Towards the drivers of value creation in the biogas industry; enablers and inhibiters in the Netherlands

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Abstract

The Dutch biogas industry is developing slowly and in many instances still unviable. Insights in the drivers of value creation may help to create viable biogas business networks. This research explores these related drivers and accordingly, proposes a new and comprehensive definition of a driver of value creation. This definition focuses on the enabling and inhibiting factors of value creation in a business network and forms the backbone of three case studies. The results suggest the presence of four specific drivers as necessary for a viable biogas business network: stability and certainty, partner alignment, local opportunities and economies of scale.

Keywords: Drivers, Value, Biogas

Introduction

The need for renewable and non-polluting energy resources is causing the energy transition from fossil to renewable energy. Biogas can play an important role within this transition, and it is expected to replace approximately 10% of natural gas in the future in the Netherlands (Welink et al., 2007). However, despite biogas being a renewable energy source with beneficial balancing capabilities, the biogas industry is not developing rapidly and in many instances is the production of biogas still unviable (Rabobank, 2013). It is, however, unclear why the biogas industry is often unviable and not developing as expected. As a result, it is unclear how to transform the biogas industry into a viable, self-sufficient industry that creates value for all the stakeholders involved.

One of the main characteristics of viable businesses is that they should create sufficient value for all the stakeholders involved in the business network (Chesbrough et al., 2006). Therefore, it is crucial to understand the drivers of value creation (DOVC) within biogas business networks, because such drivers can explain the creation of value for the stakeholders involved. However, most research in the biogas industry focusses on technical aspects, and a literature review reveals that the DOVCs in the biogas industry have not been investigated

explicitly. Therefore, it is unclear how this industry creates value and which DOVCs affect this value creation. As a result, it is unclear how this industry should develop in order to become viable. This raises the following research question: "What are the main drivers of value creation in the Dutch biogas industry?"

The literature, however, lacks a clear and comprehensive definition of a DOVC. Some scholars mention DOVCs in the literature, such as Amit and Zott (2001) with respect to e-business, and Wubben et al. (2012) concerning biomass valorisation. Though Wubben et al. (2012) do not provide any definition and the conceptualisation of drivers by Amit and Zott (2001) is focusing only on factors that enhance the creation of value. However, practice shows that there are factors inhibiting value creation as well. It is important to consider these inhibiting factors, because they need to be transformed into factors enhancing value creation.

The contributions of this paper will be twofold. First, the paper presents a new and comprehensive definition of a DOVC, which focuses on the enabling and inhibiting factors of value creation in a multi-stakeholder business network. Secondly, the paper determines the DOVCs in the Dutch biogas industry. The results suggest the presence of four specific drivers as necessary for a viable biogas business network. These four drivers provide directions for improving existing biogas business cases and help to develop new biogas business models that are viable.

The remainder of the paper is structured as follows. Section 2 provides a short explanation of the main concepts used and Section 3 elaborates on our proposed definition of a DOVC. Subsequently, Section 4 illustrates the research methodology used. Section 5 provides the results and discussion, and finally the paper is concluded in Section 6.

Background information

The Dutch biogas industry is characterized as a networked industry with many different types of stakeholders involved and organized in a decentralised manner (i.e., production and consumption is spread all across The Netherlands). The latter is in contrast with the traditional natural gas industry, which has a centralized character. These stakeholders of the biogas industry can be categorised into two distinct groups: commercial stakeholders (e.g. biogas producer, biomass trader, energy retailers, and consumers), and non-commercial stakeholders (e.g. governmental bodies, inspection agencies, and regulators). Together these, often interdependent, stakeholders form business networks in which they have to cooperate with each other in order to create value and pursue their interest. However, these interests are often different (e.g. generating profit, reducing CO2 emissions, or securing safe and reliable transport of energy) and sometimes competing, making cooperation hard.

Value creation concepts

To understand value creation and investigate DOVCs, it is important to define the related concepts. Hence, this section elaborates on the concepts of value, value creation and value creation analysis.

The concept of value

According to Bowman and Ambrosini (2000), value comprises two components: *use value* and *exchange value*. Use value stands for the specific quality or usefulness of a job, task, product, or service as perceived by users in relation to their needs (Lepak, Smith and Taylor, 2007; Bowman and Ambrosini, 2000). Exchange value stands for the monetary amount received when the job, task, product, or service is sold or exchanged. It is the amount paid by the buyer to the seller for the perceived use value supplied (Bowman and Ambrosini, 2000).

Inherent in this conceptualisation is the interaction between two stakeholders. In addition, a stakeholder supplying use value has to perform value-creating activities with his specific

resources and capabilities to transform procured use value into new use value for subsequent value exchanges (Bowman and Ambrosini, 2000; Lado and Wilson, 1994; Pfeffer, 1995). In the end, value is created when the exchange results in a more beneficial situation for both stakeholders involved. By doing so, the monetary exchange value must exceed the producer's costs of creating this use value (Lepak, Smith, and Taylor, 2007). In addition, a distinction is needed between value creation and value capturing, recognizing that the stakeholders involved in a value creation process are not necessarily the only ones capturing the created value (Lepak, Smith, and Taylor, 2007). A society benefitting from sustainable energy production and consumption clearly illustrates this since the society is not involved in the actual value-creating process between a producer and consumer, but gains the benefits of CO2 reduction.

Value creation analysis

A value creation analysis is necessary to determine the DOVCs of a specific business network. Value creation is described by different theories (Table 1). These theories have different perspectives and their own units of analysis, posited as sources of value creation, and it is argued that value creation cannot be fully explained by such a single theory in isolation (Amit and Zott, 2001). Hence, in order to truly understand the value creation in a specific business network, it is proposed to integrate these sources of value creation and their units of analysis into a holistic and comprehensive study (Amit and Zott, 2001; D'Souza et al., 2014).

Table 1 – Theories with related source of value creation and level of analysis (Amit and Zott, 2001)

Theory	**Source of value creation**	**Level of analysis**
Value chain framework (e.g. Porter, 1985)	Value-creating activities	Stakeholder level
Resource based view (RBV) (e.g. Barney, 1991)	Resources and capabilities	Stakeholder level
Transaction cost economics (TCE) (e.g. Williamson, 1981)	Transactions (value exchange relationships)	Dyadic level
Inter-firm value networks (e.g. Moore, 1996)	Business network	Network level

Drivers of value creation

To understand and investigate DOVCs, it is important to define this concept clearly. Hence, this section elaborates on the definitions of a DOVC found in the literature and the new definition proposed and applied in this research.

Drivers of value creation in the literature

Amit and Zott (2001) propose four interrelated DOVCs in e-business: lock-in, novelty, efficiency, and complementarities. Wubben et al. (2012) further propose partner alignment, complementary resources, and governance of relationship as drivers of biomass valorisation. Some overlap exists between these two sets of value drivers, since both mention complementarities as a DOVC.

Wubben et al. (2012) do not provide a definition of the term DOVC, making the comparison with others hard. Amit and Zott (2001) state that the term value driver refers to 'any factor that enhances the total value created by an e-business', focussing on factors enhancing value creation only. However, practice shows that certain factors clearly inhibit value creation as well. This is important, because the factors that inhibit value creation should be mitigated or transformed into factors that enable value creation. Doing so will lead to the viability of the biogas industry. Accordingly, there is a need for a comprehensive definition of a DOVC.

Extending the notion of a driver of value creation

To address the above-mentioned gap, a DOVC is here defined as a factor that enables or inhibits value creation in a business network. More specific, a factor is classified as a driver if evidence can be found that the presence of that factor enables value creation, and the absence of the same factor inhibits value creation (see Figure 1). A good example is the factor local opportunity; some biogas producers may have the local opportunity to exploit heat due to a greenhouse in close proximity, while other producers may lack this local opportunity. A situation in which this factor is present clearly enables value creation, and a situation in which it is absent clearly inhibits value creation, since not all the potential value can be created and captured. Hence, this factor will be denoted as a DOVC.

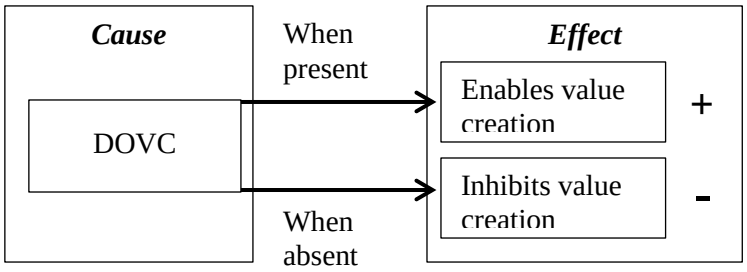

Figure 1 – Definition of a DOVC; when present, it enables value creation, when absent, it inhibits value creation

There is a clear link with the above-mentioned sources of value creation. When present, a DOVC triggers a source of value creation and stimulates the value-creating process. When absent, a DOVC hinders or even prevents a source of value creation to start the value-creating process. Hence, a DOVC is an essential dimension in the value-creating process. The absence of a local opportunity for heat consumption for example constrains the transactions to be made that create related values. However, when such a local opportunity is present, transactions creating the values can be made (Figure 2 schematically visualizes this). Unlike sources of value creation, DOVCs are domain specific. Therefore, it makes sense to investigate them for specific businesses as in this study the biogas industry.

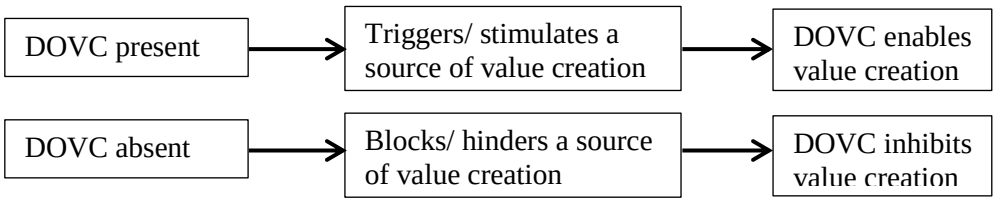

Figure 2 – Visualization how the presence or absence of a DOVC affects a source of value creation and in turn enables or inhibits value creation

Research methodology and data

A lack of theory concerning DOVCs in relevant industries emphasizes the need for explorative case study research. Case studies are not sufficient to support or reject a theory (Blumberg et al., 2005). Nevertheless, it is a useful approach to explore topics still under-investigated. It can assess theories well (Gummesson, 2000), and it can help to develop hypotheses (Flyvbjerg, 2006), which is the objective of this research.

In order to generalize and gain a better understanding of the DOVCs in the biogas industry, we have chosen three different cases for analysis to offer sufficient variation but simultaneously keep the research manageable. (1) The first case is a dairy farm with a bio-digester. This is still the most common instance of a biogas production installation, although

this number is diminishing. The farmer produces biogas, digestate, heat, and electricity out of animal manure and biomass. (2) The second case is an industrial food processor, producing large quantities of green gas (biogas upgraded to natural gas quality) and digestate out of waste streams yielded from the main production process. We observed a growing trend toward such installations. (3) The third case is a network of biogas producers, processors, and consumers connected by a private dedicated biogas grid. This is a more complex and unique case in the Netherlands, and very different to the other two cases.

Data collection and deriving the DOVCs

We carried out 27 in-depth interviews with domain experts and stakeholders of the cases studied. The interviewees include biogas producers, distribution system operators, energy retailers, equipment suppliers, local and regional governments, regulators, researchers, network/ interest organisations, and consulting firms. Interviews were carried out using a semi-structured questionnaire focussing on the several units of analysis of the theories presented in Table 1. All interviews lasted between 45 min. and 2.5 hours and were carried out in a period of four months. Eventually, a validation meeting was held about processed data and preliminary conclusions with 10 persons, five of them interviewees.

The raw interview data is transcribed and subsequently transformed into tables and models that illustrate the different units of analysis and their sources of value creation as described by Amit and Zott (2001). The tables summarize the value-added activities, resources, capabilities and main interests of stakeholders and the models visualize the business network of stakeholders with their transactions and interdependencies. This is subsequently used as input for the cause-and-effect analysis to derive the DOVCs, as shown in Figure 3.

Using a cause-and-effect analysis, we determine which factors affect value creation. When the stakeholders create value, the responsible factors are determined. This same process is performed when certain stakeholders are not able to create the intended values, resulting in different factors that affect this lack of value creation. As a last step, it is determined which of these factors meet the classification of a DOVC, as stated in Section 3.

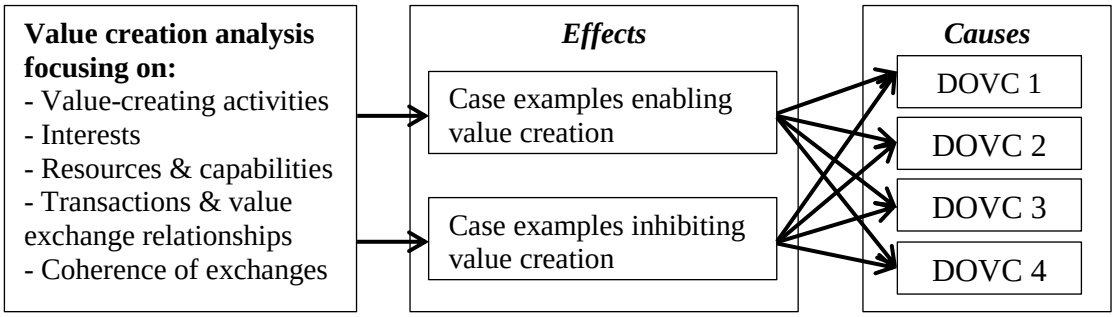

Figure 3 – Process of deriving the DOVCs; the DOVCs as causes are derived of the effects found in the value creation analysis

Results and discussion

The analysis has led to six factors of which four meet the classification of a DOVC as denoted above and two are not classified as a DOVC. Table 2 shows that of those four DOVCs, every single driver is present in all three cases. Every single DOVC fulfils an enabling and inhibiting role. Furthermore, enablers and inhibitors are found in all three cases. In addition, we found that the DOVCs can be both present as an enabler and as an inhibiter in a single case, for example with partner alignment in Case 1. These findings lead to the following conjecture: *Stability and certainty, partner alignment, local opportunities and economies of scale are necessary DOVCs to develop a viable biogas business network.*

Table 2 – Overview stating which DOVC enables (En.) and inhibits (In.) value creation in a case

	Case 1		Case 2		Case 3		**Over all cases**	
DOVC:	En.	In.	En.	In.	En.	In.	**En.**	**In.**
1. Partner alignment	x	x	x	x	x		**x**	**x**
2. Local opportunities		x	x		x		**x**	**x**
3. Economies of scale		x	x		x		**x**	**x**
4. Stability and certainty	x	x	x	x	x	x	**x**	**x**

The remainder of this section presents the empirical findings supporting the conjecture and elaborates on the DOVCs individually.

Partner alignment

The need for long-term, intensive cooperation between stakeholders in the biogas industry, often with conflicting interests, explains the need for partner alignment. Partner alignment is defined as the degree to which collaborating stakeholders are aligned with each other and can be realized in terms of strategy, technology, and relationships (Emden et al., 2006).

The relational view, a theory developed by Dyer and Singh (1998), provides a link with partner alignment. This theory uses dyads of firms as the unit of analysis to explain *relational rents*, which is defined as 'a profit jointly generated in an exchange relationship that can only be created through the joint idiosyncratic contributions of the specific alliance partners' (Dyer and Singh, 1998). In this theory, different sources of relational rents are proposed (i.e., knowledge-sharing routines, relation specific assets, complementary resources, and effective governance). Wubben et al. (2012) add partner alignment to this list as a source of relational rents for biomass valorisation, which actually has a strong link with biogas valorisation. In addition, a relation can be made with *lock-in*, a driver found by Amit and Zott (2001), since the realization of partner alignment needs some investments and efforts. This prevents cooperating with others, since this incurs such investments and efforts again. As a result, stakeholders engage in repeat transactions, which is the core of a lock-in as described by Amit and Zott (2001).

Partner alignment mainly affects the establishment and efficiency of transactions between stakeholders. As a result, this DOVC has mainly a link with value exchange relationships and the coherence of exchanges as a source of value creation, explained by transaction cost economics and inter-firm value network theory.

Table 3 – Empirical findings supporting partner alignment

Partner alignment enhancing value creation:	**Found in:**
• Clear standards and regulations enable the cooperation between the DSO and biogas producer who initially had conflicting interests. This helped to align both stakeholders on a technical level, making value creation possible.	Case 1
• Due to an immature market a stable demand and supply of green gas (GG) is not around. A shared vision of cooperation and alignment on the strategic level between the GG producer, consumer, and energy retailer created a fruitful and beneficial cooperation, making biogas production and consumption possible.	Case 2
• The separation of biogas production and biogas processing results in high dependencies and intensive cooperation. The biogas producer needs a processor in order sell his gas, and a processor needs the producer to supply biogas. These stakeholders need to be aligned at the technical, strategic, and relationship level due to their close nature of cooperation and mutual dependency.	Case 3

Lack of partner alignment inhibiting value creation:	Found in:
• Due to scarcity plays the biomass trader a dominant role in biomass allocation. Biogas producers are highly dependent on a biomass trader for their input, but this is not vice versa. Both stakeholders are not aligned with each other on a strategic level, making cooperation hard for biogas producers.	Case 1
• Power from biogas faces competition from wind and solar, which is often cheaper. This makes power generated by small-scale biogas producers less attractive for energy retailers. However, the biogas producers are dependent on them to sell their power but are not able to enforce a competitive price. This lack of partner alignment on the strategic level makes it hard to create sufficient value.	Case 1
• The GG producer and DSO have conflicting interest (i.e., a purely financial interest and an interest focused on safety and security). However, the GG producer needs the DSO to sell his GG. Since both stakeholders are not aligned on the strategic and technical level, cooperation is difficult and inefficient for the GG producer.	Case 2

Local opportunities

Due to geographic restrictions regarding biogas production and valorisation, a stakeholders' local environment plays an important role. Immobility of production assets, low value density of used input and produced output, and potential nuisance mainly cause this. Local opportunities support stakeholders' value creation potential by utilizing case specific opportunities the direct local environment offers.

The root cause of this driver is mainly the localization of assets with respect to a trade-off in transportation costs of raw materials and finished goods, and the appropriateness of the location concerning nuisance. This affects the optimal location of production installations and hence, can be seen as an operational research problem. A link can be found here with site specificity (Williamson, 1985), which refers to the situation in which immobile, subsequent production stages of different stakeholders are located closely to each other in order to reduce inventory, transportation and coordinating costs (Dyer, 1996a).

Local opportunities mainly affect the value-creating activities of stakeholders, stakeholders' unique resources, and the efficiency of transactions as sources of value creation. The local environment with their opportunities determines namely which specific activities and transactions will be executed, and how efficient these transactions are in order to create value. In addition, a unique local opportunity can be seen as a specific resource, providing a competitive advantage over others.

Table 4 – Empirical findings supporting local opportunities

Local opportunities enhancing value creation:	Found in:
• A grid with sufficient capacity is nearby the production location enabling GG injection.	Case 2
• Production and processing of biogas are separated. Hence, both types of processes can be done on their most suitable place.	Case 3
Lack of local opportunities inhibiting value creation:	**Found in:**
• The remote location of biogas production and processing offers no opportunities to sell produced heat, wasting a potential valuable product.	Case 1

Economies of scale

In general, economies of scale are the economic advantages realized by operating on a larger scale. In the biogas industry, different dimensions have been found in which economies of scale affect value creation. First, it is found that economies of scale reduce the costs per unit, often due to the realization of more efficient operations. Besides, economies of scale allow to

insource specific resources and capabilities. This lessens interactions and transactions and hence, dependencies with other stakeholders resulting in a higher efficiency of transactions. In addition, economies of scale justify investments that are more expensive. This generates additional possibilities of value creation (e.g., economies of scale can justify a small biogas producer, formerly limited to electrification only, to invest in GG production assets).

Resulting from this it can be concluded that economies of scale as a DOVC mainly affects the resources and capabilities of stakeholders, their value-creating activities, and performed transactions as sources of value creation.

Table 5 – Empirical findings supporting economies of scale

Economies of scale enhancing value creation:	**Found in:**
• High production rates create economies of scale, making GG production and injection possible.	Case 2, 3
• Economies of scale allow to insource key resources. This results in fewer interactions with other stakeholders creating a less dependent and more efficient business case.	Case 2
Lack of economies of scale inhibiting value creation:	**Found in:**
• A lack of economies of scale forces to outsource key resources resulting in many interactions with other stakeholders. This results in a dependent business case, which is vulnerable and less efficient.	Case 1
• A lack of economies of scale does not justify expensive investments such as GG injection installations. Hence, small-scale biogas producers have limited alternatives to create valuable products.	Case 1

Stability and certainty

The degree of stability and certainty affects the value-creating potential in the biogas industry. Stability and certainty can be found in different aspects such as prices (e.g. biomass, electricity, GG, GG certificates, transportation of power & gas), supply of goods (e.g. biomass, electricity, GG), demand for goods (e.g. biomass, electricity, GG, manure), and policy/ governance issues (e.g. regulations, agreements on injection requirements). Since low margin commodity products play a dominant role in the biogas industry, efficiency is of great importance. In addition, the biogas industry is characterized by capital intensive assets and intensive cooperation. As a result, the degree of stability and certainty, in whatever form, can have a severe impact since this affects the efficiency of operations and transactions, influences the cooperation, and affects the willingness to invest in expensive assets. If stability and certainty is secured, stakeholders can improve their value-creating activities and collaborations and work more efficiently instead of putting effort into the adaption to new situations. This creates higher value by means of the actions and transactions performed. In addition, stakeholders know what to expect and hence, are more eager to invest.

As a result, stability and certainty affects the following sources of value creation: the value-creating activities, performed transactions and value exchange relationships, and the coherence of exchanges. This can be explained by the value chain logic, transaction cost economics, and inter-firm value network theories, respectively. Uncertainty is one dimension to describe transaction costs (Williamson, 2005), explaining the extent to which transactions are subject to disturbances that can hinder the transaction and hence, the creation of value (Schneider et al., 2013). Stability and certainty concerning for example demand, policies, or agreements can influence the realization and execution of transactions. This can subsequently affect the efficiency of internal operations providing a link with the value chain theory. In a business network, it should be realized that instability and uncertainty at one stakeholder will subsequently affect others, due to all kind of relations and interdependencies. Hence, this will affect the performance of many other stakeholders' value-creating processes.

Table 6 – Empirical findings supporting stability and certainty

Stability and certainty enhancing value creation:	**Found in:**
• Clear standards and regulation of injection requirements create certainty.	Case 1
• Long-term stable demand for green electricity creates certainty and stability for energy retailers and producers to develop a business case.	Case 1
• Own biomass possession by the biogas producer ensures a stable and secure supply for biogas production, which is in contrast to Case 1.	Case 2, 3
• Cooperation and agreements between the GG producer, energy retailer, and consumer of GG creates sufficient stability and certainty of demand and supply to develop a business case in a rather immature market.	Case 2
Lack of stability and certainty inhibiting value creation:	**Found in:**
• Changing GG injection requirements affects operational and transactional processes incurring cost and decreases trust.	Case 2
• Changing policies concerning biomass requirements and subsidy provision.	Case 1, 2, 3

Conclusion

This paper researches the value creation and its related DOVCs of the Dutch biogas industry. It is important to understand these DOVCs, because such drivers can provide directions for improvement. This is necessary, since the production of biogas is in many cases still unviable and the industry is developing slowly. Hence, the challenge is set to transform this industry into a viable, self-sufficient industry that creates value for all the stakeholders involved.

Since the literature lacks a clear and comprehensive definition of a DOVC, a new and comprehensive definition is proposed. This focusses on the enabling and inhibiting factors of value creation in a multi-stakeholder business network. This definition is used as the backbone for the analysis of three different cases in the Dutch biogas industry. A lack of relevant previous studies forced us to apply such an explorative and qualitative research strategy. Data is gathered by interviewing a large and varied number of stakeholders active in the cases, and domain experts with a thorough knowledge of the industry in general. The results suggest the presence of stability and certainty, partner alignment, local opportunities and economies of scale as necessary DOVCs for a viable biogas business network. Hence, these four drivers provide directions for improving existing biogas business cases, and help to develop new biogas business models that are viable. As a result, the contributions of this paper are twofold. First, it provides a new definition of a DOVC, and secondly, it sheds light on the DOVCs in the Dutch biogas industry.

Performing this research has raised new questions and provides directions for further research. Further research has to be done to underpin the results obtained more thoroughly. Similar types of cases as studied in this research can therefore be used. However, other types of cases such as wastewater treatment plants, or waste collectors producing biogas are recommended as well. In addition, it can be interesting to adopt a more quantitative approach. Such an analysis can reveal more in-depth insights into the value creation, and concludes with a better quantitative substantiation about created values, the viability of a network, and a relation between DOVCs and specific created values.

Acknowledgements

This research has been financed by a grant of the Energy Delta Gas Research (EDGaR) program. EDGaR is co-financed by the Northern Netherlands Provinces, the European Fund for Regional Development, the Ministry of Economic Affairs, Agriculture and Innovation and the Province of Groningen.

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