handle different types of uncertainties
- Drawbacks of the method is that it is requires relatively advanced mathematics and that it is a problem specific tool
- ROA is not extensively used by the process industry sector or by the energy sector and has previously not been applied to analyze a joint investment in an industrial process cluster







Structure investment for common understanding and strategy formulation – example



Combined analysis of cluster energy efficiency investment – summary of paper example

 Shows how the previously identified retrofit solution(s) can be modified into "investment packages" distributed over time

=> allow for a "simpler" initial investment and permitting for an evaluation of both the cooperation and the market development before expanding the investment and the number of actors involved

- It is beneficial to make the initial investment and prepare the system for a later expansion. The natural gas price and the hurdle rate have the largest impact on the results.
- Including ROA broadens the stakeholder group and adds additional (strategic) aspects to the previously "one-dimensional, technical investment"
- The two companies involved in the base investment have decided to jointly proceed with the project making their own internal analysis using the ROA as a starting point







Suggestion: Combining TSA, retrofit and ROA gives added value



Reflections as an introduction for discussion

- We suggest that a combined approach based on TSA, retrofit analysis and ROA is suitable when evaluating a multi-party energy efficiency investment or energy efficiency investments in a cluster
- The combined approach can function as a "tool" for **common understanding and strategy formulation**
- Can propel the decision making process through a focus on the solutions/collaborations which are judged to be most beneficial from an economic and/or organizational point of view
- The results can also be used as a base when discussing how to divide the investment burden and the potential profit of the investment, something which is important to address to ensure progress in the investment process
- The potential of an external actor? One possibility could be for one company to take responsibility for the common utility system. This would reduce the complexities associated with the energy efficiency investment and allow for a more financial perspective.

Thank you for your attention, now it is time for discussion!

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