German Federal Environment Agency, Dessau-Rosslau

Chemical Leasing as a model for sustainable development with test procedures and quality criteria on the basis of pilot projects in Germany

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Contents

1 Summary

Chemical Leasing is an innovative business model in which payments are no longer based on the amount of chemicals consumed, but on the function performed for the user (e.g. a certain area cleaned to a certain standard). This means that the consumption of chemicals becomes a cost factor for the producer rather than being a revenue factor. As a result, the producer has an economic interest in reducing the consumption of chemical products by means of process optimisation. The consequence is closer cooperation between the producer and the user of the chemicals. This offers economic benefits for both partners, and in particular, as a result of the lower consumption of chemicals it can lead to resource conservation, energy savings, a reduction in the environmental impact, and avoidance/reduction of risks arising from the use of chemicals.

In the research project of the German Federal Environment Agency, quality criteria were developed on the basis of eight pilot projects with the goal of ensuring high standards for the business model with respect to environmental and health aspects. The following quality criteria were developed:

a) Steady improvements concerning the environmental and health-related impacts caused by chemicals and the use of associated machines and equipment

b) Improved handling of chemicals in terms of risk avoidance/reduction

c) Avoidance of substitution by higher-risk substances

d) Improved energy efficiency relating to the use of chemicals

e) Transparent risk distribution and sharing of economic improvements between the contractual partners

f) Monitoring improvements in terms of the above-mentioned criteria

These quality criteria for the research project were discussed by a working group and are currently being tested by the United Nations Industrial Development Organisation (UNIDO) prior to adoption. The results of the application in international pilot projects are published in the annual reports issued by UNIDO on its Chemical Leasing activities. It is to be expected that the ongoing international case studies will be evaluated in the annual reports for 2010 and 2011.

In addition, the quality assurance criteria were elaborated with regard to possible public support for Chemical Leasing and a goal-oriented communication and smooth cooperation between the participants.

In addition to the development of quality assurance criteria, the pilot projects were used to analyse factors which obstruct or promote the successful implementation of Chemical Leasing. Furthermore, recommendations were made for incentives and suitable communications measures for the dissemination of the business model.

The pilot projects cover various manufacturing sectors, and address the topics of substitution and also the use of new, innovative technologies in combination with Chemical Leasing. The projects were chosen in order to reflect typical constellations of producers and users of chemicals, involving multi-level processes and the participation of various companies:

- *Pilot project 1: Cleaning pipes and containers in the food and pharmaceutical industries*
- *Pilot project 2: Use of PVC for automotive underbody coating*
- *Pilot project 3: Production, further-processing and use of catalysts*
- *Pilot project 4: Cleaning, pre-treatment, and coating of metal surfaces*
- *Pilot project 5: Use of abrasives in the metal industry*
- *Pilot project 6: Glass bonding using sealant tape*
- *Pilot project 7: Coating aluminium sheet for beverage can lids*
- *Pilot project 8: The use of pesticides in agriculture in agriculture*

In addition, in this report a ninth pilot project[1] (Use of Disinfectants in clinics and hospitals) is considered in terms of the quality criteria developed for it.

The project was presented at various international events as a German contribution to sustainable chemicals' management. In the course of national workshops and information events, possible contributions of Chemical Leasing as a sustainable business model were presented and the experience gained in the pilot projects was discussed.

The experience gained in the research project shows that initial euphoria and high expectations do not necessarily guarantee a successful end and that it will be essential in the coming years to carry on analysing constraints as they emerge and develop ways of overcoming these.

Various activities initiated within the framework of this research project will be continued further. It is expected that the Chemical Leasing business model will spread rapidly in the coming years and will contribute to improvements in the fields of health and the environment while at the same time helping to make the participating companies more competitive.

[1] This project was initiated by the *Deutsche Umweltstiftung*.

2 Background and objectives

The Chemical Leasing concept

Chemical Leasing is an innovative business model in which payments are no longer based on the amount of chemicals consumed, but on the function performed for the user (e.g. a certain area cleaned to a certain standard). This means that the consumption of chemicals becomes a cost factor for the producer rather than being a revenue factor. As a result, the producer has an economic interest in reducing the consumption of chemical products by means of process optimisation. The consequence is closer cooperation between the producer and the user of the chemicals. This offers economic benefits for both partners, and in particular, as a result of the lower consumption of chemicals, it can lead to resource conservation, energy savings, a reduction in the environmental impact, and avoidance/reduction of risks arising from the use of chemicals. Figure 1 shows how the service-oriented Chemical Leasing business model establishes a shared interest for the producers and suppliers of chemicals and their customers – the less the better.

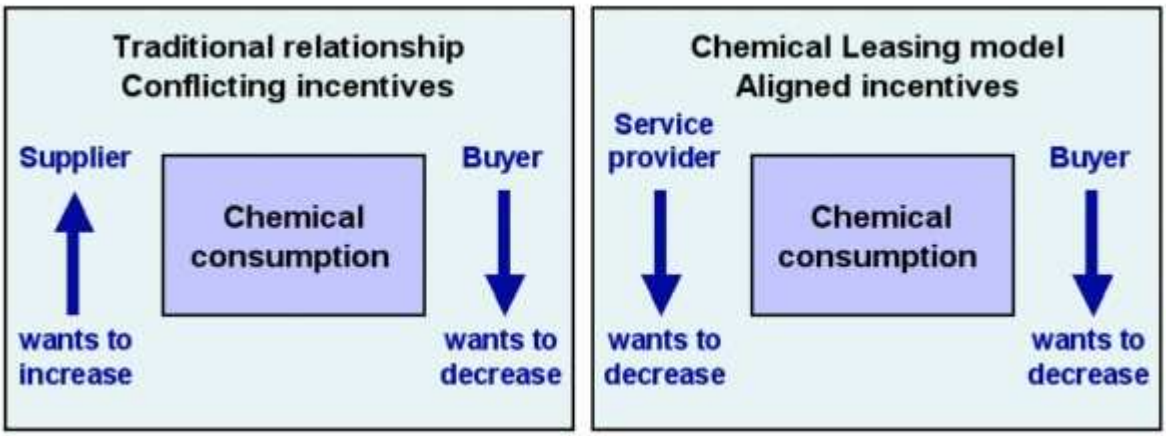

Figure 1: Chemical Leasing models produce common interests

The historical development of Chemical Leasing

Chemical Leasing has already been used by individual companies in various forms for many years. However, it has not established itself in any systematic fashion in industrial processes or sectors, nor has it received broad publicity or been the subject of scientific discourse. In 2002, the Austrian Environment Ministry launched an initiative to systematically present the economic aspects together with the environmental advantages. Pilot projects were successfully initiated and promoted and the term “Chemical Leasing” was established as a brand name. The Austrian initiative was adopted by UNIDO in 2004 and implemented in various sectors in three pilot countries (Egypt, Mexico, and Russia). By targeted publicity and further successful examples, Chemical Leasing was established as a promising activity within the framework of the Strategic Approach to International Chemicals' Management (SAICM). Colombia, Serbia, Sri Lanka and Morocco were included as pilot countries. The participants and interested institutions met regularly to discuss their experience, and

representatives of the German Federal Environment Agency also took part. Germany has now also started a Chemical Leasing initiative, and key parts of this are reflected in this report.

Relevant environmental problems

In all the cases where Chemical Leasing has been successfully applied it has been possible to achieve improvements for the environment and for human health because the consumption of chemicals is reduced and their handling is improved. The improvements affect:

a) Reduced quantities of waste

b) Reduced water pollution with chemicals

c) Reduced air pollution

d) Reduced exposure to chemicals at the workplace

e) Avoidance/reduction of risks from handling chemicals

Examples and further possibilities for promoting Chemical Leasing

As explained, Chemical Leasing offers economic benefits for all the parties involved. However, it has been found that the business model is not always an automatic success, firstly because the potential partners may lack knowledge and experience, and secondly because there are various potential constraining factors. It is therefore essential for the broader dissemination of the business model and the realisation of the environmental advantages that the feasibility is demonstrated by means of suitable case examples and that appropriate experience reports are available. Other ways in which Chemical Leasing can be promoted include the provision of incentives, which can be relevant with respect to the development of innovative applied technologies for reducing the amounts of chemicals used.

Quality criteria

Quality criteria are intended to help to establish a high standard for Chemical Leasing. It should be noted that quality criteria in general are not intended to establish binding rules for Chemical Leasing, but rather to contribute to the smooth functioning of the business model. Quality criteria are therefore seen as offering support for the participants in order to achieve a high standard for various dimensions of the “Chemical Leasing” business model.

A high standard is important for the following sectors:

a) Specific environmental improvements

b) Specific economic improvements

c) Efficient deployment of public funds

d) Targeted communications to promote Chemical Leasing

e) Efficient and smooth cooperation between the parties involved

Objective of the research project

Against the background outlined above, the objective of the project is the development of quality criteria for Chemical Leasing with an emphasis on the protection of human health and the environment. Specific and practicable criteria are to be presented and proposals made on ways to anchor these in Chemical Leasing business models. Model Chemical Leasing projects are to serve as a basis on which to derive quality criteria. The model projects are also taken as examples for the discussion of suitable incentives and communications strategies for the further dissemination of this business model.

3 Status quo of Chemical Leasing in Germany

3.1 Comparing Chemical Leasing and other business models

Key statements

1) *Chemical Leasing is a service-oriented business model*

2) *Comparable business models are: Leasing, Chemical Management Services, Outsourcing, Pay-on-Production, Contracting, Single Source Supply, and Cost per Unit*

3) *All these models focus on the benefits and associated services provided, rather than on the transfer of ownership of an object*

4) *The main differences between the models concern which processes are optimised and how*

As explained in the previous sections, “Chemical Leasing” is a business model in which the use-oriented payment of chemicals replaces the classic payment for a quantity of chemicals. The core of the business model is that it will be in the economic interest of both the user and the producers of chemicals to reduce the consumption of chemicals. In addition to this core component, Chemical Leasing also includes other elements such as improved handling, continuous process optimisation, etc. These principles were described by UNIDO together with the international Chemical Leasing working group in the following definition:

> *Chemical Leasing is a service-oriented business model that shifts the focus from increasing sales volume of chemicals towards a value-added approach.*
>
> *The producer mainly sells the functions performed by the chemical and functional units are the main basis for payment.*
>
> *Within Chemical Leasing business models the responsibility of the producer and service provider is extended and may include the management of the entire life cycle.*
>
> *Chemical Leasing strives for a win-win situation and aims at increasing the efficient use of chemicals while reducing the risks of chemicals and protecting human health. It improves the economic and environmental performance of participating companies and enhances their access to new markets.*
>
> *Key elements of successful Chemical Leasing business models are proper benefit sharing, high quality standards and mutual trust between participating companies.*

Overview of service-oriented business models

Chemical Leasing can be classified as a service-oriented business model. Figure 2 identifies the most important service-oriented business models and offers an overview of their common features and differences. In the following, Chemical Leasing is compared with the other business models and the differences are discussed in more detail.

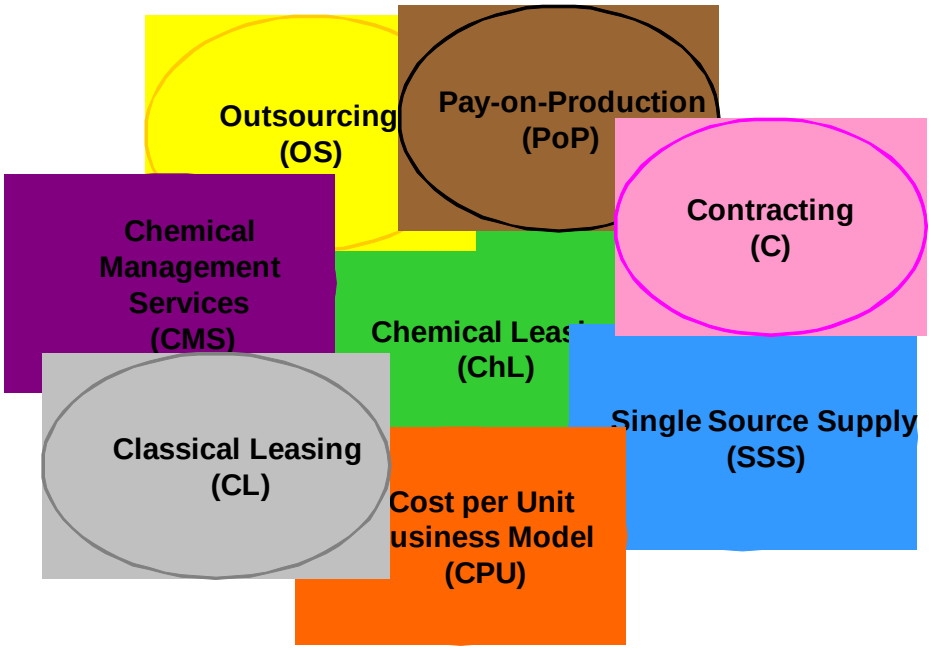

Figure 2: Service-oriented business models with similarities to Chemical Leasing

Leasing

Leasing in its original form covered the transfer of the use of land or property for a limited period in return for regular payments, and was later used by analogy to apply to other assets or services. Leasing in recent decades has been developed as a new financing model which allows companies to obtain immediate use of plant, property or equipment in exchange for regular payments to the Lessor over a period of time. Leasing can take a variety of contractual forms, differing with respect to the Lessor, leasing object, or the form of payment (cf. Bögli 1984 p. 8f., Gabele and Kroll 1992 p. 16f.).

A common feature of such leasing contracts is "[…] that the owner of a good, the Lessor, undertakes to allow the Lessee full use of the good for a specified period of time against periodic payments, the so-called leasing rates" (Bitz 2000). Basically, the Lessee acquires the right to use a good but not the actual ownership of it. But instead of having to pay the full price up-front, it is only necessary to pay regular (monthly) leasing instalments. This is in accordance with the idea that a customer is interested in using something (e.g. a car) rather than in owning it.

In most forms of leasing, e.g. financing leasing, the object risks and maintenance costs are borne by the Lessee. This transfer of duties and obligations from the owner is the main difference to the "traditional" forms of renting (Feinen 1990). In the case of Chemical Leasing, in contrast, the range of responsibility of the Lessor is extended to include new tasks in *supply chain management*, training customer personnel, or recycling of residual materials. By means of this intensification of the cooperation, Chemical Leasing offers the

possibility for longer-term business relationships and additional opportunities to take on work for new customers.

Classic leasing differs from Chemical Leasing in particular in that the former does not include process optimisation or more intensive cooperation with exchange of expertise between the contract partners, all of which are typical for Chemical Leasing. A further important difference is that classic leasing does not involve a transfer of ownership, whereas this may sometimes be the case with Chemical Leasing.

Chemical Management Services

Chemical Management Services (CMS) is a *Business-to-Business* model with many parallels to the Chemical Leasing model. A long-term strategic business relationship between a provider of management services (not necessarily the producer of chemicals) and the user of these chemicals is intended to reduce the life-cycle costs and risks, and also the environmental impact (Oldham and Votta 2003). The focus of CMS lies on the services which are related to the chemicals, based mainly on the management of chemicals for a user with respect to purchase, delivery, storage, recycling, disposal, monitoring of emissions, risk management, and quality measurements. Like Chemical Leasing, CMS has the goal of breaking up volume-oriented sales incentives by disconnecting the amount of chemical sold and the profitability (Reiskin et al. 2000). Both CMS and Chemical Leasing align the interests of the chemicals provider and user – towards a “less is more” approach.

The service offered can involve the more efficient use of chemicals and process optimisation, but this is not necessarily an element of CMS (Oldham and Votta 2003). In contrast, Chemical Leasing always aims to increase the efficiency of chemicals (benefit by amount). CMS can cover a range of services, which can include Chemical Leasing but does not necessarily do so. The focus of Chemical Leasing is always on process optimisation, and further services can be offered optionally, as a rule by the chemical producer, and only in exceptional cases by a third party.

Outsourcing

Large companies at the end of the 1950s would typically have many auxiliary subsidiaries operating very uneconomically and at far above usual market prices. Such companies gradually began to contract out functions and services and separated themselves from the inefficient in-house operations and subsidiaries, in a process which eventually became known as *outsourcing* (Köhler-Frost 1995). There are various forms of outsourcing, which can differ according to their form and scope, functionality and organisational structure (Eschlbeck 2009). Outsourcing transfers the process responsibility to a third party. Contracting out in this way can counteract extreme fixed cost pressures and can also allow a company to concentrate on its main business activity. This focus on core competence is a component which is also offered by Chemical Leasing.

The contracting out of critical functions in the production process, such as the use of chemicals in a manufacturing company, involves a strategic content which goes beyond the traditional understanding of *outsourcing*. Chemical Leasing (like *chemical management*

services) is distinguished from *outsourcing* by a shift of focus away from a physical product output towards a service-based, functionality-oriented partnership (Reiskin et al. 2000).

With *outsourcing* the production is usually relocated. Depending on the location of the new place of production this may be referred to as *onshoring*, *nearshoring* or *offshoring*. However, most *outsourcing* activities do not offer any process optimisation as a result of more intensive cooperation between the producer of chemicals and the user. A producer of chemicals would as a rule not agree to take on the entire production process of the user. However, Chemical Leasing aims at achieving an optimised division of responsibility for the process between producer and user. Chemical Leasing usually takes place at the original production site and significant support is provided by the chemicals' producer with application expertise.

Pay-on-Production

Pay-on-Production (PoP) refers to an operator model for manufacturing plant and equipment, and brings together as contract partners the plant manufacturer and the user of the plant. This business model is found in particular in the automotive industry (Decker and Paesler 2004). The plant manufacturer finances, plans, builds, operates, and maintains the plant at the user's factory. In contrast to Chemical Leasing, where the payment is based on the function of the chemical, with the PoP approach the payment is based on the output of the production plant (e.g. the number of assembled cars). The producer of chemicals is not necessarily involved in this business model. Plant and machinery remain the property of the plant manufacturer, who can initiate process optimisation through an exchange of expertise. In the case of Chemical Leasing, the producer of the chemicals often retains ownership of them, and in contrast to the PoP model remains a mandatory business partner. Some Chemical Leasing models also include the plant manufacturer as a partner and in this way extend the scope for comprehensive process optimisation.

Contracting

The *contracting* business model is mostly used in the facility management sector, e.g. for central heating, refrigeration, lifts and escalators, lighting and ventilation. It brings together the operator of plant and equipment and the user. The plant and equipment operator supplies the deliverables (heating, power, steam, etc.) and also plans, finances and operates the relevant plant and equipment over a fixed period. *Contracting* agreements make it possible, for example, for the user to benefit from modern energy-efficient technologies without having to meet the very high investment costs which may be involved (Reisz 2002). The supplier in turn can benefit from long-term supply contracts.

Due to the differences between the parties involved it is not possible to compare this business model directly with Chemical Leasing, which necessarily involves a production company. However, there are analogies in the distribution of financial savings: In the case of *contracting*, by way of an example, savings from reduced energy costs are shared between the operator of the plant and equipment and the user; in Chemical Leasing, the user of the chemicals usually operates the plant, and the producer of the chemicals and the user share the financial benefits of reduced consumption. As with Chemical Leasing, the focus in *contracting* is also on process optimisation. Because the responsibility for maintenance and

repairs can be assumed by the provider of the plant and equipment, contracting can also be classed as a service-oriented business model.

Single Source Supply

With the *Single Source Supply* model, the operator purchases the product (e.g. a car chassis) and with a view to process optimisation then processes this with chemicals (e.g. paint) before selling it back to the user. In the case of Chemical Leasing, in contrast, the user always retains ownership of the product.

Single Sourcing: The cooperation with a supplier becomes so intensive that this is used practically like a department of the company and receives additional assignments, such as research and development tasks. Contracts usually contain provisions relating to delivery but also concerning quality (Niebling 2006).

Cost per unit

Cost per unit business models are very similar to Chemical Leasing for practical purposes, but they do not usually involve additional services, e.g. recycling the chemical, counselling about optimum disposal, management of safety data sheets, training for the user's personnel, etc. In the case of Chemical Leasing these are (intended) side-effects of more intensive cooperation.

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3.2 REACH and Chemical Leasing

Key statements

1) *REACH is a European Regulation leading to legal obligations, whereas Chemical Leasing is a voluntary business model.*

2) *The successful implementation of both Chemical Leasing and REACH requires as a precondition an intensive exchange of information between the partners involved along the value-creation chain. Companies using Chemical Leasing as a business model can achieve synergy benefits with respect to their REACH obligations.*

3) *REACH offers indications of the extent to which a substitution of chemicals is desirable, possible, or not permissible. These principles can be adopted by Chemical Leasing business models.*

4) *Chemical Leasing shows how the consumption of a smaller amount of chemicals can improve the economic position of both producers and users. By means of more intensive cooperation and communication along the supply chain, it therefore implements the REACH objective of improving industrial competitiveness.*

REACH Regulation

The REACH Regulation[2] which came into force on 1 June 2007 provides EU-wide chemicals legislation which calls for a uniform risk management system at the European level, and which considerably simplifies and harmonises the previous legislation on chemicals. The acronym REACH stands for Registration, Evaluation, Authorisation and Restriction of Chemicals.

Risk management

REACH is intended to ensure the safe use of chemicals. Risks can result from exposure to dangerous or harmful substances, and the level of exposure depends mainly on the way a chemical is used. Such risks can be reduced by adopting suitable measures, which may include good operating practice, implementing suitable technology, or providing protective equipment for the personnel involved.

Registration

All chemicals produced, imported or marketed in the European Union in amounts exceeding one tonne per annum and producer/ importer are to be registered in a central database. The "One Substance - One Registration" principle applies, according to which a substance only

[2] Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the registration, evaluation, authorisation and restriction of chemicals (REACH), Official Journal of the European Community L 396 (2006)

has to be registered once, even if it is produced or imported by a number of companies. This is intended to promote the joint utilisation of available data.

Substances which are regarded as being of high concern are subject to special authorisation provisions.

REACH affects the entire market. This is expressed in the requirements for data sharing and the communication along the supply chain and to downstream users (REACH Regulation Titles IV and V). At the same time, under REACH the affected companies are called on or are required to work together for the collection of data. This involves both forming *Substance Information Exchange Fora* to share substance information for registration, as well as the obligation to share existing information in the case of registered substances (both REACH Regulation Title III).

Communication

Before the REACH Regulation came into force there was no legal basis for the producers of chemicals to obtain details from their customers about what they are using their products for. But in order to be able to prove safe use, producers need to know where and how their chemicals are being used. Due to REACH, it is now easier to identify the use of the chemical, because this information is communicated along the supply chain.

The producers and importers of chemicals transmit information about the risk characteristics and the safe use of their substances in the form of a safety data sheet. The users of the chemicals examine this information and where appropriate carry out their own safety assessments.

Reallocation of responsibility

An important principle of the REACH Regulation is the shift in responsibility for chemicals from the authorities to industry. “The reversal of the burden of proof is a key component of the REACH system, which will lead to a 'no data - no market' approach” (Jakl 2008a). REACH specifies an exchange of information, with monitoring measures along the supply chain. The EU Regulation also includes rules for the division of costs and cooperation as well as documentation and assessment procedures (Jakl 2008b).

In addition to the producers and importers of substances, the users are also given obligations, and they share responsibility for safety measures.

Similarities and differences between REACH and Chemical Leasing

The common feature of Chemical Leasing and REACH is that both relate to chemicals and their use. Both strategies represent a paradigm shift and have a joint philosophy of sharing: Companies share the research costs for the REACH registration; responsibility is spread over all levels of the supply chain, and there is an active exchange of information.

Both REACH and Chemical Leasing have a life-cycle orientation. Both also promote and implement measures for the quality control of both the chemicals and their uses, including the associated emissions (Jakl 2008a).

The successful implementation of both Chemical Leasing and of REACH requires a more intensive exchange of information between the partners involved along the value-creation chain.

Furthermore, both have as objectives:

- A reduction in risks resulting from the use of chemicals
- An improvement in the industrial competitiveness as a result of more responsible production and use of chemicals
- The generation of economic advantages by the increased use of the expertise and information of all those involved.

However, in addition to such common features, there are also clear **differences**: While Chemical Leasing is a voluntary business model, REACH is an EU Regulation which is binding in the Member States.

The two strategies also differ in terms of their objectives and motivation: REACH is an EU-wide **risk management** system and thus contributes to the **safe use** of chemicals. In contrast, the main aim of Chemical Leasing is the **reduced use** of chemicals. In contract to REACH, which is a binding and directly applicable legal instrument, Chemical Leasing also has a clear economic interest – a reduction in the consumption of chemicals can reduce production costs, and the resultant benefits for the environment can be used to promote a company's image.

Interactions between REACH and Chemical Leasing

In view of their many shared features, REACH and Chemical Leasing can interact and provide mutual support in achieving their goals.

REACH offers a legal basis for the producer /importer of chemicals to request information from customers about the use to which they are put, and calls for closer interaction between the producer/importer and the user. This more intensive communication promotes a change in corporate culture so that it is easier to overcome existing barriers to the increased cooperation involved in Chemical Leasing. Aspects of REACH which relate to the transfer of information along the supply chain are also covered by the Chemical Leasing model. Both approaches promote an increased networking of expertise between the producers and users of chemicals.

REACH provides principles on which to assess the extent to which a substitution of chemicals is possible, desirable, or impermissible. These principles can be included in Chemical Leasing business models. *O*n-going environmental and economic optimisation is an inherent part of Chemical Leasing, and the substitution of particularly harmful chemicals aimed for in REACH is one aspect of this optimisation process.

It is anticipated that the REACH Regulation will result in risk management becoming more important for companies. Chemical Leasing offers improved risk management, and this could help to promote this business model.

The use of Chemical Leasing ensures the compliance with the duty propagated in REACH of responsible handling and is a key to the required “adequate control” (Jakl 2008b).

Conclusion

“Chemical Leasing uses the structures and procedures of REACH, translates them into economic advantages and at the same time supports REACH compatibility” (cf. Jakl 2008b).

Companies which use Chemical Leasing as a business model can achieve synergy benefits regarding their REACH obligations.

Chemical Leasing shows how producer and user can improve their economic position with lower consumption of chemicals. It therefore puts into practice the REACH goal of improving the competitiveness of industry, by means of more intensive cooperation and communication along the supply chain.

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3.3 Overview of the existing potential for manufacturing sectors and processes

Key statements

1) *Chemical Leasing always has potential when processes can be optimised in terms of the consumption of chemicals and when the suppliers are willing and able to contribute expertise.*

2) *There are no sector-related limitations to the implementation, but the chances of success are higher for Chemical Leasing when it involves ancillary or secondary processes which are not part of the core competence of the user of the chemicals. Processes such as cleaning, coating, painting, bonding, disinfecting, in particular are suitable for Chemical Leasing.*

3) *The integration of plant and equipment manufacturers considerably extends the potential for Chemical Leasing because they can contribute additional expertise to the process optimisation. This is particularly valuable in cases which depend on the fine tuning of chemical inputs, plant and equipment, and process parameters (e.g. the use of pesticides in agriculture).*

4) *In this project it was not possible to quantify the potential impact of Chemical Leasing in Germany. On the basis of previous experience, and taking into account the key influencing factors, a rough estimate suggests that with suitable communications measures (cf. Section 5) the consumption of chemicals could be reduced by more than 10 000 t per annum, offering economic benefits for all the participants.*

5) *In addition to potential savings on the domestic market, opportunities in other countries could also lead to an improved economic situation for German exporters, because these often have more expertise relating to potential applications.*

Pre-conditions for Chemical Leasing business models

The Chemical Leasing business model will as a rule only function well if the following pre-conditions are met:

1) There is scope to reduce the amounts of chemicals used. Reduction must be possible in a way which does not have a negative effect on the quantity and quality of the end product.

   Applications in which chemicals have to be used in fixed proportions, or where the consumption of chemicals is determined by specific chemical reactions are therefore not suitable Chemical Leasing business models.

2) The supplier of the chemicals is willing and able to contribute relevant practical expertise to the process optimisation.

   If the producer or supplier of chemicals has no practical expertise then they cannot take part in the process optimisation. The switch from a quantity-oriented payment to a use-oriented payment will not generate any impulse to reduce consumption.

3) Chemicals are used according to legal requirements.

   If chemicals are being used in Germany then among other things it is necessary that all REACH requirements are met in good time. In the case of hazardous chemicals the use must be an identified application for which an exposure scenario has been developed in the registration dossier.

Suitability of industrial sectors and processes

Provided the pre-conditions are met, Chemical Leasing is applicable in all industrial sectors, and processes where chemicals are involved.

Chemical Leasing leads to closer cooperation between the suppliers and users of the chemicals and involves the exchange of expertise, so that trust between the partners and confidentiality are key factors for success. In particular when the consumption of chemicals is linked to their core business, companies are often very reticent to share their expertise. It could be expected that Chemical Leasing will function better when the chemicals are used in ancillary or secondary processes such as cleaning, coating, painting, water treatment, bonding, disinfecting etc. This theoretical expectation was confirmed in the pilot projects.

A characteristic of the Chemical Leasing business model is that the producers of chemicals reduce their costs by reducing the amounts of chemicals consumed. Investments in process optimisation are thus in their interests, as long as there is an economic advantage in the amortisation of the investments. Many processes have been optimised in the past in Germany. This means that in many cases Chemical Leasing would only be economically viable above certain minimum quantities which define the potential for the applicability of the business model. The situation is different in emerging economies, where such process optimisation is possible with less effort.

Extending potential by including further partner in the Chemical Leasing business model

As explained above, the two partners, the chemicals producer (or supplier where appropriate) and the user of the chemicals, are decisive for the functioning of the model. Both partners introduce expertise and optimise the processes with the objective of reducing the consumption of chemicals in their own economic interests.

It can also be interesting to integrate other partners with additional expertise in the business model. This applies in particular for manufacturers of plant, machines and equipment. They can usually contribute by optimising the plant and equipment with respect to the specific chemicals used and the final product.

In some practical applications, the plant manufacturers can play the most important role in Chemical Leasing because they are able to introduce key innovations to reduce the amounts of chemicals used. Where in such cases the machines are not sold to the user, this results in a combination of classic leasing and Chemical Leasing.

Estimating the potential of Chemical Leasing business models in Germany[3]

In Germany, more than 50 million tonnes of chemicals are used every year. The large majority of this is in the value-creation chain in the chemical industry involving reactions with fixed proportions of chemicals. As explained, such processes are not well suited for Chemical Leasing.

Probably in the order of 10 million t of chemicals per annum are used in processes where there is a realistic prospect of implementing Chemical Leasing, particularly in the following sectors (rounded figures):

Solvents	7 000 000 t
Surface coatings	1 500 000 t
Adhesives	500 000 t
Pesticides	50 000 t
Disinfectant	50 000 t

A pre-condition for Chemical Leasing is that there is potential for optimisation and that this business model is also attractive for the producer. Precise assessments would require detailed market studies, which would be beyond the resources of this project. However, based on the experience of the project team it is possible to estimate roughly that Chemical Leasing can result in an average reduction of 10-20% of chemicals used in about 1% of the possible application cases.

This would represent an overall annual reduction potential of 10 000 – 20 000 t in Germany.

[3] Data is used from the German Statistical Office in combination with statements from industrial associations and experience in the implementation of Chemical Leasing projects.

For important chemicals this gives the following rough estimates for the reduction potential:

Solvents	7 000 – 14 000 t
Surface coatings	1 500 – 3 000 t
Adhesives	500 – 1 000 t
Pesticides	50 – 100 t
Disinfectant	50 – 100 t

It is expected that up to 20% of this potential will be realised over the next 5 years, which would represent an annual reduction of approx. 2 000 - 4 000 tonnes.

Export opportunities and potential

The figures given above reflect the situation in Germany, where production processes using chemicals are already relatively sophisticated in an international comparison. This means that there is less optimisation potential for Chemical Leasing than in other countries. Whereas an average reduction of 10 – 20 % could be expected in Germany, experience in emerging economies shows that reductions there could be twice as high.

The greater potential also makes the business model more attractive, from both an economic and environmental point of view.

It is therefore expected that the German chemical industry – which is strong in terms of both the export and the use of existing expertise – will use the opportunities offered by Chemical Leasing.

This will not lead *a priori* to a reduction in German exports of chemicals, because improved competitiveness could result in other chemicals producers being forced out of the market. In any case, the use of Chemical Leasing with German participation in emerging economies will mean lower emissions, less waste, and reduced health impacts and risks.

Here too it is difficult to quantify the potential, but it is probably in the same order of magnitude as those for Germany.

3.4 Evaluating constraints and incentives

Key statements

1) *Chemical Leasing is a relatively new business model, so that anticipated constraints and incentives can play an important role in the possible implementation. In some cases an incentive for a producer or supplier of chemicals can represent a constraint for a user (e.g. tighter ties between supplier and customer), or vice versa.*

2) *Many perceived constraints or incentives arise due to the lack of knowledge or unrealistic expectations of those involved. Against this background, examples and model projects are very important, because they make specific experience available.*

3) *The most important constraint is lack of trust between the partners. As a rule, this will lead to the failure of the business project unless trust can be restored by means of suitable measures (e.g. measurement of important process parameters).*

4) *There is no clear hierarchy of incentives but the most important elements can be grouped under improved competitiveness (lower costs, better links with customers, etc.).*

Incentives and constraints from the perspectives of various actors

The Chemical Leasing model necessarily involves a chemicals' supplier with the required expertise, and a user of the chemicals. In some cases it may also be appropriate to integrate the manufacturer of the plant and equipment, because their additional expertise can significantly increase the scope for process optimisation. The advantages and disadvantages arising from the Chemical Leasing model for these three participants (supplier, user and plant/equipment manufacturer) are considered in the following sections as potential incentives or constraints in the initial decision-making process. The different perspectives are essential for assessing many factors: closer ties to the customer may be an advantage for producer and suppliers, but the same can be perceived as a disadvantage by the user. For this reason the various participants are considered separately.

Incentives and constraints from the perspective of the chemicals producer or supplier

Incentives from the point of view of the chemicals producer include:

+ Increased customer ties
+ Improved profitability
+ Earnings from previously unpaid services
+ Earlier, better identification of customer needs
+ Possibly increased applications for new developments and product optimisation
+ Positive, environmentally friendly and innovative image
+ Better overview of disposal options and their control in terms of product responsibility

Customer ties are the result of a combination of technical and emotional factors. For the producer, long-term customer ties represent a competitive advantage over competitors. Frequent contacts and the exchange of expertise generally have a positive influence on the formation of long-term ties with customers.

The sale of expertise and previously unpaid services also represents an additional benefit for the suppliers. In the past, when the user called on the producer to make knowledge available concerning the applications of the chemical products supplied the producer was not able to reflect this in the product price. Chemical Leasing makes it possible to charge for these performances, and thus creates more transparency for all involved about the real costs.

In addition to this possibility of increasing revenues, the improved profitability associated with Chemical Leasing also represents an incentive.

The intensification of customer ties offers the supplier the opportunity to identify changing customer requirements better and more quickly. However, this requires the unification or adaptation of internal company communications so that information is passed rapidly between the relevant departments.

Closer customer ties and improved lines of communication can in turn provide additional openings for new developments and product optimisation.

Chemical Leasing reduces environmental impacts and health risks, frequently as a result of the implementation of innovative measures which offer increased efficiency. Therefore this business model has a positive image, which can also be construed as an incentive. Quality criteria (see Section 4) also have the goal, among other things, of maintaining this positive image.

Producers have a better overview of and increased control over their product if they remain informed about the product's life cycle. This can be achieved most easily if they remain the owner of the chemical. In this way the producers are most likely to meet the demand they increasingly face “to accept responsibility for their products, including during and after their use”.

On the other hand, there are also constraints which can cause the producer as a potential cooperation partner to hesitate before committing to a Chemical Leasing business model:

- Lack of confidence in the cost accounting; loss of control over key revenue factors
- Various suppliers for the same chemical product
- Competition problems concerning the transmission of expertise
- Lack of perceived optimisation potential
- High levels of investment needed to achieve process optimisation
- Problems calculating the fluctuation of prices for raw materials
- Questionable quality and reliability of the preparatory processes
- Training requirements
- Questions of liability
- Lack of security regarding a weaker business partner

The most important constraint is the lack of trust between the partners. This can be expressed as concern about the opportunities for controlling the process or product parameters. This is frequently associated with reluctance to pass on *know-how* and with associated competition problems.

A further constraint can arise if there are various suppliers for the same chemical product. The worry might be that one producer has to shoulder the costs involved in the optimisation of a process but competitors could still be involved subsequently. In that case, the benefits associated with Chemical Leasing would lie solely with the user.

Optimisation potential must reach a certain threshold level in order to pay back the investments necessary for the implementation. Low optimisation potential and high investment requirements for process optimisation can therefore represent a considerable constraint.

Preparatory processes can have a considerable influence on the outcome of optimisation and determine constraints relating to quality and calculation problems.

In addition, the supplier's employees who come into direct contact with the user must receive training which puts them in the position to intensify customer relations and possibly to diminish constraints for the user.

It is difficult to define questions of liability for the use of chemicals. The possible influence of the implementation of service-oriented strategies on the producer liability must be investigated for each case individually and may tend to constitute a constraint.

The good standing of the partners in a service-oriented business model such as Chemical Leasing is of considerable importance. If the user encounters economic difficulties it is in some cases impossible to find a comparable secondary market with sufficient demand for the chemicals specified by the user.

Incentives and constraints from the perspective of the user of the chemicals

Incentives from the point of view of the user of the chemicals include:

+ Cost benefits
+ Concentration on core competence
+ Availability of chemical expertise
+ Increased safety
+ Avoiding over-capacity

The networking of know-how through close ties to a partner who provides the chemical engineering and/or plant expertise means that the user can allocate fewer resources to development. By buying in knowledge, it is possible to achieve cost advantages regarding the solution of technical problems. There are further cost advantages for the user in terms of reduced capital costs for plant, inventory and storage space as well as a possible reduction of administrative overheads.

Sharing the process optimisation means that the user can release capacity for the core competence of their own production. However, from the perspective of individual employees this can represent a disadvantage, because they may feel their jobs are threatened if external experts from the supplier of the chemicals take over their responsibility for the process optimisation.

REACH requires intensive cooperation between producer and user. This is also a core component of Chemical Leasing, and in particular the availability of chemical expertise is regarded as an advantage by the users.

Rohe (2009) uses a game theory approach to show that if REACH requirements are taken into consideration both the supplier and the user of chemicals would decide in favour of the service-oriented business model offered by Chemical Leasing. On the basis of these findings, Rohe expects the concept to become increasingly widespread.

With the producer assuming responsibility and liability, security requirements can be harmonised, and as a rule the user will perceive the improved safety levels to be an incentive.

By outsourcing parts of the procedures, the user has the advantage of not having to maintain capacity which is underused.

As opposed to the incentives, there are also constraints and uncertainties:

- Dependency due to the tight relationship between user and suppliers
- Loss of flexibility
- Flow of expertise to competitors via the plant constructor and/or producer of chemicals
- Loss of jobs due to rationalisation effects
- Uncertainty about the compliance with technical specifications in an external plant

- Technical and logistical problems with the transport of products to and from external plants

While the suppliers view long-term customer ties positively, the user may feel increasingly dependent on the suppliers and view this as a drawback. The increased dependency and the integration in a know-how network make it more difficult from the point of view of the user to rapidly adopt flexible solutions involving competing producers. The user may also be worried that the close cooperation with the producer or plant constructor may lead to *know-how* leaking to competitors. However, Joas & Schott (2003) point out that this constraint can apply equally for conventional customer-supplier relationships, but in this case it is frequently underestimated.

If a user company has experienced personnel and plant which is already operating near capacity, then outsourcing in the form of a transfer of responsibility to the suppliers of the chemicals or plant may raise questions concerning rationalisation. This can demotivate personnel, who are the carriers of know-how, and under certain circumstances may lead to an incomplete transfer of knowledge which can result in considerable interface problems.

If a technological task is physically moved to another location, then in the initial phase increased testing may be needed in order to ensure compliance with technical specifications. Furthermore, an external plant or the relocation of process steps may cause technical problems, e.g. mechanical damage during transport, or logistical problems, e.g. production bottle-necks.

Incentives and constraints from the point of view of the plant constructor

If the user leases the chemicals and the plant, and if in such a model the plant constructor takes the place of the chemicals producer as the contact partner for the user, then the incentives and constraints are the same as for the chemicals suppliers. The fact that the plant constructor would be able to offer plant either for sale or for leasing could constitute a further incentive.

The plant constructor has the opportunity to further develop and modify the plant, and thus to generate additional revenue rather than leaving this business sector open to the user or third parties. However, a constraint is that more capital has to be committed for longer periods, because the responsibility for investment switches from the user to the plant constructor. This is particularly disadvantageous if the plant constructor has a limited capital base and thus also has to find external investors. Plant constructors face the same uncertainties about users in economic difficulties as do the chemical producer. The plant constructor would have difficulties finding takers on a secondary market for used leased plant if a lessee gets into economic difficulties. A further disadvantage could be that the plant supplier incurs increased overheads when coping with unfamiliar administrative procedures and formalities (Joas & Schott 2003, p. 74 f.).

Overview of incentives and constraints

Incentives	Constraints
Chemicals' producer or supplier	
Improved customer ties	Lack of trust in methods of cost allocation, difficulty to co revenue parameters
Improved profitability	Several suppliers for the same chemical product
Revenue for previously unpaid services	Competition problems regarded the spread of know-how
Better and earlier identification of customer needs	Low perceived optimisation potential
Possible wider applications for new developments and product optimisation	High investments needed to achieve process optimisation
Positive, environmentally-friendly and innovative image	Problems calculating price fluctuations for raw materials
Better overview of disposal routes and improved product responsibility	estionable quality and reliability of the preparatory processes
	Training requirements
	Liability questions
	Worries about economically weak partners
User	
Cost benefits	Dependency due to close customer-supplier ties
Concentration on core competence	Reduced flexibility
Availability of chemical expertise	Flow of know-how via the plant constructor and/or chem producer to competitors
Improved security	Loss of jobs due to rationalisation effects
Avoidance of overcapacity	Uncertainty about meeting technical specifications with an external plant
	Technical and logistical problems for the transport of products to and from external plants
Plant constructor	
Closer customer ties	Increased capital requirements
Increased range of offers	Uncertainty with economically weak user companies
Revenue from existing know-how and previously unpaid services	Increased administrative overhead

Table 1: Overview of constraints and incentives for Chemical Leasing

Literature

JAKL, T.; SCHWAGER, P.: *Lessons learned – The Way Forward*. In: JAKL, T.; SCHWAGER, P. (eds.): *Chemical Leasing goes global - Selling Services Instead of Barrels: A Win-Win Business Model for Environment and Industry*. Vienna: Springer Verlag, 2008.

JOAS, REINHARD; SCHOTT, Rudolf: *Hemm- und Förderfaktoren*. In: JAKL, T.; JOAS, R.; NOLTE, R.F.; SCHOTT, R.; WINDSPERGER, A.: *Chemikalien-Leasing – Ein intelligentes und integriertes Geschäftsmodell als Perspektive zur nachhaltigen Entwicklung in der Stoffwirtschaft*. Vienna: Springer Verlag, 2003. – 142.

ROHE, A.: *Spieltheoretische Aspekte beim Chemikalien-Leasing*. (dissertation - MSc in Business management, University of Göttingen, (unpublished)

3.5 Certification systems for Chemical Leasing

Key statements

1) *There are no established certification systems for Chemical Leasing on the market.*

2) *Members of the project team have developed such a system which can be used as required.*

3) *There is currently little demand for certification systems, and independent audits are only felt to be necessary in some cases.*

4) *Management systems such as ISO 9000 or ISO 14001 are regarded on the markets as a good basis for Chemical Leasing.*

The basic idea of Chemical Leasing is a division of labour in the production process. Production steps such as cleaning, surface treatment and coating, impregnation, dyeing, etc. require the use of chemicals by a service provider who not only produces and markets these chemicals but can also user them effectively. In addition there are auxiliary processes such as the transport and storage of chemicals and the recycling or disposal of used chemicals. These processes require high levels of technical expertise and permanent research and development activities in order to improve the effectiveness and efficiency with which the chemicals are used and to improve the state of the art.

Technical expertise about the use of chemicals is often lacking along the process chain in the case of products for which the chemicals are used in a supplementary fashion. Small and medium-sized enterprises are also often overwhelmed by the legal requirements and technical demands involved with the handling of chemicals, because the acquisition of the necessary knowledge about the safe and effective handling of chemicals would be too cost-intensive and time consuming. Even vehicle manufacturers, who have considerable technical expertise of their own in sheet metalworking, the use of plastics, metal processing, and on-board electronics, regularly outsource the surface treatment of metals, surface coating, the management of cutting fluids, or waste water treatment. Where this involves passing activities on to the producers of the chemicals it is not usually referred to in the automotive industry as “Chemical Leasing”, although it does correspond to the model in principle.

Such a division of labour in the production process requires a high level of trust between the Chemical Leasing partners. They must be confident that each will perform effectively and efficiently to the agreed quality levels and in compliance with legal provisions and environmental protection requirements, and will constantly work to improve their performance. This trust is not only essential for Chemical Leasing, but is the basis of every business agreement for the delivery of products and performances.

In order to ensure that this trust is not based solely on experience and emotions, but has a sound legal, contractual, technological and management basis, principles of quality management were developed more than two decades ago and formulated in ISO standards. Regarding quality management, EN ISO 9001 contains a catalogue of requirements for company management processes, production processes and supplementary processes.

The underlying precept of the standard is the commitment to a continuous process of improvement on the basis of the “plan – do - check - act” cycle. But in addition to the formulation of such a requirement, another revolutionary aspect of ISO 9001 was the fact that compliance with the requirements of the standard had to be monitored by a neutral expert at regular intervals and confirmed by a certificate. In order to maintain this system of auditing and certification at a high and credible level, exacting demands were placed on the audit, the competence of the auditor and on the certification procedure. Only certificates issued in accordance with internationally agreed rules by accredited certification bodies are evidence of a functioning quality management system. In order to ensure the credibility of these certificates, the auditors are examined annually and subjected to quality control by the accreditation bodies. These certificates have established themselves as a basis for trust in partnerships between suppliers, service providers or recyclers in production processes.

This principle of auditing and certification by qualified and accredited auditors was extended in the 1990s to cover environmental protection (ISO 14001) and from about the year 2000 to occupational health and safety (OHSAS 18001). In addition to the compliance with legal requirements, which are particularly complex in the cases of the environment and health and safety, the focus is also on continual improvements to the protection of the environment and the health and safety of company employees. The standards also specify the necessary framework conditions for the safe, environmentally sound handling of substances in accordance with a management system. This provides the appropriate instrument for producers or service providers who wish to prove to their business partners that in addition to quality the company management also attaches great importance to environmental protection and occupational health and safety.

In various sectors (such as the automotive industry, aviation industry, and in part also in the chemical industry) the presentation of an appropriate certificate is a basic requirement for all business relationships. This shifts the trust between the parties from an emotional level to one based on factual and externally audited criteria. Producers of chemicals, at least in industrialised nations, often already have a certified management system which they can bring with them as service providers in a Chemical Leasing partnership.

A logical step would be to adapt the requirements of this management system and the certification principles to Chemical Leasing business models, in order to ensure regular external control of the quality and the environmental compatibility of the services provided and of the contractual agreements on which they are based. However, no certified Chemical Leasing partnerships are known.

Chemical Leasing partnerships can bring with them the risk that one partner may accuse the other of failing to comply with the agreed requirements, quality criteria, environmental concerns or requirements for the safe handling of chemicals. Furthermore, litigation can result if outsourced processes which are the responsibility of the chemicals' supplier result in inadequate products or unsatisfactory long-term quality. Such cases, either in or out of court, will usually require examination by an external expert. This situation can be avoided if the main features of the Chemical Leasing partnership are examined at regular intervals by a neutral expert and the compliance with the mutual agreements is certified.

The following chapter introduces quality criteria relating to health and environmental protection which are important for the success of Chemical Leasing models. These are mainly derived from the provisions of the above-mentioned standards for quality

management and environmental and occupational health and safety management, and also take into account key preconditions for a successful Chemical Leasing partnership.

4 Quality criteria

4.1 Goals of quality criteria

1. Quality criteria should help to establish a high standard for Chemical Leasing

This core statement describes the function of quality criteria. The intention is that quality criteria should not, as a whole, establish binding rules for Chemical Leasing, but their main goal should be to make sure that the business model operates as well as possible. Quality criteria are therefore conceived as supporting the participants in their efforts to achieve high standards for various dimensions of the “Chemical Leasing” business model.

2. A high standard is important for the following sectors:

a) Specific environmental improvements

b) Specific economic improvements

c) Efficient deployment of public funds

d) Targeted promotion of Chemical Leasing

e) Efficient and smooth cooperation between the participants

a): Chemical Leasing was conceived as a business model which met the goals of “sustainable consumption” (cf. the declaration of the Johannesburg summit and the SAICM Declarations of Dubai and Geneva). Against this background, environmentally-related improvements are an integral part of the model, as reflected in the UNIDO definition of Chemical Leasing. It is therefore important that quality criteria are drawn up which provide a suitable standard in terms of environmental improvements.

b): Chemical Leasing is a business model which can only function satisfactorily if both the supplier of the chemicals and the user achieve specific economic improvements, because the increase in efficiency achieved jointly by the partners can be regarded as the “engine” of the business model. Quality criteria which contribute to an increase in economic efficiency thus make an important contribution to the functioning of the business model.

c): In principle, Chemical Leasing is based on the commercial benefits of the participants, and therefore does not require any state support. However, experience shows that there are various constraints which can block the dissemination of the business model. Overcoming these constraints can also be in the national interest, in order to achieve the positive effects of Chemical Leasing both with relation to the environment and the economy. The necessary efficiency of state aid can be promoted by suitable quality criteria. For this special case, quality criteria can not only have a “supporting function” but can also ensure compliance with minimum standards.

d): As already mentioned, Chemical Leasing is at present not a self-starter. The various constraints to its dissemination are considered in Section 3.4. A key problem is that important

information may not be available due to inadequate communications. Successful Chemical Leasing offers a commercial advantage over competitors, so that discretion and minimum external communications are in the fundamental interest of the participants. On the other hand, a high standard of external communication is necessary in order to initiate widespread implementation. Here too, quality criteria can provide support for the participants.

e): Chemical Leasing leads to more intensive cooperation between the provider and user of the chemicals with the goal of exploiting the potential to reduce the consumption of chemicals. Process optimisation can hardly be achieved without smooth cooperation. For this reason it is important to have a high standard of cooperation between the user and supplier of chemicals and also with any other parties involved.

3. Quality criteria are the result of a voluntary agreement between the participants; they should not be regarded as "semi-legal provisions" which are precursors of future legislation

The voluntary nature of Chemical Leasing has already been explained, and its focus is on the economic benefits for the participants. Even though Chemical Leasing supports environmental objectives, it would run completely counter to the spirit of the business model if it were to be implemented by some form of blanket legislation. To this extent, the voluntary nature of the quality criteria is essential.

4. Quality criteria should continue to help to distinguish Chemical Leasing business models from other business models and in this way to support the dissemination of Chemical Leasing. However, they cannot and should not lead to a redefinition of Chemical Leasing.

5. In the following, principles are introduced which consist of appropriate quality criteria together with guidelines for the activities of the individual participants

4.2 Principles for a sustainable "Chemical Leasing" business model

The Chemical Leasing principles developed in the following serve three aims:

1. Specific environmental improvements as a key element of sustainability
2. Specific economic improvements as long-term motivation for the participants to implement the business model
3. Protection of the positive image of the Chemical Leasing business model. This could be damaged, for example, if activities are marketed, promoted and disseminated as Chemical Leasing although they are unacceptable in terms of environmental or health considerations (compare also with the principles for communications).

The following criteria have been developed:

a) Continuous reduction of the impact on health and the environment by chemicals and the plant and equipment utilised

This criterion addresses a key element of the Chemical Leasing business model, namely the joint efforts of all participants to optimise the use of chemicals so that the desired output can be achieved with fewer chemicals. It is important for the operationalisation of the criterion that the reduced consumption of chemicals can be expressed in terms of environmental improvements. This frequently takes the form of a reduction in the amount of waste or lower emissions. The greater the environmental improvements, the better fulfilled is the quality criterion. Reductions in energy consumption are achieved in most cases as a result of the reduction in material flows, and should be taken into consideration. In addition to the environmental impact of the chemicals, the impact of machines and equipment also has to be considered ("overall balance"). The analysis of the examples has shown that a material flow analysis before and after Chemical Leasing is a suitable way of initially registering the desired improvements.

In additional to the environmental impact, the criterion also covers health and safety risks. The target is in particular a reduction in the exposure to chemicals, which can also be determined by the material flow analysis. The practical effects of the more intensive cooperation between producers and users are also of importance. While the exchange of information about the chemicals which are sold in a classic business model is concentrated on the safety data sheets, with Chemical Leasing there is much more intensive communication in many cases and the implementation of improvements. This demonstrates the synergy between the legal approach of the REACH Regulation and the voluntary business model of Chemical Leasing.

b) Improved handling of chemicals in terms of risk avoidance/ minimisation

This extends the logic of criterion a) to cover potential impacts (risk dimension). The criterion is quantified in terms of the extent to which risks can be avoided or reduced. The case examples show that the criterion frequently plays little or no role, but in some cases this criterion is of central importance (e.g. sealing of windows).

In addition to the environmental and health-related dimension, the criterion also has an important economic component which plays a role in particular when there are changes in the liabilities of the participants.

c) Avoidance of substitution by higher-risk substances

Chemical Leasing aims to increase the efficiency of use of the chemicals. In some cases, this can be achieved by substituting chemicals, although this may conflict with sustainability objectives if the substitute chemicals pose higher risks for health and the environment. The case studies show that in many cases this criterion is not relevant because there is no intention of substituting chemicals.

If substitution is being considered, it is necessary first to establish whether this would present a greater risk for health and environment. This can be based on the classification in accordance with REACH / GHS and the exposure of environmental sectors and individuals.

d) The use of chemicals and improved energy efficiency

This criterion is relatively easy to quantify in terms of the CO_2 balances. Various national and international examples show that energy efficiency can be improved in many cases. However, as a rule such success is not sufficiently appreciated and is not communicated.

e) Transparent risk distribution and sharing of economic improvements between the contractual partners

Both these aspects are essential for the long-term application of the business model. While commercial improvements are relatively easy to quantify in terms of the monetary value, the risk distribution between the partners is a more complex matter. This is discussed below in Section 4.5.

f) Monitoring the improvements in terms of the above-mentioned principles Problems:

- Determining monitoring measures
- How can commercial confidentiality be maintained when handling sensitive monitoring data?

4.3 Principles relating to state support for Chemical Leasing

As part of the research project, a system of criteria was developed with which to assess potential projects in terms of possible state support. This can cover a range of measures, from information events, through raising awareness among users, to supporting producers with the development of applications technology which allow a reduction in the amounts of chemicals used.

The objectives for the criteria system are thus the same as those for the quality criteria developed above.

The following criteria are proposed on the basis of the experience gained in the model projects:

a) Reduced emissions and waste from the chemicals employed

b) Provable risk reduction

c) Reduction of energy consumption

d) Sufficient multiplication potential

e) Potential in terms of economic target parameters (opening up new markets, improved international competitiveness)

f) Potential for research and development (availability and applicability of new technologies and substances).

A matrix system for the integration of all parameters and quality criteria (with possible weighting) was developed for the incentive and communications strategy presented in Section 5.

4.4 Principles for target-oriented communications to promote Chemical Leasing

On the basis of the examples presented in Section 6, the following criteria were developed:

a) Meeting the confidentiality requirements of the partners

b) Objective presentation of the experience from Chemical Leasing projects; transferability of experience

c) Quantification of environmental and health-related improvements

d) High multiplication effects of communications measures

e) Targeted communications

Their suitability and further details are discussed in the presentation of the individual pilot projects.

4.5 Principles relating to the smooth cooperation of the participants

With a view to the smoothest cooperation of the Chemical Leasing partners, reference is made to existing and proven quality criteria relating to environmental protection, occupational health and safety, and the proper provision of services, in accordance with EN ISO 9001, EN ISO 14001, and OHSAS 18001. The basic requirements of these standards were identified, and specific additional requirements of the Chemical Leasing projects were included, in particular the contractual agreements. As far as these criteria are applicable for the project in hand, compliance should be checked regularly by the Chemical Leasing partners or by a neutral third party, if it is felt that this will provide increased credibility and transparency. If cases of non-compliance or faulty developments are identified, appropriate counter-measures can be taken. This provides an improved basis for trust and contributes significantly to the smooth cooperation in the partnership.

The quality criteria take into account the two key phases of a Chemical Leasing project:

- At the start of the partnership: the specification of the contractual agreements and the framework conditions for the project, taking legislation and other legal aspects into account
- In the course of the project: the criteria for the “quality” of the cooperation.

The underlying principle is that a clear formulation of contractual agreements before the start of the project helps to reduce conflicts and make the cooperation during the project smoother.

4.5.1 Contractual agreements and framework conditions

Before the conclusion of contractual agreements between the Chemical Leasing partners, the following criteria should be analysed and defined:

- The scope and objectives of the Chemical Leasing project; if appropriate a programme should be formulated with milestones and deadlines for completion of parts of the project.

- The methods and objectives of the project and the specification of areas in which improvements are sought; e.g. product quality, environmental impact, health protection for personnel.
- The definition of the basis for a fair payment for the performances of the partners; these include agreed methods, quality standards, environmental and health and safety aspects, etc.
- The regulation of the responsibilities of the Chemical Leasing partners at all levels.
- The definition of the lines of communication in written and oral forms, together with the appropriate intervals.
- The definition of suitable performance parameters, process parameters and levels of resource consumption in order to characterise the process, with their appropriateness and testability.
- The methodology, precision, and frequency of measures to monitor the performance, process parameters and resource consumption.
- The specification of effective warranty regulations.
- The protection of expertise and data, in particular for confidential processes.
- Determining which documents should be archived, and in necessary also for how long.
- Agreement between all partners on a mutually acceptable duration for the contract.
- The definition of conditions for the premature termination.

4.5.2 Legal requirements and compliance

Laws and other legal regulations play an important role in Chemical Leasing projects, which often involve handling hazardous chemicals. The analysis of the regulatory requirements should cover the follow points in particular:

- Question of liability, especially also product liability
- Air pollution prevention in accordance with the Federal Ambient Pollution Control Act and associated regulations
- Protection of water and soil in accordance with the Water Management Act and *laender* regulations, as well as the Federal Soil Protection Act
- Waste disposal in accordance with the Act for Promoting Closed Substance Cycle and Waste Management and Ensuring Environmentally Compatible Waste Disposal
- Compliance with the Chemicals Act and the Prohibition of Chemicals Ordinance, in particular relating to hazardous substances
- Compliance with the European Union REACH programme
- The dangerous goods legislation for the transport of chemicals

- Noise abatement, both at the workplace and in the neighbourhood of production plant
- Work safety with analysis of the workplace and risk evaluation (required in Germany)
- The health of employees at their workplace, taking into account applicable occupational exposure limits (OELs) and the required personal protection equipment.

In Germany, the Chemical Leasing partners, in particular a producer or user of chemicals, are aware of these legal requirements. It should therefore not be too much of a problem to ensure compliance with them. It is more difficult to analyse the legal requirements in other countries, in particular non-European countries, which may have few legal requirements if any. In such cases, the Chemical Leasing partners must agree to comply with requirements and limit values e.g. at the workplace, to meet international targets for emission limit values or substance concentrations at the workplace, and to correspond to the state of the art.

4.5.3 Product and services quality

The aim of Chemical Leasing projects is to make the use of chemicals more effective, efficient, and safer, with a lower environmental impact. This can best be achieved if a series of conditions and parameters are specified for the production process. These include in particular:

- Effective controls and possibly also clearance procedures for incoming chemicals and materials.
- Determining suitable physical quality parameters for testing products, such as purity, layer thickness; adhesion bond strength, surface characteristics
- Ensuring high process stability with corresponding reproducibility and constancy of the determined quality parameters.
- The application of suitable statistical process monitoring.
- Ensuring the long-term stability and quality of the process.
- Systematic monitoring of all testing equipment.
- Determining the proportion of products which cleared on first testing (*First Pass Yield*), the rate of rejection, and the proportion receiving reworking.
- The systematic labelling and traceability of products.
- The regulated handling of customer property.
- The regulated handling of incoming goods which are not up to specifications and faulty products.
- Determining systematic product protection, and proper storage and packaging of products.

These are familiar quality management requirements in accordance with EN ISO 9001, and they are standard in medium-sized and large German enterprises. However, for Chemical

Leasing projects they have a special significance because in the production process two or more partners have to work together without friction. Where materials and products are transferred across interfaces, the conditions governing these have to be clearly regulations.

When defining and monitoring the quality of products and services it is helpful to have parameters which reflect the process and which can conveniently be checked at regular intervals. Such parameters can then be used to demonstrate the stability of the process or to identify deviations from the target values at the earliest possible stage. Such parameters must have a specific relevance for the process (e.g. the use of resources per tonne of product). It must also be possible to compare sequences of values in order to be able to identify changes at an early stage, they must be updated at regular intervals, and they must satisfy the need of Chemical Leasing partner for information.

4.5.4 Management principles

Smooth cooperation between the Chemical Leasing partners also requires agreements about the organisation, and responsibility for the management of the project. The following criteria are also derived from the principles and regulations of standardised management systems.

- The areas of responsibility of the partners are defined, so that there is no overlapping of responsibilities or gaps between responsibilities.
- The project objectives and project milestones are agreed and monitored.
- Environmental improvements are monitored by checking the situation at regular intervals; any necessary corrective measures are taken at the management level.
- If there are deviations form the project objectives the causes are analysed and corrective measures are defined, implemented and regularly checked.
- The necessary regulations for the safe and environmentally-friendly operation of plant and equipment and the substances used already exist. They include procedural and work regulations, operational regulations for plant and machinery, regulations for working with dangerous substances, Safety data sheets for the substances used, etc.
- Regular training of personnel in accordance with legal requirements and in-house regulations. Attendance should be documented by the signature of the participants and records archived.
- Due care should be taken to protect the health of workers, in particular by making the necessary personal protective equipment available.
- Regular management inspection tours of the plant, self-evaluations and internal auditing processes should lead to on-going correction and improvement measures.
- The project management should regularly assess the status of the project, the achievement of goals, process stability, and make necessary corrections, etc. As a result of this evaluation, the orientation of the projects should be confirmed or corrected by mutual agreement. The input data for these management evaluations are jointly defined and results recorded in order to document the continuity of management decisions.

5 Incentives and communications to promote Chemical Leasing in Germany

5.1 Objectives

Chemical Leasing allows a sustainable use of chemicals. Firstly, it reduces the consumption of chemicals, and secondly it reduces risks by improving chemical handling. Due to the environmental and health-related advantages it offers, high-quality Chemical Leasing is approved both by the government (environmental and trade ministries) as well as by sectors of industry and environmental organisations. This has been clearly demonstrated at various national and international events (e.g. SAICM Conferences in Berlin and Geneva) as well as in the national steering committee for this research project (cf. minutes in the Annex).

A core element of Chemical Leasing, in addition to improving the protection of human health and the environment, is the economic benefit which the participants can achieve by using the business model. It therefore ought to spread without further outside intervention, but this is currently not happening. The most important constraints responsible for this are described and analysed in Section 3.4.

The main objective of incentives or government activities must therefore be to overcome hindrances and in this way to initiate the self-supporting dissemination of the business model.

In summary, the state incentives and communications measures should concentrate on the following key points:

- Informing producers and users about the functioning of the business model and raising awareness about the advantages.
- Information about the optimisation of processes and the handling of chemicals.
- Supporting measures to increase trust between the partners (e.g. by helping to produce the clear and transparent data needed for the monetary settlement).
- Promoting the development of expertise about the implementation among producers and suppliers of chemicals.
- Contributing to overcoming the traditional sales concept (payment of chemicals by quantity).
- Developing suitable monitoring/controlling systems (these are regarded as essential).
- Meeting investment requirements by suitable financing instruments.
- Providing further documented pilot projects as references.

According to current assessments, it will only be possible to realise the potentials estimated in Section 3.3 if state incentives and targeted communications make it possible to overcome the barriers to Chemical Leasing projects. However, it must be borne in mind that

government incentives and communications alone will not be sufficient, and the participant companies will always have to develop their own initiatives.

Government incentive systems and communications measures address various dimensions:

Environmental policy dimension:

Chemical Leasing leads to a sustainable use of chemicals. It can be shown that environmental and health impacts are reduced in a quantifiable fashion, and existing risks are also reduced. By linking economic success and environmental advantages, the business model ensures long-term improvements.

Chemical Leasing is a suitable element of Germany's environmental strategy in particular due to its positive effects in terms of

- Lower resource consumption (raw materials, energy)
- Lower emissions and waste
- Reduced risks for the environment and for personnel

Economic and political dimension:

With regard to the economic and political dimensions, the following target groups it is necessary to analyse the following target groups

- Chemicals producer
- Chemicals dealer
- Chemicals user
- Machine and plant manufacturer

For all target groups, Chemical Leasing can offer improved competitiveness (cf. incentives in Section 3.4). To this extent the business model has a significant economic dimension.

In particular the following aspects play a role in the framework of the economic consequences of Chemical Leasing:

- Long-term business relationships (for producers, suppliers and users of chemicals)
- More precise knowledge about customer requirements and range of performances (for producers, suppliers and users)
- Compensates for existing competitive disadvantages (for producers)
- More rapid economic returns on R&D investments (for producers)
- Process optimisation and cost reductions (for users)

- More intensive communications for process optimisation, also required by REACH (for producers and users)

International development dimension:

Chemical Leasing allows the transfer of technology and expertise to emerging economies and developing countries and thus contributes to international development targets.

Research policy dimension:

An integral element of Chemical Leasing is the stimulation of further technological development. Applied research is clearly at the focus of the interest.

In addition to this research policy dimension, it should also be noted that new partners such as chemicals wholesalers could also be involved in research activities induced by Chemical Leasing.

5.2 Overview of experience with international support

At the international level there is experience with financial support and with communications and promotion measures. This reflects in part the potential significance of Chemical Leasing for achieving certain goals.

In Austria, the Life Ministry reimburses 50% of the consultancy and development costs incurred in a Chemical Leasing project. This support has helped with the successful implementation of certain projects, but it has not yet led to the widespread distribution of the business model.

UNIDO promotes Chemical Leasing by means of consultancy services which are currently being provided by national and international experts for pilot projects in seven countries (Egypt, Mexico, Russia, Morocco, Serbia, Sri Lanka and Colombia). This support has considerably raised the international profile of Chemical Leasing and has resulted in several successful pilot projects in various sectors.

The UNIDO initiative is backed up by various communications measures (video, book, Web site, congresses), financed in particular by Austria. In Spring 2010 the winners of the first “Global Chemical Leasing Awards” were announced. Initiated by UNIDO and the Austrian Ministry of the Environment, this is intended to raise the profile of the increasing numbers of examples for the successful implementation of the model. Prizes of EUR 20 000 were awarded by an international jury for the categories “Pilot project”, “Consultancy service”, “Scientific publications” and “Public relations work”.

5.3 Catalogue of suitable incentive measures for Germany

Possible components of a stimulus system for German Chemical Leasing activities:

A) *Support for producers and suppliers of chemicals with respect to applied expertise and the availability of more efficient technology*

1. Targeted information events to establish an exchange of knowledge and experience (first meeting in March 2010 in cooperation with DECHEMA)

2. Training of personnel from interested companies

3. Research programme to promote

    a) Applied technologies which can reduce consumption of chemicals,

    b) Monitoring technology

    c) Control systems and IT solutions

    d) Recycling technologies for used chemicals

B) *Assistance with establishing Chemical Leasing-business models in Germany and promoting their export*

1. Developing a tool kit, e.g. with regard to drawing up contracts, monitoring, dealing with questions of liability, responses to increased prices for raw materials, etc. (helps to remove constraints)

2. Promotion measures similar to UNIDO (brochures, book, seminars)

3. Partial payment of costs for advisory services

4. Support in other countries (e.g. by information events at embassies, arranging local partners)

5.4 Initial implementation of measures concerning the communication of Chemical Leasing in Germany

In the course of the project, various communication activities and public relations work has been carried out.

- ***Website***

A Web site has been set up under www.chemikalienleasing.de which is updated at regular intervals. It offers an overview of the project background and the core results, and informs about German Chemical Leasing pilot projects.

- ***Chemical Leasing publications*** *during the project period*

- Geldermann, J.; Joas, R.: *Chemical Leasing as a model for sustainable development;* Presentation at the 11th Conference on Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction (**PRES 2008**); 24 - 28 August 2008, Prague, Czech Republic. Conference Proceedings.

- Geldermann, J.; Joas, R.: *Chemical Leasing as a model for sustainable development; Lecture* at Centre de ressources des technologies pour l'environnement (CRTE) - Centre de Recherche Public (CRP) Henri Tudor, 16 October 2008, Esch-sur-Alzette, Luxembourg.

- Walter-Rohde S., Joas R., Richter S.: *Chemical Leasing a business model for sustainable chemistry – a pilot study on quality criteria in Germany,* Society of Environmental Toxicology and Chemistry (**SETAC**) Europe 18th Annual Meeting, 25 - 29 May 2008, Warsaw, Poland. Poster.

- "Beim Leasing muss Chemie stimmen", *Umweltschutz* 9, **2008**, 35-37

- "Vertrauen ist gefragt", *Chemische Rundschau*, No 12, **2008**

- *UBA Presseinformation*, No 14/**2009**

➢ *German steering committee on Chemical Leasing*

The steering committee set up in the course of the project forms the German interface with the international Chemical Leasing working group to support the discussion of results and the initiation of model projects. The steering committee has proved its value, and will be retained throughout the duration of the project.

Following the example of the German steering committee , similar structures have meanwhile been established in Serbia, Sri Lanka, Morocco and Flanders, Belgium.

➢ *Cooperation with UNIDO*

In the course of the project, the attempt has been made to achieve synergy effects between the project of the Federal Environment Agency on Chemical Leasing and the international UNIDO initiative. It was possible to make a German contribution towards establishing international quality criteria. Testing of the quality criteria developed in Germany has already started in eight countries.

In addition, the quality criteria were also used for the evaluation of candidates for the international *Chemical Leasing Awards*.

With regard to cooperation with UNIDO, it should also be mentioned that the results of the German project have been presented at various national workshops in Serbia, Egypt, Sri Lanka, and Colombia and their applicability has been discussed.

- ***International Working Group on Chemical Leasing***

In the course of the project, the international working group was informed on numerous occasions about the development of Chemical Leasing in Germany. Presentations were made to the events in

- Dakar, 15 Sep. 2008: "Pilot projects in Germany - Experience and first results including quality criteria"

- Geneva, 13 May 2009: "Future activities of the international ChL working group (e.g. synergies to similar models, ChL in agriculture, agreement on quality criteria)"

- ***Activities within SAICM; International and national meetings***

At the following national and international events, reports were delivered about the experience gained in the project of the German Federal Environment Agency:

- *National SAICM Meeting in Berlin, 6 June 2008;* Strategic approach for international chemicals management

- *IFCS Forum V, Dakar, 15 September 2008*

- *Conference on Resource Efficiency in Rhineland Palatinate, 1 December 2008;* "Resource conservation by Chemical Leasing"; (Ministry of the Environment and Economics, Rhineland Palatinate)

- *ICCM2 - Chemical Leasing Side Event, 13 May 2009; Geneva*

6 Initiating and monitoring model projects

6.1 Selecting suitable sectors, processes and partners for pilot projects

As part of the research project, 3 model projects were to be monitored scientifically. The experience gained was to be used to establish quality criteria, and the pilot projects were to support the dissemination of Chemical Leasing by acting as “Lighthouse projects”.

Drawing on the international experience of the project team it was thought desirable that the model projects should meet the following criteria:

- Experience with implementation

  (=> This means that a comparison is possible between Chemical Leasing and the classic sale of chemicals, quantitative results can be obtained; without such experience, model projects are often only able to deliver estimates and prediction for a before and after comparison)

- Contracts with quality criteria are available

  (=> Proven quality criteria can be adopted, quality criteria which have proved to be inappropriate can be avoided)

- Potential for widespread implementation

  (=> Model projects are important for promoting Chemical Leasing, good potential for dissemination therefore increases the value of a pilot project)

- High profile

  (=> The high profile of a model project also supports the subsequent dissemination of the business model)

- Large reduction potential, clear environmental advantages

  (=> Large reduction potential and clear environmental advantages can enhance the attractiveness of the Chemical Leasing business model.)

- New technology

  (=> Chemical Leasing can offer an interesting way to launch new, innovative technologies; additional quality criteria may be relevant)

- Integration of various participants

  (=> this may make it necessary to include additional quality criteria)

- Multi-level processes

  (=> this may also require additional quality criteria)

- Export opportunities

  (=> The German chemical industry is very well positioned for export business; Chemical Leasing can help to expand export opportunities so that model projects in this sector can promote the business model)

- Involvement of small- and medium-sized enterprises

  (=> In many cases, Chemical Leasing is only viable above a threshold level of chemicals' consumption; this is more likely to be the case for large companies. In order to cover the broad spectrum of applications for Chemical Leasing, it is therefore important to integrate model projects with SMEs.

- Chemical Leasing and substitution

  (=> The substitution of chemicals is one of the critical points of Chemical Leasing, because for environmental and health and safety reasons it is not desirable to replace a substance by another substance which poses a higher risk. In this case, quality criteria are very important)

In order to cover all these criteria, it was found helpful to have a larger number of pilot projects (eight). The quality criteria were also used in a ninth pilot project, initiated by the *Deutsche Umweltstiftung* (The use of disinfectants in clinics and hospitals).

List of model projects:

Pilot project 1: Cleaning pipes and containers in the food and pharmaceutical industries

Pilot project 2: Use of PVC for automotive underbody coating

Pilot project 3: Production, further processing and use of catalysts

Pilot project 4: Cleaning, pre-treatment, and coating of metal surfaces

Pilot project 5: Use of abrasives in the metal industry

Pilot project 6: Glass bonding using sealant tape

Pilot project 7: Coating of aluminium band for manufacturing beverage can lids

Pilot project 8: The use of pesticides in agriculture

The quality criteria as outlined in Section 4 are also applicable in an external Chemical Leasing project (Pilot project 9: The use of disinfectants in clinics and hospitals) initiated by

Deutsche Bundesstiftung Umwelt together with Schülke & Mayr GmbH and Worms Clinic. This will be implemented as soon as the appropriate project status has been reached.

The following figure shows how the pilot projects cover the various criteria:

Criteria	Met by model project
Experience with implementation	1 2 3 4 5
Contracts include quality criteria	1 3 4 5
Potential for broad implementation	1 4 5 7 9
High profile	2 6 7 8
Reduction potential / environmental benefits	1 4 8
New technologies	6
Various participants involved	2 3 4 6 7 8
Multi-level process	4 6
Export oppurtunities	1 4 5 8
Involvement of SEMs	5 6 8
Chemical leasing with substitution	6

Figure 3: Model projects and the criteria they cover

6.2 Pilot project 1: Cleaning pipes and containers in the food and pharmaceutical industries

6.2.1 Overview

Mode of operation and partners:

The classic business model envisages that chemicals for cleaning pipes, tanks, and containers are purchased on the basis of a price per unit volume or weight. This means that the more chemicals are used then the greater is the supplier's profit. With Chemical Leasing, payment is based on the amount of the final product obtained (e.g. kegs of beer or tonnes of chocolate), in compliance with strict purity specifications and hygiene regulations. This means that the profit of the chemicals' supplier increases with a lower consumption of chemicals. It is then in the interests of the supplier of the chemicals to help the user to optimise the production process by introducing expertise.

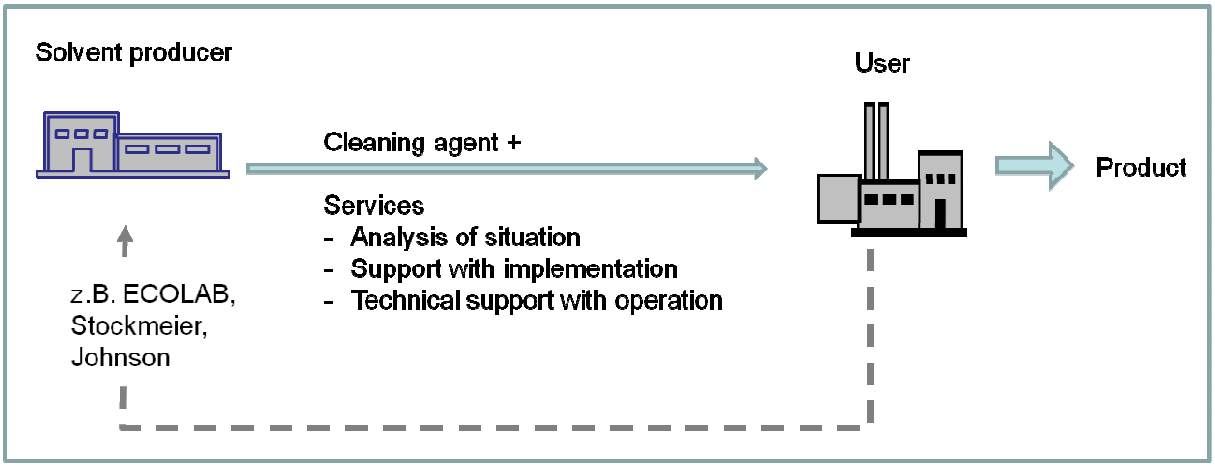


Figure 4: Participants in “Cleaning pipes and containers in the food and pharmaceutical industries”

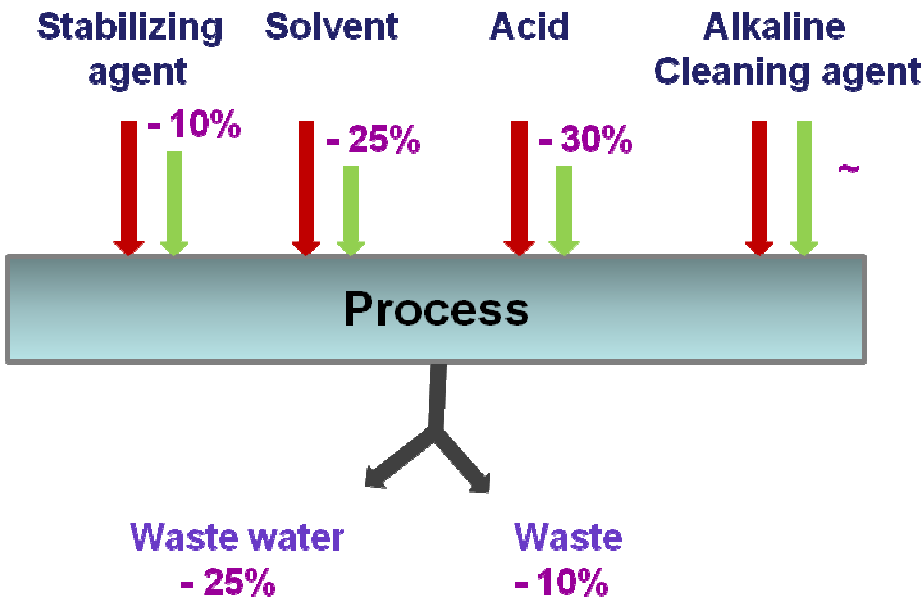
Selection criteria:

The example was selected because

- Previous experience has been gained with implementation,
- Contracts with quality criteria exist,
- Large reduction potential and environmental advantages is expected,
- Widespread implementation seems possible,
- Export potential can be realised.

Environmental results:

The Chemical Leasing business model leads to a lower consumption of cleaning agents. These reductions are due to process optimisation and can be expected to be stable. The lower consumption leads to a reduction in waste and to reduced effluent load. Energy will also be conserved, both through direct effects (e.g. less heating and pumping due to fewer cleaning cycles), and indirect savings due to a reduced flow of materials.



Indirect energy conservation (lower materials flow): ~ 25%

Direct energy conservation (fewer cleaning cycles): ~ 10 %

Economic results:

The process optimisation initially leads to an increased burden for the supplier of the chemicals which is only gradually balanced out by the reduction in the amounts of chemicals supplied, until subsequently an economic benefit results. A certain minimum size of the plant and the initial level of consumption of chemicals is therefore a precondition if the business model is to be economically attractive. The break-even point for the supplier of the chemicals is set at less than one year. For the user, the business model will usually involve only a very short amortisation period, because in most cases no major investments are necessary.

6.2.2 Results of the application of quality criteria

Principles for sustainability:

The first criterion relates to the continuous reduction of the impact on health and the environment by chemicals and the plant and equipment utilised. In the example, Chemical Leasing can be shown to reduce the consumption of chemicals. This leads in the direct causal chain to a reduced environmental impact as a result of reduced amounts of waste and effluent burden. Health-related impacts in the example are negligible, because the chemicals are mostly used in closed plant. To this extent, a reduction of the health impact is less relevant. Theoretically, a *continuous improvement* is achievable, but this is not necessarily the case in practice. Typically there will be an improvement at the start of the Chemical Leasing contract when the supplier contributes expertise to the process optimisation. But although the supplier has a permanent interest in reducing the amounts used, as a rule nothing changes for a longer period once the initial optimisation has been implemented, and the process consumption parameters remain largely unchanged. However, the observation period in this example was quite short, and it could well be that further improvements would be introduced in the course of a longer contract. In summary, this criterion is relevant in this case, and the example fulfils the requirements well.

The second criterion relates to improved handling of chemicals in terms of risk avoidance and risk reduction. In the example there was a reduction in the inventory of chemicals, which was in the mutual interest of the partners as a result of the Chemical Leasing contract and which led to reduced risks. The criterion was relevant and the example fulfils the requirements well.

The third criterion relates to avoiding substitution by higher-risk substances. And interesting effect in this example was that instead of a straightforward substitution (i.e. Chemical A is replaced by Chemical B), a lower-concentration cleaning solution was replaced by a higher concentration one. Since the actual amount of cleaning agent was registered (rather than the amount of aqueous solution) and acidic and base chemicals neutralised one another, there was an overall environmental benefit. The exposure to chemicals in not increased, and there are no grounds to assume health risks. The results of the analysis show that the criterion is relevant and the example fulfils its requirements.

The fourth criterion concerns improved energy efficiency. The example shows that Chemical Leasing can make a significant contribution. In addition to the direct energy savings due to fewer cleaning cycles, there are also important indirect energy savings. This effect has often been given insufficient consideration in previous investigations of Chemical Leasing. But the contribution to climate protection through the reduced consumption of chemicals is an important contribution to sustainability which should be properly documented and communicated.

The fifth criterion for the sustainability concerns a transparent distribution of risks and the division of economic benefits between the contract partners. It was difficult to collect the relevant data for this example. It can be assumed that there was no significant change in the risk distribution in comparison with the classic model. The distribution of the commercial improvements was not disclosed, but it can be assumed that the user had greater advantages than the supplier of the chemicals. This assessment is based on the fact that users can insist on Chemical Leasing when calling for tenders, whereas suppliers cannot use this business model for most of their acquisition.

The sixth criterion concerns monitoring measures and the systematic registration of the values of key parameters. This criterion is met with fully in the example and is also part of the contract.

In summary, the quality criteria for sustainability in this example were fulfilled well and are justified in terms of the high standard for environmental protection and health and safety requirements.

Principles relating to state support:

The example “Use of cleaning agents in the food and pharmaceuticals industries” could be an interesting case for state support because it would be possible to achieve a sustainable reduction of emissions and waste chemicals and a reduction in energy consumption, with sufficient multiplier potential in terms of broad dissemination.

Possible support should not concentrate on a financial subsidy for the companies involved, because Chemical Leasing in this sector can rapidly generate economic advantages. However, there is the interesting possibility of supporting communications measures (e.g. information events, brochures), in order to overcome existing gaps in knowledge. It could also be interesting to promote technologies for process optimisation in the course of research and development projects. These are not only the basis of potential improvements in Germany, but also define export potential with regard to innovative technology.

Principles for target-oriented communications:

Maintaining the needs of the partners for discretion has proved an extremely important element of communications measures. The cleaning agents and chemicals used are as a rule standard products, so that competitive advantages take the form of expertise concerning the optimised application. Communications extending beyond the supplier and user is seen primarily as a potential threat to this competitive advantage. A quantification of environmental and health-related improvements is, however, possible in an anonymised form, as is the objective presentation of the experience. There are currently only low levels of communication and there is no precise targeting of communications measures or utilisation of the multiplier potential.

Principles for smooth cooperation between the partners:

In the existing contracts in this example the conditions for cooperation are specified in some detail. The following parameters are particularly important:

- Optimisation in the analysis phase is mainly the responsibility of the chemicals' supplier, in the implementation phase it is a joint responsibility.
- The operation is largely the responsibility of the user.
- Compliance with legal requirements for hygiene and purity and relevant specifications forms part of the contract and is monitored.

- Process parameters are monitored and values documented.
- The personnel of the user are trained by the supplier.

A special certificate is not thought to be necessary by the companies involved. Both partners have an ISO 9000 certificate, which is regarded as a good precondition for cooperation under a Chemical Leasing contract.

6.2.3 Summary and possibilities for a broad implementation

The implemented project documents both the applicability of the business model for the consumption of cleaning agents, as well as the suitability of the quality criteria.

The economic advantages for the participants are as easy to demonstrate as the advantages for the environment and health.

Because of the work on process optimisation which the chemicals' supplier has to carry out, a minimum consumption of chemicals is necessary in order to generate interest among producers. This limits the scope of application, in particular among smaller companies.

6.3 Pilot project 2: *Use of PVC for automotive underbody coating*

6.3.1 Overview

Mode of operation and partners:

The classic business model for the application of PVC underbody coating in the course of vehicle construction involves chemicals being purchased for a price per kilogram. This means that the revenue of the supplier depends on the amount of the chemicals delivered, and that he has an economic interest in a high level of consumption.

In contrast, for the Chemical Leasing model in this example a charge would be made per vehicle (varying according to the type of vehicle). Both partners then share an interest in keeping the use of chemicals as low as possible to produce a functioning coating which fulfils the quality requirements. It is characteristic of this example that the expertise of the PVC producer is combined with that of other participants (producers of applications and application systems), in order to optimise the amounts of material use and to monitor and support the technical implementation.

Selection criteria:

The example was selected because

- Previous experience with implementation,

- High profile is ensured (“Lighthouse” project),
- It was intended to illustrate the possibility for further process optimisation from an existing high technological level,
- A number of participants are involved

Environmental results:

Not available, as the example could not be implemented

Economic results:

Not available, as the example could not be implemented

6.3.2 Results of the application of quality criteria

Principles for sustainability:

The first criterion relates to the continuous reduction of the impact on health and the environment by chemicals and the plant and equipment utilised. .

Reduced environmental and health impacts in the example were expected due to the optimised deployment of PVC – these would have related both to the final amount of waste to be disposed of, and also the lower consumption of materials and energy due to the need to produce less PVC.

The second criterion relates to improved handling of chemicals in terms of risk avoidance and risk reduction, i.e. to potential impacts (risk dimension). For this example, very little effect if any was expected, because occupationally health and safety measures are already at a very high level.

While the **third criterion** (substitution) was not relevant, advantages were expected for the **fourth criterion** (improved energy efficiency) as a result of the overall CO_2-balance of the delivery chain. It would have been interesting to compare the effects of a lower production of materials (PVC, additives) with a lower fuel consumption of the vehicles due to reduced vehicle weight.

The fifth criterion (transparent distribution of risk and sharing of economic improvements between the contractual partners) and **the sixth criterion** (monitoring and systematic registration of key parameters) were included in the project planning, but could not be considered due to the termination of the project.

Principles relating to state support:

The project was not in fact implemented because of constraints concerning an optimisation of established processes which were regarded as being technically well-developed, and which results in particular in the project being classed as a low priority. State support could not have removed these constraints.

Principles for target-oriented communications:

There were particular expectations for the project with regards to targeted communications in support of the implementation of Chemical Leasing. A successful pilot project with an automotive manufacturer would have raised the profile considerably. On the other hand, this expectation could have raised additional constraints among the participants. It can therefore be concluded that when initiating a pilot project the aspect of subsequent state support should be introduced very carefully and defensively.

Principles for the smooth cooperation of the partners:

Since the pilot project was not implemented, despite many preparatory consultations and proposals, it was not possible to test the principles for smooth cooperation between the partners.

6.3.3 Summary and possibilities for a broad implementation

On the part of the chemicals suppliers there was and is considerable interest in the implementation of Chemical Leasing for PVC underbody coating in the automotive industry. The major car maker involved experienced considerable constraints against making changes to established processes. Ongoing restructuring processes in the company meant that the timing was also probably unfortunate, and this project was only rated as being of secondary importance.

The development of the examples and the analysis of the constraints experienced give no indication that Chemical Leasing could not function as envisaged for the application of PVC in the automotive industry. It is possible that the project could be taken up again at a later point in time, or that there could be cooperation between the suppliers side and other car makers.

6.4 Pilot project 3: Production, processing and use of catalysts

6.4.1 Overview

Mode of operation and partners:

For Chemical Leasing in this pilot project a complex model was developed with four participants:

- Producer of the catalyst
- Processor of the catalyst
- Leasing company
- Manufacturing customer

The starting point of the business model is the financing by a leasing company of the production of a certain amount of catalyst by the producer. The leasing company becomes owner of the catalyst and leases this to the producer. As security for its financing, the leasing company remains owner of the catalyst with appropriate guarantees from the producer and /or processor.

The producer delivers the catalyst to the processor. After handling, the catalyst is delivered in its final form to the customers (here referred to as A, B, and C). They use the catalyst in their production until it is exhausted, when it is returned to producer for recycling.

The producer pays a lease to the leasing company for the use of a certain amount of the catalyst which circulates around the system. On the other hand, the producer receives a lease from the processor (for making the catalyst available for processing) as well as a premium from A, B, and C. The processor receives a lease payment from A, B, and C for making the catalyst available for production. Each company registers the amounts of catalyst received and passed on. The leasing company is reimbursed for any losses via the producer.

All participants (except the leasing company) have an interest in keeping the losses of catalyst as low as possible, because these will have to be paid for. In view of this, a group of experts from the producer, processor and customers is formed to exchange know-how about minimising losses (Phase I).

All those involved in the materials flow (apart from the leasing company) also have an interest in using the smallest possible amount of catalyst to produce a given amount of the final product. The expert group therefore also consider how to optimise the use of the catalyst (Phase II).

The following figure gives an overview of the material flows / contractual agreements between the parties.

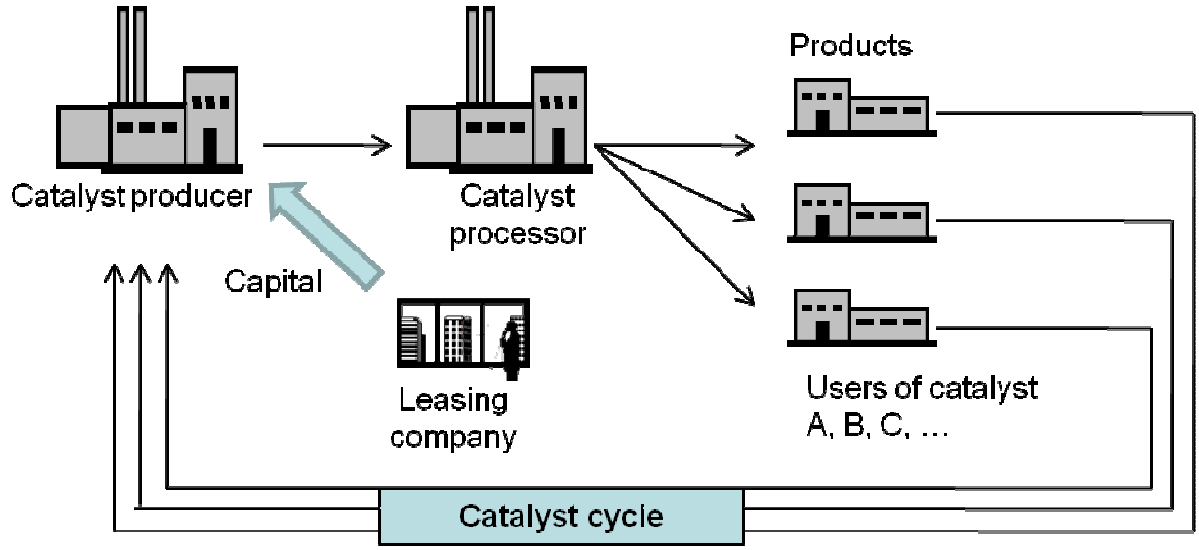


Figure 5: Participants in “Use of catalysts”

Selection criteria:

The example was selected because

- Previous experience had been gained with leasing catalysts,
- Contracts with quality criteria already existed,
- A leasing company was already involved,
- Considerable environmental leverage possible,
- International and national business could be promoted,
- System with several companies and decision-makers exists.

Environmental results:

The example is still in a development phase, and the quantification of environmental consequences is not yet possible. It is expected that the reduction in the amount of catalyst required and the reprocessing chemicals will be in the order of 20-30%.

Economic results:

The economic results cannot be quantified at the present stage of the project, but in view of the interest shown by all participants it is expected that the model will generate economic benefits for them all.

6.4.2 Results of the application of quality criteria

Principles for sustainability:

The first criterion relates to the continuous reduction of the impact on health and the environment by chemicals and the plant and equipment utilised.

For the example it is expected that Chemical Leasing will lead to a reduction in the consumption of chemicals. This leads in a direct causal chain to a reduction in the environmental impact. Notably, mining the precious metals involves the consumption of large amounts of energy and material inputs. The criterion of a *continuous* improvement is subject to limitations. After the successful implementation of the project it is expected that there will be a stepwise, but not continuous improvement with respect to process optimisation within the catalyst cycle.

Phase II involves optimisation for the various customers. Here too there will not be continuous improvements, but process deficits for each customer will be redressed in specific optimisation steps as and when they are recognised. There is interest in a continuous improvement, but for practical reasons a stepwise realisation is expected.

On the basis of the project conception it can be assumed that the first criterion can be fulfilled.

The second criterion relates to improved handling of chemicals in terms of risk avoidance and risk reduction. It is expected that this criterion will be fulfilled well, because the optimisation of handling is a core task of the project team.

The third criterion relating to avoiding substitution by higher-risk substances is not relevant for the example “Use of catalysts”, because this only involves reducing the use of the same substance.

The fourth criterion concerns improved energy efficiency, which can be expected at various points along the materials flow. Of considerable importance is the reduction in mining activities associated with the reduced amount of precious metal used. A further key factor is the improvement in the energy efficiency of the production process for which the catalyst is used.

The fifth criterion relates to the transparent distribution of risk and sharing of economic improvements between the contractual partners. This planned by the integration of all participants in joint project groups (as described above). The comprehensive registration of the incoming and outgoing amounts of catalyst is regarded as essential if the model is to function properly, and it also forms the basis for the monitoring and systematic documenting of key parameters (**Criterion 6**), as well as for the contractual allocation of risks and economic benefits.

Principles relating to state support

The example will fulfil the criteria “Emissions reduction and less chemical waste”, “Provable risk reduction” and “Reduction of energy consumption”.

However, this one off example offers little or no prospect of a wider direct dissemination. The pilot project will, however, deliver mechanisms for a multi-level optimisation at various points along the value-creation chain with the Chemical Leasing business model. This experience can be applied to other applications of catalysts, so that potential can be fulfilled in terms of economic parameters such as opening up new markets or improved international competitiveness.

To this extent there is an interest in state support in order to make the experience gained available to a broader circle of companies. Direct support for the participants or the promotion of technical solutions is not regarded as a priority by the project team.

State support could also be appropriate if a leasing company is not available as a partner. In this case, government loans or sureties could help to start the business model.

It is not possible at this stage to identify potential with respect to research and development.

Principles for target-oriented communications

As in other cases, meeting the confidentiality requirements of the partners has proved to be an extremely important part of the communications measures. The main risk is seen to lie in multilateral communications between the various partners along the delivery chain about specific project results. In the course of implementation of the project it will therefore be very important to clearly define the responsibilities and communications possibilities of the members of the optimisation team.

The aim of public communications must be to show how the business model works and to present the basic concepts of cooperation which have been developed. The participants can be expected to have an interest in the presentation of experience in an abstract form, because this offers PR benefits (“innovative company”) with marketing effects (“attracting potential customers”).

Targeted communications in this example therefore means that the experience and operating mechanisms of Chemical Leasing are passed on to the various participants with differing responsibilities and positions along the delivery chain.

Principles for smooth cooperation between partners

The cooperation between the participants must be clearly regulated. The following parameters are of key importance:

- The documentation of flow of catalyst must be transparent and comprehensive.
- The remit and responsibilities of the optimisation team must be clearly designated.
- Technical specifications exist at the various stations of the value-creation chain and are to be complied with correspondingly; the optimisation team is working on possible improvements to the provisions for the technical specifications.

The participating companies do not see the need for a special certificate. The partners have ISO 9000 certification, which is regarded as a good precondition for cooperation under a Chemical Leasing contract.

6.4.3 Summary and possibilities for a broad implementation

The pilot project is both technically demanding and the combination of participants is complex. The implementation has proved to be more time-consuming than expected. While the economic benefits are at present unclear, environmental benefits relating to the extraction of the necessary precious metals are undisputed.

Currently, the participants have declared their basic willingness to participate, negotiations are currently ongoing, and the concrete implementation is expected in 2010.

A widespread implementation is not expected in view of special technology, but there is the hope that the knowledge gained about the new form cooperation between participants could lead to the successful implementation of Chemical Leasing in the catalyst sector.

6.5 Pilot project 4: Cleaning, pre-treatment, and coating of metal surfaces

6.5.1 Overview

Mode of operation and partners:

In the classic business model, substances are bought for the pre-treatment / coating of surfaces by weight, so that the revenue of the supplier of chemicals increases if more chemicals are consumed.

With Chemical Leasing the payment is based on an agreed price for each unit area which is pre-treated or coated.

Three companies are involved in the pilot project:

- Company A, which pre-treats the raw metal components.
- Company B, which powder coats the pre-treated components.
- Company C, which provides the untreated components for A and receives the surface coated components from Company B.

Chemical Leasing is established as a principle along the entire production chain (B pays A according to the pre-treated area, C pays B according to the coated area, all partners profit from a reduced consumption of chemicals).

The following figure illustrates the relationships:

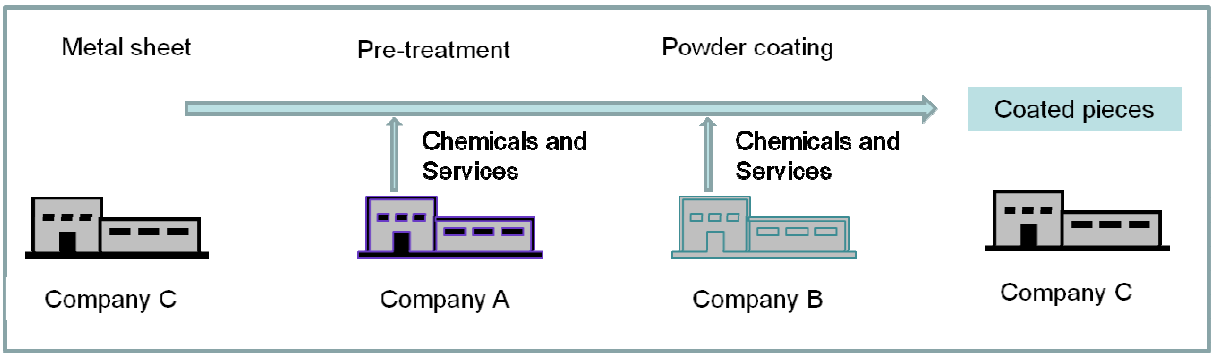


Figure 6: Participants in “Cleaning, pre-treatment, and coating of metal surfaces”

Selection criteria:

The example was selected because

- Previous experience has been gained with implementation,
- Contracts with quality criteria exist,
- Widespread implementation seems possible,

- Large reduction potential and environmental advantages are expected,
- Various participants are involved,
- Multi-stage processes,
- Export potential can be realised.

Environmental results:

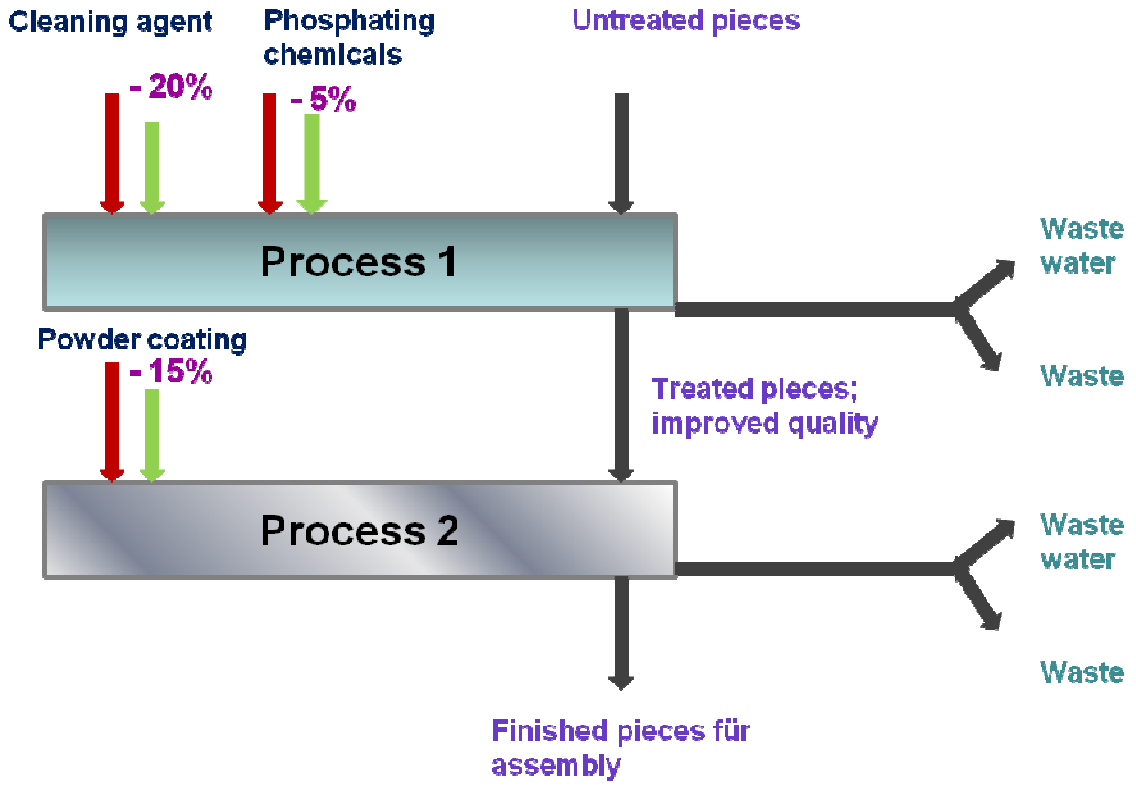
The Chemical Leasing business model leads to process optimisation and the reduced consumption of chemicals for surface treatment (pre-treatment / powder coating). These reductions can be quantified as follows:

Cleaning agents: - 20 %

Phosphating chemicals: - 5 %

Powder-based paint: - 15 %

The savings in the material flow can be presented as follows.



The reduced consumption also leads to indirect energy savings of about 15% (through material flows) and direct energy savings of less than 5 %(as the result of process changes).

Economic results:

Process optimisation involves additional effort and expenditure for the partners:

- Through the formation of the project group
- For process optimisation, laboratory analyses, tests of new admixtures, and variations of process parameters

This is compensated for over time by the reduced amounts of chemicals used. A certain minimum size of the plant and the previous level of consumption of chemicals is therefore a precondition if the business model is to be economically attractive. The threshold for the economic advantage of the partners depends on various parameters; in this specific case an amortisation period of 1-2 years can be assumed.

6.5.2 Results of the application of quality criteria

Principles for sustainability:

The first criterion (continuous reduction of the impact on health and the environment by chemicals and the plant and equipment utilised) is provable as a result of the reduced flow of chemicals in the example. There are little or no health-related impacts because the plants in which the chemicals are used are for the most part enclosed. To this extent, a reduction of health damage is less relevant. In summary, this criterion is applicable in the example and is well fulfilled.

The second criterion relates to improved handling of chemicals in terms of risk avoidance and risk reduction. Lower inventories and improved dosing are also advantages in terms of potential impacts (risk dimension), although this is not quantifiable. The criterion can be regarded as having been fulfilled in the example.

The third criterion (avoidance of substitution by higher-risk substances) was not relevant in this example because the optimisation is achieved by improvement of the process parameters.

The fourth criterion, improved energy efficiency for the use of chemicals, can be demonstrated in the example in particular by means of the reduced material flow. A further saving is achieved by the reduced number of rejected components which have to be coated again.

The fifth criterion concerning a transparent distribution of risk and the sharing of economic benefits between the contractual partners was achieved by a contract between the supplier of the powder-based paints and the supplier of the pre-treatment chemicals.

The sixth criterion (monitoring and systematic registration of key parameters) is applied in the example. A system is available by means of which excessive consumption by the user is reported to the supplier of the chemicals so that the problems can quickly be solved.

Principles relating to state support:

The following criteria were met for state support:

g) Reduced emissions and less chemical waste

h) Provable risk reduction

i) Reduction of energy consumption

j) Sufficient multiplication potential

k) Economic potential (opening up new markets, improved international competitiveness)

l) Potential for research and development (availability and applicability of new technologies and substances)

However, as in Example 1, support should not be concentrated on financial subsidies for the companies involved, because in this field Chemical Leasing can generate economic benefits.

Effective support could be provided for communications measures (e.g. information events, brochures), in order to raise general awareness.

In particular with a view to improving the adhesion of powder-based paints and optimising surface properties, nanotechnology could be of interest. However, such research and development projects are already being funded. In terms of the quality criteria, it would be of interest to subject such approaches to an environmental and health-related survey.

Principles for target-oriented communications:

The confidentiality requirements are also a priority for the participants in this example. The improvements in the process represent a competitive advantage for all partners, and this should not be endangered by communications with third parties.

Communications between the partners are very important in this example,

A quantification of environmental and health-related improvements is not possible in an anonymised form, nor is an objective presentation of the experience gained. There have been few communications measures, with virtually no precise targeting of communications measures or exploitation of multiplier potential.

Principles for smooth cooperation between the partners:

The contract for this example has relatively detailed provisions covering cooperation. The following parameters are of key importance:

- The supplier of the powder-based paints has overall responsibility for the optimisation of the production line.
- There is a joint team for the optimisation.
- The production line is mainly the responsibility of the user.
- Process parameters are monitored and values documented.
- The personnel of the user are trained by the supplier.
- The willingness of the chemicals' supplier to provide short-term solutions for special occurrences on the production line.

A special certificate is not thought to be necessary by the companies involved. The partners have an ISO 9000 certificate, which is regarded as a good precondition for cooperation under a Chemical Leasing contract. .

6.5.3 Summary and possibilities for a broad implementation

The example involves a technology which is broadly used across various sectors. The quality criteria are appropriate and are fulfilled in the example. The environmental and health impacts of a possible future implementation of nanotechnology would have to be examined analogously to a substitution of chemicals.

A broad implementation can be anticipated for the coming years in view of the initiative shown by the supplier of chemicals in this case. It can be assumed that the users will take as *benchmarks* the values typically achieved with Chemical Leasing (e.g. 10m^2 per kg powder-based paint).

6.6 Pilot project 5: Use of abrasives in the metal industry

6.6.1 Overview

Mode of operation and partners:

The Chemical Leasing constellation in this example involves two partners. The conventional method of charging for the amount of abrasive used is replaced in this case in the metal industry by charges which are based on the area of sheet metal which is treated, or on the basis of the length of ground rail. Both parties have an interest in using a little abrasive as possible.

It should be noted that this example does not involve “chemicals” in the narrower sense or within the meaning of REACH, because abrasives are classed as tools or “articles”. However, the example shows that the principles and quality criteria applied in Chemical Leasing also function in this case.

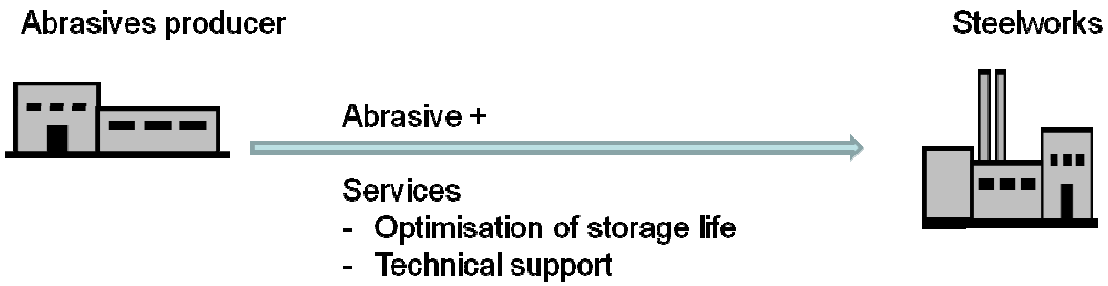


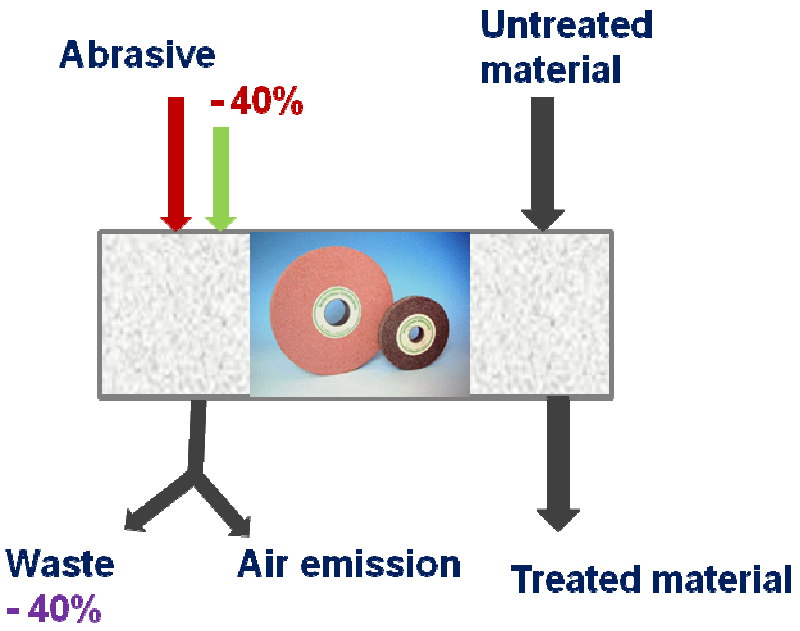
Figure 7: Participants in “Abrasives in the steel industry”

Selection criteria:

The example was selected because

- Previous experience with implementation,
- Contracts with quality criteria exist,
- Widespread implementation seems possible,
- Export potential can be realised,
- There is considerable multiplication potential,
- SMEs can be integrated.

Environmental results:



The Chemical Leasing business model leads to about a 40 % reduction in the consumption of abrasives. This leads to a corresponding reduction in waste. Air emissions are also reduced, although these could not be quantified for this example.

Economic results:

The process optimisation involves extra costs and effort for the supplier of the abrasives, which are compensated for over time by the reduced amounts of abrasive used. A certain minimum size of the plant and the previous level of consumption of abrasives is therefore a precondition if the business model is to be economically attractive.

6.6.2 Results of the application of quality criteria

Principles for sustainability:

The first criterion relates to the continuous reduction of the impact on health and the environment by chemicals and the plant and equipment utilised. .

In the example, Chemical Leasing leads to a significant reduction in the consumption of abrasives, and consequently to a reduced environmental impact. There is also continuous improvement inasmuch as there is regular further development of abrasives, with new compositions and improved storage life. In summary, this criterion is applicable in this case and has been fulfilled well.

The second criterion relates to improved handling of abrasives in terms of risk avoidance and risk reduction. In the example there was a clear overall reduction in the amounts of abrasive used. Since the classic business model had already led to suitable health and safety measures, the improvements achieved in the example did not lead to a reduction in risks proportional to the reduction in abrasives. But the criterion is fulfilled in the example.

The third criterion relates to avoiding substitution by higher-risk substances. Changes are made to the composition of the abrasives in order to improve abrasive properties and the storage life. Diamond and CBN grinding wheels can be expected to wear much better. Though there is substitution, this does not involve replacing harmless components (e.g. aluminium oxide, silicon carbide) by more dangerous ones. There is also less exposure, so that the third criterion is fulfilled in this example.

Energy efficiency can be shown to be improved in the example (**the fourth criterion**) by reduced material flows.

The fifth criterion (transparent distribution of risk and sharing of economic improvements between the contractual partners) is also fulfilled. The distribution of additional risks, and the fair compensation for additional services were contractually agreed; both partners benefit from the Chemical Leasing arrangement. Nevertheless, the partners emphasised that the model worked above all because of the trust which had grown out of lengthy business relationships.

The values of key parameters are regularly registered in this example – **the sixth criterion** – in order to check and where appropriate optimise the economic and environmental benefits of the model.

Principles relating to state support:

The criteria for state support are all met. As in Examples 1 (Cleaning) and 4 (Coating) state support should not concentrate on financial subsidies for the companies involved, because Chemical Leasing in this sector is able to generate economic benefits.

In particular, the further development of the composition of abrasives to include less harmful substances could be an interesting area for state support. Basic abrasives are produced abroad (in particular China) at very low costs, so that German producers need to offer efficient and specialised compositions. The provision of appropriate research grants in combination with the Chemical Leasing business model could improve the position of German producers.

The personnel of the user are trained by the supplier..

Principles for target-oriented communications:

The comments on target-oriented communications in the previous examples apply here by analogy. In terms of the propagation of the business model it seems desirable to carry out bilateral information events/workshops for producers and major users, because activities covering the whole of this highly competitive sector are not likely to be very successful.

Principles for smooth cooperation between the partners:

The contracts in this example include rather general provisions regarding the cooperation. The key parameter is the specification of the state of the surface after abrasion. The following factors are also important:

- The operation of the production line is the responsibility of the user, who bears the entire risk.
- Process parameters are monitored and values documented
- The personnel of the user are trained by the supplier.

A special certificate is not thought to be necessary by the companies involved. The partners have an ISO 9000 certificate, which is regarded as a good precondition for cooperation under a Chemical Leasing contract.

6.6.3 Summary and possibilities for a broad implementation

Even in sectors such as this which do not explicitly involve chemicals, the Chemical Leasing business model can be implemented successfully. The quality criteria are applicable and they are fulfilled in the example. The mutual trust of the business partners is regarded as a key factor for success. The producer of the abrasives is not willing to accept additional liability, which is a limitation on the widespread adoption of the business model.

6.7 Pilot project 6: Glass bonding using sealant tape

6.7.1 Overview

Mode of operation and partners:

Before the introduction of the "Glass bonding" Chemical Leasing model, charges were based on the amount of adhesive delivered to the construction site, and glass bonding was carried out on site. In the example, calculations are based on the amount of bonded glass, and bonding will probably not take place on the construction site but at suitable assembly centre. The expertise of the participants is combined in order to achieve the best possible application of the adhesive. All partners profit from the optimisation; a possible distribution of liability risks can represent a further benefit for the participants.

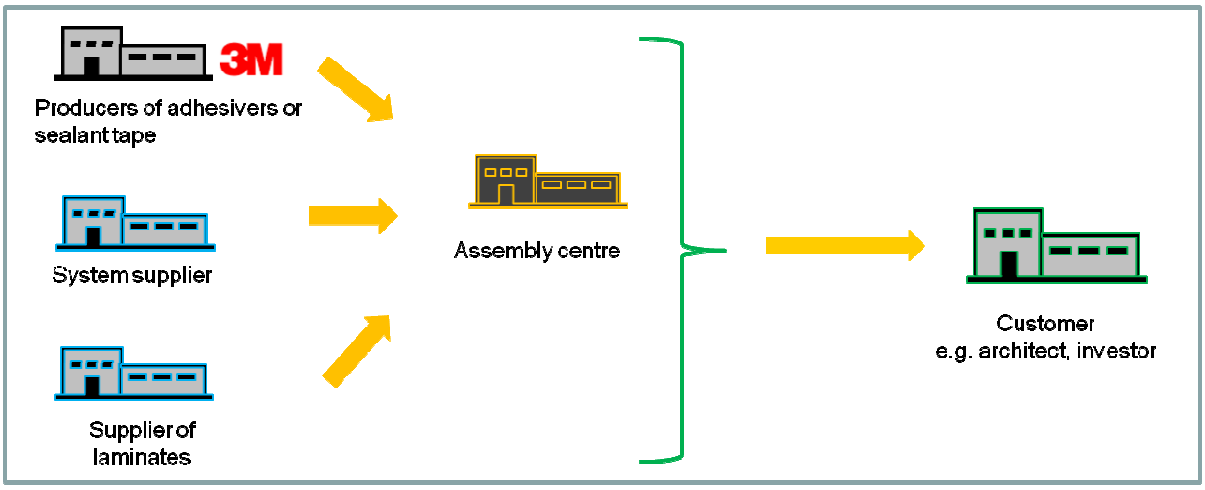


Figure 8: Participants in the Model project "Glass bonding"

Selection criteria:

The example was selected because:

- There is considerable potential for various applications,
- A new technology is involved,
- A high profile is ensured,
- There are several participants,
- A multi-level process is involved,
- SMEs can be integrated,
- Substitution exists within the Chemical Leasing.

Environmental results:

There are no quantifiable environmental results, because the project is still in the conceptualisation phase. The participants estimate a reduction of 20-30% in the amount of chemicals used.

In this example, a special bonding tape is substituted for silicone adhesive. A detailed review of the alternatives shows that the new tape leads to a reduction in risks for the environment and human health.

Economic results:

There are no quantifiable economic results, because the project is still in the conceptualisation phase. The participants expect to achieve a business model which offers improved economic parameters for all partners.

6.7.2 Results of the application of quality criteria

Principles for sustainability:

In terms of the individual criteria, the following is expected:

- Established improvements in terms of environmental impact and health risks
- Improved handling with reduced risks
- Substitution which does not lead to a worsening of the situation
- Energy efficiency which has not yet been calculated
- Redistribution of risks (anticipated)
- Monitoring and measurement systems are being planned

The first criterion relates to the continuous reduction of the impact on health and the environment by chemicals and the plant and equipment utilised. Lower environmental impact is achieved in the example by reductions to the flow of materials. A detailed quantification and material flow balance was concluded in February 2010. A reduction in health risks (exposure to chemicals) can probably also be shown in the conceptualisation phase.

The second criterion relates to improved handling of chemicals in terms of risk avoidance and risk reduction. In the example, there will probably be a relocation from the construction site to a factory with optimised supervision of the application of bonding agents, and thus a reduced risk. The supplier of chemicals can make use of specific and risk-related expertise to

supply ready-bonded elements. This will also mean that fewer chemicals have to be stored, which is of mutual benefit under the Chemical Leasing contract, and which will mean that the risks are reduced.

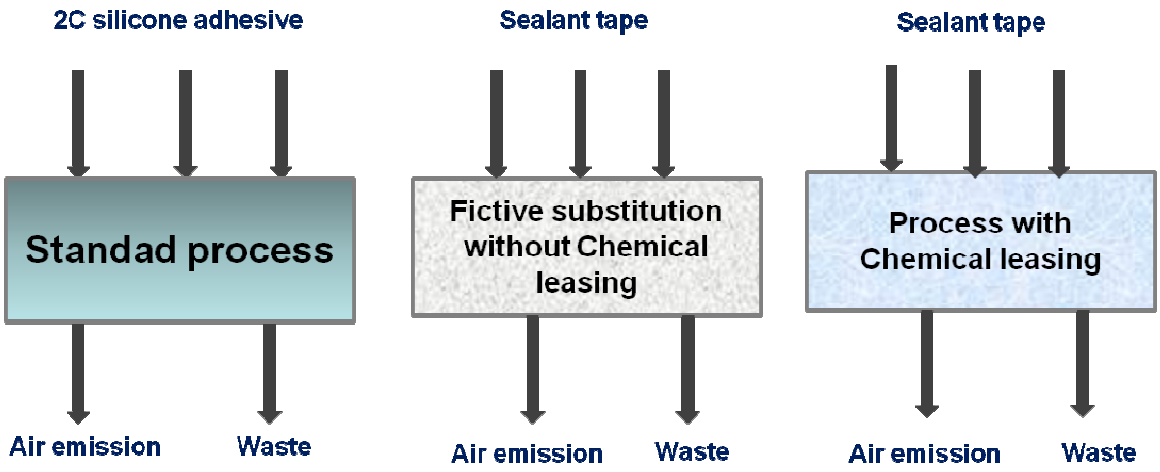
The third criterion relates to avoiding substitution by higher-risk substances. In the example it is first necessary to establish when there is an increased environmental impact and higher health risk. A starting point is the ranking of the substances according to REACH / GHS and the exposure of environmental compartments and people. The previous standard process can be compared with both an imaginary substitution without Chemical Leasing, and the real substitution with Chemical Leasing.

The effects for both the environment and human health are then assessed for the standard process and an imaginary substitution without Chemical Leasing. Finally, the expected savings by means of Chemical Leasing are included in the assessment.

The three steps of this approach are depicted in the following overview:

Step 1:

Comparison of the material flows

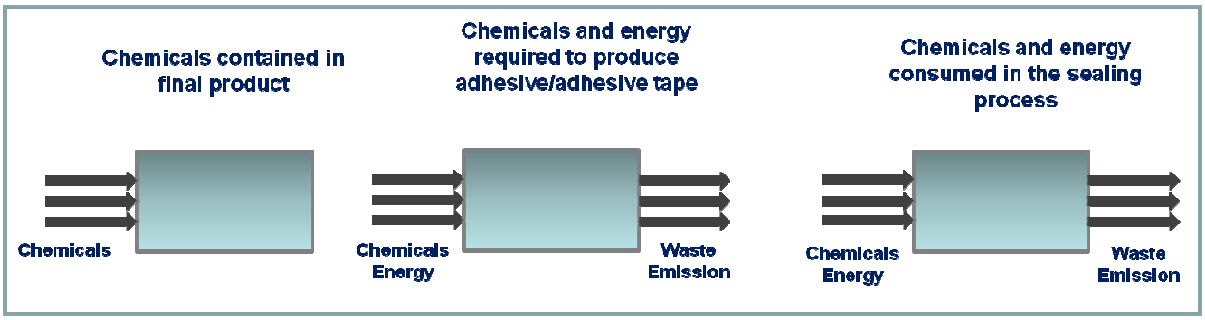


Step 2:

Assessment of the impact on the environment and health for the standard process and the imaginary substitution without Chemical Leasing

→ No actual worsening

→ No increased risk



Step 3:

Evaluation of the improvement as a result of Chemical Leasing

The specific investigation of the process envisages a detailed analysis of ten process steps for a typical customer. After approval by the company, the results and the approach adopted will be presented in the final report.

The fourth criterion concerns improved energy efficiency. This can conveniently be quantified by means of the CO_2 balances. The results in this case are a by-product of the detailed process analysis for the previous criterion.

The fifth criterion for the sustainability concerns a transparent distribution of risks and the division of economic benefits between the contract partners. Negotiations about this are ongoing. It is anticipated that the producer of the bonding tape will be prepared to take on increased risk.

The sixth criterion concerns monitoring and the systematic registration of results for key parameters. These are included as a core element of the project conceptualisation.

Principles relating to state support:

All the criteria for state support will probably be fulfilled:

a) Reduced emissions and less chemical waste

b) Provable risk reduction

c) Reduction of energy consumption

d) Sufficient multiplication potential

e) Potential with respect to economic factors (opening up new markets, improved international competitiveness)

f) Potential for research and development (availability and applicability of new technologies and substances)

A financial subsidy for the companies involved is not appropriate, because Chemical Leasing in this sector can rapidly generate economic advantages for all participants.

Support for communications measures (e.g. information events, brochures) is expected to prove an effective way to close existing gaps in knowledge and to inform about innovative solutions with reduced environmental impact and lower health risks.

Principles for target-oriented communications:

The confidentiality requirements of the participants are probably less of a priority in this case than in other examples. A main reason is that the process optimisation involves a new product and new assembly conditions which cannot simply be copied. However, precise data will only be available after the successful implementation of the project.

Quantification of environmental and health-related improvements will be possible, as will the objective presentation of the experience gained. Communications measures are currently at a very low level, but it is intended to target communications carefully and to utilise the available multiplication potential.

Principles for smooth cooperation between the partners:

The criteria developed by the project team were received positively. At present, it is being considered whether a special audit and possibly also certification should be carried out for the Chemical Leasing business model.

6.7.3 Summary and possibilities for a broad implementation

The project is currently in the conceptualisation phase, although the participants are optimistic that it can be optimised soon.

It is expected that all quality criteria will be fulfilled.

The goal is to achieve a widespread implementation for the newly developed adhesive tape both nationally and internationally.

6.8 Pilot project 7: Coating sheet aluminium for the production of beverage can lids

6.8.1 Overview

Mode of operation and partners:

Cans are one of the most important packaging forms for carbonated beverages. Consumers appreciate the feeling of freshness and refrigeration they convey. They are assembled from a cylindrical body, which may be of steel (tin plate) or aluminium, and an aluminium lid. In Europe, 50 billion cans are sold every year; the recycling rate in Germany is more than 90%.

An aluminium rolling mill produces sheet metal for the beverage can lid. The aluminium band is sealed on both sides and sold as a coil to the can lid manufacturer, where the lids are cut out and shaped. The lid is attached to the body of the beverage can after this has been filled. The coating applied in the aluminium rolling mill must meet exacting quality demands because of the further processing and the contact with foodstuffs. The coating is rolled on, so that there are virtually no losses on the input side, in contrast to the use of spray pistols ("overspray").

If the Chemical Leasing business model is to be implemented in this case, then the participants are the producer of the coating and the aluminium rolling mill. The goal is the minimisation of the use of the clear, food-safe surface coating for the aluminium sheet. In Chemical Leasing, payment is made for the area of sheet which is treated.

The discussions on the implementation of Chemical Leasing were held with one of the world's major producers of surface coatings, with some 9500 employees in more than 25 countries, and a German branch of a major player on the world market for rolled aluminium products with some 12 300 personnel in 11 countries.

In the first meeting, the management of the surface coating user showed interest in the Chemical Leasing business model. However, in the course of discussions about the delivery and production situation with the supplier it turned out that the Chemical Leasing approach is **not applicable** in this specific situation. The main reason that this pilot project could not be implemented is that both parties involved could not see any optimisation potential of the production process which would result in appreciable cost savings. The product in question is already very highly developed. The very tight specification of the surface coating quality and the legal requirements for varnish used in contact with foodstuffs leaves no room for changes to the composition of the surface coating. Nor was it possible to adapt the production plant at the lid manufacturer supplied by the aluminium rolling mill, because this also received sheet metal from other suppliers so that the specifications would also have to be coordinated with them.

Selection criteria:

The example was selected because

- Aluminium for beverage cans is a mass product and reductions could lead to appreciable environmental advantages,
- Contracts already included quality requirements,
- A high multiplication potential exists because of a targeted promotion of environmental benefits as part of marketing measures.

Environmental results:

The aluminium sheet used to manufacture beverage can lids is produced in large amounts. Improved material and energy efficiency would consequently offer environmental advantages. However, the production processes in question are already subject to a continuous optimisation process, so that the participants saw no further optimisation potential. In this example, therefore, no environmental improvements could be achieved through Chemical Leasing.

Economic results:

Once again, the large production volumes suggested the possibility of considerable economic benefits as a result of process optimisation. However, the project partners feared that the savings achieved if Chemical Leasing were realised could not be converted into cost benefits for the two project partners. They argued that the can manufacturer, on being informed of the changes in the production process would demand a corresponding reduction in the price for the coated metal.

6.8.2 Results of the application of quality criteria

Principles for sustainability:

Since in this case the Chemical Leasing model could not be implemented, the criteria will be considered here which have proved particularly critical.

A few years ago, the project partners had considerably improved the coating process. Therefore they see no further optimisation potential at present. The changes involved above all the composition of the coating solvent, and led to a considerable reduction in the proportion of volatile organic compounds. The environmental impact was thus reduced , and the increased use of water-based solvent also reduced the health risks and other production-related risks. There was no substitution involving increased risks. The principles required by Chemical Leasing regarding sustainability were on the whole fulfilled following the introduction of the previous improvements.

The distribution of risk between the partners was mentioned as a problem many times in the discussions. It became clear that the project partners had not expected any economic benefits, even if there proved to be further potential for process optimisation, due to the existing contractual constellations with the user of the coated aluminium sheet.

Principles relating to state support:

In the example, the integration of further business partners along the value-creation chain would have been decisive for the successful application of the Chemical Leasing strategy.

In order to reduce the existing hindrances to the acceptance of further business partners, it would help if state support were provided for communications measures to propagate the experience gained with successful Chemical Leasing projects. In addition, specialist articles, information events or brochures could present Chemical Leasing.

Principles for target-oriented communications:

The project partners attached considerable importance to confidentiality. The user of the chemicals was very interested in a quantification of the economic benefits and the use of these results for marketing purposes. The manufacturer of the surface coating was worried that other customers might also want to profit from any improved products and scope for cost reduction and the business relations to them could have worsened. The user of the surface coating also sees the danger that other companies which were not allowed to participate in the Chemical Leasing could turn to other business partners. Such reservations considerably restrict the scope for effective public relations activities to propagate the idea of Chemical Leasing.

Principles for smooth cooperation between the partners:

The user and supplier of the surface coating had already worked together very intensively and harmoniously before the start of the discussions about Chemical Leasing. Both companies have been successfully applying the principles of the *Continuous Improvement Process* (CIP) and *Kaizen*[4] for years, and process optimisation has been carried out continuously, including as a result of joint initiatives. A few years ago, by sharing their expertise, the surface coating procedure could be rearranged and made much more efficient (see Section 4.2 *Principles for a sustainable Chemical Leasing business model*).

The can lid manufacturer (customer of the aluminium rolling mill) has a very good overview of the market and would use it market power to demand transfer of the cost advantages arising from potential material savings. The two partners involved in Chemical Leasing would have no way of retaining any cost advantage within their companies. The alternative would be to integrate the lid manufacturer in the Chemical Leasing procedure, and such cooperation could have eliminated many of the process-specific constraints. However, this was out of the

[4] *Kaizen* refers to the Japanese philosophy of continuous improvement, which has been further developed above all as a quality management strategy.

question for the two business partners in view of their dependency on the much larger company.

6.8.3 Summary and possibilities for a broad implementation

The successful implementation of the Chemical Leasing concept requires potential for optimisation, so that cost advantages can be generated by reducing the consumption of materials and energy. However, in the case of highly-developed processes there may no necessarily be such an optimisation potential.

The producer of the surface coating would willingly consider entering into the Chemical Leasing business model with medium-sized companies if there were not tightly defined specifications, where the processes have not already been optimised, and where as a consequence one could expect greater potential for cost-reductions.

6.9 Pilot project 8: The use of pesticides in agriculture

6.9.1 Overview

Mode of operation and partners:

With the classic business model, pesticides are paid on the basis of the amount of active substances or ready-to-use mixture which is purchased. The producer also supplies mixing and application instructions. Chemical Leasing for pesticides is based on payment for the benefit of the pesticide, which can take the form of protecting a certain area of agricultural land against harmful organisms and reducing the level of pest infestation to an acceptable level. A logical basis for payment could thus be based on a price per unit area with an acceptable incidence of pests. All participants would then have a joint economic interest in reducing the use of pesticides in agriculture to a necessary level. It would be necessary to agree on a clear definition of acceptable limit of infestation, which would have to be specified for each case.

In order to achieve the minimisation, it is necessary to identify the reasons for an excessive consumption. These can include the maintenance and quality standards of the equipment with which the pesticides are applied, the experience of the farmers, and other local factors (e.g. weather conditions).

The pilot project has not yet been implemented, but discussions have been held with possible partners. There are currently indications of a possible joint pilot project with partners from Germany, Austria and Slovenia. In parallel, pilot projects are to be started in Sri Lanka, Serbia and Morocco within the framework of the UNIDO initiative .

The pilot project includes the producers of the pesticides, the suppliers, equipment manufacturers, experts for pest infestation, and farmers. The aim is to form a consortium to offer a tailor-made service for the farmers which is paid for in terms of benefit-oriented units.

The following figure illustrates the envisaged cooperation:

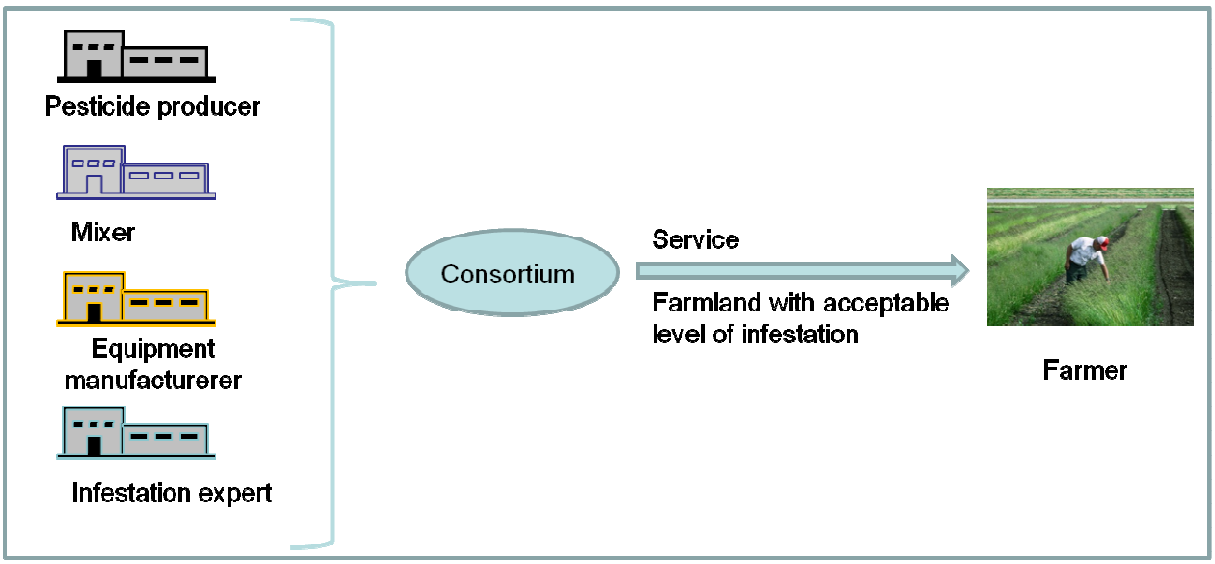


Figure 9: Participants in the model project “Pesticides”

Selection criteria:

The example was selected because

- High profile is ensured,
- Considerable reduction potential and environmental advantages are expected,
- Various participants are integrated,
- Export potential can be realised,
- SMEs can be integrated.

Environmental results:

As explained above, the pilot project is still in the planning stages. In Germany it is expected that reductions in the order of 20% can be achieved, in other countries it ought to be possible to achieve reductions of up to 60%.

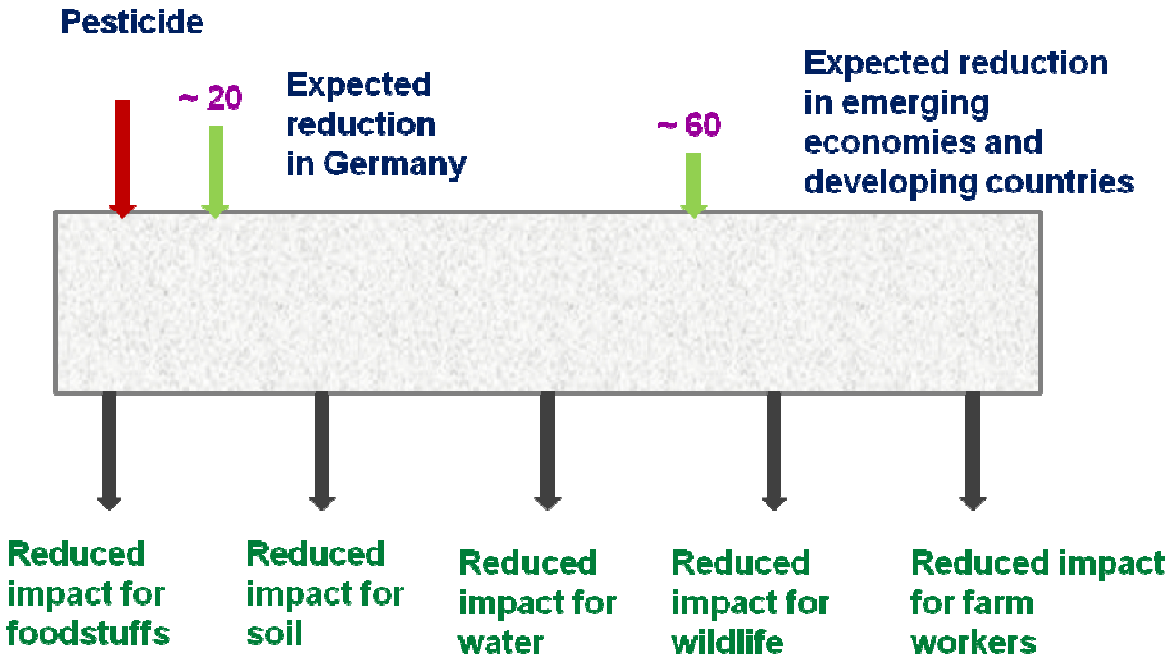


Figure 10: Expected reduction for Chemical Leasing with pesticides

Economic results:

The conceptualisation phase has shown that key sources for process optimisation are the experts on application equipment (sprayers) and the agricultural advisers. Integrating this expertise is essential for the successful implementation of the project.

There has been no economic quantification, but it is expected that the outlined potential will make the business model sufficiently attractive. In addition, there is the incentive that the use of less pesticide in agriculture will lead to lower pesticide levels in agricultural products.

6.9.2 Results of the application of quality criteria

Principles for sustainability:

- Reduction of environmental and health impacts seem certain
- Improved handling with reduced risk seems certain
- There is no substitution with substances with a higher risk; however the necessary assessments must be carried out for each individual case
- Only indirect improvements in energy efficiency are expected (due to the lower amounts used)
- The distribution of risk remains to be clarified in the course of the pilot project
- The monitoring and measuring system will also have to be developed as part of the pilot project
- Communications are not clarified and will have to be developed within the framework of the pilot project
- Criteria required for cooperation with equipment manufacturers (anticipated)
- Coordination with *Integrated Pest Management* (IPM) criteria is important (anticipated)

The conclusion is that at present it is not possible to quantify the compliance with the quality criteria with any precision. However, sustainability is expected for the Chemical Leasing of pesticides. Difficulties are expected in particular with the allocation of risks and responsibility, so that some time will be required for the implementation of the pilot project.

Principles relating to state support:

It is expected that all criteria for state support will be fulfilled:

a) Reduced emissions and less chemical waste

b) Provable risk reduction

c) Reduction of energy consumption

d) Sufficient multiplication potential

e) Potential in terms of economic factors (opening up new markets, improved international competitiveness)

f) Potential for research and development (availability and applicability of new technologies and substances).

In this case it may also be necessary to provide financial support for the farmers who take part. An application to the European Commission is currently being prepared.

Principles for target-oriented communications:

In contrast to the other examples, Chemical Leasing for pesticides is not expected to involve calls for high levels of confidentiality. The process optimisation requires the avoidance of errors – and the objective presentation of experience should be in the interest of all participants. The quantification of environmental and health-related improvements may represent a considerable challenge in the project, because various parameters influence the results (climate, infestation cycles). Quantification over a number of years is therefore necessary.

The communications are taking place against the background of an immense multiplication potential in Germany and worldwide. This means that targeted, actor-specific communications will be very important.

Principles for smooth cooperation between the partners:

There is not yet any experience about the cooperation between the participants. Due to the comparatively complex situation and the difficult allocation of responsibility and risk, it is expected that the quality criteria will play an important role.

6.9.3 Summary and possibilities for a broad implementation

The “Pesticides” pilot project is currently in the negotiations phase. It is already apparent that there is considerable potential here for Chemical Leasing, in particular because of:

- A possible integration /combination with IPM / the new EU law relating to pesticides;
- The global economic and environmental potential
- The lively interest in scientific monitoring

German producers of pesticides are involved in the conception of the pilot project, but suitable agricultural users of pesticides in Germany have not yet been identified. Interest has been shown mainly by users from other countries.

6.10 Pilot project 9: Use of disinfectants in hospitals

6.10.1 Overview

Functioning of Chemical Leasing and partners:

In the classic business model, disinfectants are purchased by volume or weight. This can either be a concentrate requiring dilution or mixing, or it may be a ready-to-use mixture. With the Chemical Leasing business model and benefit-oriented payment, the expectation is that hygienic conditions can be improved while reducing the use chemicals.

In a project of the *Deutsche Bundesstiftung Umwelt,* this pilot project is being carried out by Schülke & Mayr GmbH and the Worms Clinic. The project team will receive documents about the project and apply the quality criteria. Results will be passed on to the Federal Environment Agency as soon as they are available.

7 Outlook

The research project of the Federal Environment Agency has aimed to strengthen Chemical Leasing in two respects:

- In terms of content, with easily-applicable quality criteria which support a high standard of the business model from an environmental and health-related point of view;
- In terms of implementation, because model projects make practical experience available and suitable communications increase awareness about Chemical Leasing.

Both goals were achieved. The research project will also influence the future development of Chemical Leasing, because:

+ The quality criteria have been adopted by UNIDO and are now being tested and implemented in various international projects,
+ The quality criteria are also being used for the selection of International Chemical Leasing Award winners,
+ The German steering committee set up in the course of the project (in analogy to the international working group) will continue to operate, and following this example national working groups have also been established in other countries (e.g. Serbia, Morocco, Sri Lanka),
+ Communications will be continued with manufacturing companies and business associations in Germany about the implementation of Chemical Leasing (e.g. as part of the DECHEMA colloquia),
+ The political dimension of Chemical Leasing has been further established as a contribution to SAICM.

However, the experience of the research projects also shows that not every project which is begun with enthusiasm and high hopes can be brought to a successful conclusion, and that it will be vitally important in the coming years to analyse the constraints which have been encountered and to develop ways of overcoming these.

8 Annex

8.1 Minutes of the 1st steering committee meeting

1. National steering committee meeting for the project "*Chemical Leasing as a model for sustainable development with test procedures and quality criteria on the basis of pilot projects in Germany"*

23 June 2008, UBA, Berlin, 11.00 a.m. - 4.00 p.m.

Moderation: Dr. Steffi Richter

Project leader: Susanne Walter-Rohde

The detailed agenda, list of participants and all presentations are contained in the appendix.

1. Welcoming remarks

The first steering committee meeting began with welcoming remarks followed by the presentation of the agenda. The practical orientation of the steering committee meeting discussions was emphasised.

2. Background and objectives of the project; Function of the working group

The German Chemical Leasing project has been conducted since January 2008 by a project team made up of BiPRO, the University of Göttingen and TÜV SÜD. The objective is to initiate Chemical Leasing pilot projects in various sectors in Germany, to identify multiplication potential, develop quality criteria and promotion concepts, and to communicate the results effectively.

The steering committee is intended to establish links with producers, users, scientists, authorities, and consultants and to integrate their views in the approaches adopted and the proposed solutions. The steering committee is the German interface for the activities of the international Chemical Leasing working group.

3. Introduction of the participants

The participants at the steering committee meeting introduced themselves and outlined what they expected from the meeting.

4. Introduction of Chemical Leasing

The presentation by BiPRO explained in detail the basic principles, mode of operation and the definition of Chemical Leasing. Examples of international Chemical Leasing activities highlighted the scope of application. Chemical Leasing could only be briefly compared and contrasted with other business models due to lack of time.

The presentation led to the following comments, objections and conclusions:

- Technical optimisation potential of the process in question is a precondition for the start of a Chemical Leasing project.
- In order to start a Chemical Leasing project successfully it also necessary to have a basis of trust between the partners and a willingness to exchange know-how. The

internal cooperation and the transparency can lead to dependency and in particular the user can lose flexibility. This is an important constraint.
- When deciding on the applicability of Chemical Leasing models, the core competence of the company should be considered. From the point of view of the user, Chemical Leasing works in particular when it does not affect core competence. It is necessary to consider whether Chemical Leasing is appropriate for a company on a case-by-case basis.
- The various participation models for Chemical Leasing make it possible to include manufacturers of plant and equipment, recycling companies, and trading companies.
- The concept of “leasing” only relates to one part of the Chemical Leasing model, which is much more than merely a financing model. Therefore Chemical Leasing should be given a sub-title which makes the meaning clearer. Several ideas were discussed.
- In the English definition of Chemical Leasing, the sentence “Chemical Leasing is a win-win situation” should be changed to “Chemical Leasing strives for a win-win situation”.

5. Potential for Chemical Leasing in Germany and procedure for the selection of example cases

BiPRO presented a methodology for the selection of promising pilot projects and an optimum approach to the promotion of Chemical Leasing. The suitability of chemicals for Chemical Leasing, the differentiation of chemicals according to production statistics, and the evaluation of sectors and processes according to the NACE Code were discussed.

- The decision tree for assessing the suitability of chemicals for Chemical Leasing will be revised and specified further, so that there are no unwanted eliminations. It should be as open as possible for all processes and options.
- The evaluation of sectors according to the NACE Code seems to be very helpful for core processes, but only of limited relevance for cross-sectoral processes.
- It was recommended that at the present stage of the project the selection should be very broad, experience should be collected from every sector, and existing optimisation potential in Germany sought. Above all, technological processes should be identified which are not yet already very advanced, but which are working with process chemicals and additives (e.g. agriculture).
- It was proposed to consult with sector associations, which have extensive knowledge of their field.
- The groups discussed the extent to which substitutions form part of the Chemical Leasing concept and whether it is only concerned with “best practice” or whether the approach can also lead to new options being found for processes. It was concluded that Chemical Leasing is always concerned with process optimisation. Where the participants have shared interests and there is innovation management there may also be scope for a chemical free option.

6. State of work on quality criteria

TÜV Süd presented a first draft of a broad quality criteria catalogue for Chemical Leasing projects. The quality criteria will in future be developed further in parallel to the pilot projects, tested in the case examples, and if appropriate abridged or improved. It was pointed out that quality criteria are often raised by the Chemical Leasing partners and in addition to environmental criteria, trust-building measures are also called for.

The following comments and proposals were made:

- CMR substances and other chemicals requiring authorisation under REACH (e.g. PBTs) should not be excluded *a priori* from Chemical Leasing- projects, since they may offer scope for Chemical Leasing and the more efficient use of input factors. The use of CMR substances as substitution products must be avoided (in accordance with REACH). The aim should be to reduce the use of substances requiring authorisation.
- The complementary elements linking Chemical Leasing and REACH and the differences between them should be communicated better.
- The question was raised about which criteria were really necessary for promotion of Chemical Leasing projects and at which phase in the project these criteria should be formulated: at the proposal stage or later.
- It was recommended that the quality criteria should be specified and tested in the pilot projects. In each individual case, additional environmental criteria should be developed and assessed. An environmental audit at the end of each case example would make it possible to present environmental benefits quantitatively.
- Health-related and environmental quality criteria have different objectives and they should be examined and evaluated separately.

7. State of work on a promotion strategy

Various dimensions of a promotion strategy for Germany and possible components were outlined.

- The proposal of promotion in the form of R&D investments was thought to be very promising.
- The importance of raising national and international awareness for Chemical Leasing was emphasised. Several “Lighthouse projects” were essential for this.
- It is important to present Chemical Leasing in the context of SAICM.

8. Status of the examples

Six Chemical Leasing examples from various sectors and at differing stages of development were presented, and it was proposed that in the course of the project a catalogue of industrial experience should be drawn up.

9. Public relations work and Website

The presentations could not be held at the meeting due to lack of time, but they are in the appendix. PR work on Chemical Leasing includes activities within SAICM, at international conferences and workshops, and also publications, and a Website.

The next steering committee meeting is planned for March 2009.

8.2 Minutes of the 2nd steering committee meeting

2nd steering committee meeting for the project "Chemical Leasing as a model for sustainable development with test procedures and quality criteria on the basis of pilot projects in Germany"

30 April 2009, UBA, Berlin, 11:00-16:00

The detailed agenda, list of participants and all presentations are contained in the appendix.

1. Welcoming remarks and introduction of the participants

The second steering committee meeting began with welcoming remarks and the introduction of the participants

2. Background and objectives of the project

The German Chemical Leasing project has been conducted since January 2008 by a project team made up of BiPRO, the University of Göttingen and TÜV SÜD. The objective is to initiate Chemical Leasing pilot projects in various sectors in Germany, to identify multiplication potential, develop quality criteria and promotion concepts, and to communicate the results effectively. It was emphasised that Chemical Leasing can make a significant contribution to sustainable chemistry.

3. Overview of Chemical Leasing

The current project status was presented in overview and the main developments since the last steering committee meeting briefly explained.

In addition to Chemical Leasing, there are other comparable service-oriented business models on the market in Germany. The mode of operation and the current developments of business models such as Chemical Management Services (CMS), classic leasing, Contracting, and Pay-on-Production models were compared with Chemical Leasing, and the main similarities and differences discussed. In particular in comparison with CMS it was emphasised that Chemical Leasing promotes applicability and sustainability, and the focus is not simply on cost optimisation, e.g. for personnel costs.

In addition, synergy between Chemical Leasing and the European Union Chemicals regulation REACH was considered in more details. Potential was found, in particular with respect to more intensive cooperation and communications along the supply chain. The

transfer of knowledge and experience from Chemical Leasing projects to REACH and in other sectors is already working (e.g. safety data sheet, incident reports). It was noted that Chemical Leasing supports REACH compatibility, but there are as yet no indication of REACH promoting service -oriented business models. It was proposed that interactions could be initiated between REACH and Chemical Leasing, e.g. by presenting the Chemical Leasing approach at REACH information events.

An overview was given of the presentation of German Chemical Leasing activities at national and international levels. International activities included the cooperation with UNIDO, participation in the international working group for Chemical Leasing, and various conference contributions. The German Chemical Leasing Web site is constantly updated, although confidentiality is respected when referring to the examples.

4. Overview of the German pilot projects

When selecting case examples in Germany various sectors, processes and company sizes were taken into consideration in order to ensure a broad range of pilot studies. Eight Chemical Leasing examples at various stages of development were presented. Due to lack of time, four examples were discussed in detail, and the others only considered briefly. The comments are to be understood as additions to the detailed presentations.

Example 1: Cleaning in the food and pharmaceuticals industries

This is an established and well-documented example, in a field in which charges had been based on the amount of cleaning agents purchased from the producer. It was emphasised that in this sector the producer often requires the user to have a “critical size”. The effort involved in the optimisation should be balanced by a minimum savings potential for the producer, and this is more likely to be the case with larger partners. A critical size could be achieved by cooperation between users and the inclusion of plant constructors.

Example 2: Underbody coating in the automotive sector

Instead of charging for tonnes of PVC, payment is made for each vehicle treated. The project partners include PVC powder producers, paste producers, manufacturers of application systems, and an automotive company. Discussions are to be resumed and additional partners are to be included from the start. A major automotive company would then be contacted with a more precise proposal, or the packet will be offered to other car makers.

Example 3: Catalysts

Partners in this pilot project are producers of catalysts, processors, users, and a leasing company. It was explained that the leasing company owns the catalyst and provides the finances for the precious metal, although without any technical involvement. All the participants involved in the technical processes have an interest in minimising losses and optimising the system, because losses have to be replaced. Precise registration and allocation of losses (during recycling, processing, etc.) is essential. Currently the project is in Phase 1 (minimising losses). Phase 2 (minimising the amounts used) is in preparation.

In the discussion, the limitation of resources was brought up (e.g. indium). It was agreed that this effect would be considered in the Chemical Leasing approach. The inclusion of financial

investors in Chemical Leasing could be of interest in particular for start-Up companies in nanotechnology/surface coating technology.

Example 4: Surface coating

This approach includes the entire supply chain from pre-treatment, through coating to finishing of metal sheet. This example raises in particular opportunities for the export of German technology.

Example 5: Abrasives in the metal industry

This is an established project which could possible be extended to include additional producers.

Example 6: Glass bonding

This pilot project in the construction sector aims at minimising the waste of adhesives and achieving a sustainably improved environmental audit. The goal is to move towards charging for a complete modular solution. Currently, options are being considered, partners identified, and roles allocated. In addition, aspects of the distribution of risk and acceptance of liability need to be clarified.

Example 7: Coating of beverage can lids

With the participation of Coca-Cola, this project promises to have a considerable lighthouse effect. Concrete discussions are in progress on a pilot start.

Example 8: Pesticides

There is considerable European interest in the pesticide pilot project, in particular in combination with Integrated Pest Management (IPM). Several German producers are interested, but suitable users are currently being sought.

5. Quality criteria for the environment and human health

An overriding project objective is the development of quality criteria for Chemical Leasing with the focus on the protection of human health and the environment. A proposal has been developed for this on the basis of the discussions at the 1st steering committee meetings, suggestions made by the international working group, and feedback from companies involved in national and international pilot projects.

The quality criteria were developed on the basis of four considerations:

- Requirements for protection of human health and the environment;
- Targets for protection of human health and the environment;
- Environmental and health-related criteria in terms of fundability;
- Criteria relating to cooperation between participants.

In the discussion the following points were raised and proposals made :

- Differentiation was suggested for the second requirement concerning hazardous chemical and substitution: A definition of “dangerous substances” in the Chemical Leasing criteria could be based on the REACH Regulation. Substitutions should not be completely banned,

but should only be permitted when no overall "environmental and health-related disadvantages" result. It was proposed that potential interactions between Requirements 1 and 2 should be examined. Requirement 2 may be a special case of Requirement 3.

- The philosophy of "continuous improvement" should be reflected in Requirement 3. This criterion should ensure scope for various starting conditions and for the promotion of innovations.

o Monitoring measures should be explained in more details, because they are not only important for quality criteria, but also for the trust between existing and potential Chemical Leasing partners. A problem when deciding on specific monitoring measures is that many companies involved in Chemical Leasing (or potential participants) require some (monitoring) data to be treated confidentially.

- The question was raised whether criteria could be added to the internationally accepted definition of Chemical Leasing and whether it would be adequate for formulate only target criteria (without requirements).

- A range of formulations for criteria were considered, from soft approaches (in line with the 12 Principles of Green Chemistry after P.T. Anastas) to hard approaches (on the basis of ISO standards).

- It was agreed to bring requirements and targets together, initially in the form of a catalogue of principles which should be used and tested in the projects.

6. Approaches for a possible promotion strategy for Chemical Leasing in Germany

This presentation could not be given in the meeting due to lack of time, but it is included in the appendix. Various dimensions and possible components of a promotion strategy for Germany were presented.

7. German contribution at SAICM meeting on 13 May in Geneva

On 13 May in Geneva a Chemical Leasing side event to the ICCM-2 Conference took place under the title "Green Industry – Innovative approaches to sound chemicals management", organised by UNIDO, Germany and Austria. In the course of this event, the German Chemical Leasing Initiative was presented.

The third steering committee meeting is planned for mid-November 2009.

8.3 Minutes of the 3rd steering committee meeting

3rd steering committee meeting for the project "Chemical Leasing as a model for sustainable development with test procedures and quality criteria on the basis of pilot projects in Germany"

6 November 2009, Federal Environment Agency, Berlin, 11:00-16:00

The full agenda, list of participants, and the presentations are contained in the Annex.

1. Welcoming remarks and presentation of participants

The third steering committee meeting began with welcoming remarks and the introduction of the participants.

2. Background and objectives of the project

The German Chemical Leasing project has been carried out since January 2008 by a project team made up of representatives of BiPRO GmbH, University of Göttingen, and TÜV SÜD. The objective is to initiate Chemical Leasing pilot projects in various sectors in Germany, to identify multiplication potential, develop quality criteria and promotion concepts, and to communicate the results. The project is reaching its conclusion at the end of January 2010. The draft version of the final report of the project will be made available for comments in the middle of December.

3. State of work on quality criteria for health and environmental protection

A priority objective of the project is the development of quality criteria for Chemical Leasing focusing on the protection of the environment and human health. On the basis of the comments and discussions at the 2nd steering committee meeting, the intentions of the quality criteria were presented and quality criteria as part of the principles.

Quality criteria should establish a high standard for Chemical Leasing and contribute to the best possible functioning of the business model. In this context, the voluntary nature of the quality criteria was emphasised; these are guidelines and not binding regulations.

A high standard of Chemical Leasing is important in particular for the following sectors:

- Specific environmental improvements
- Specific economic improvements

- Efficient deployment of public funds
- Targeted communications to promote Chemical Leasing
- Efficient and smooth cooperation between the participants

A side-effect of the quality criteria is that they afford a clear distinction to other business models, while existing synergy effects can be used and the dissemination of Chemical Leasing can be supported.

On the basis of the comments made at the 2nd steering committee meeting, the quality criteria were defined as part of Principles, which are also intended to provide orientation of the activities of the participants.

Four basic principles were differentiated:

I. Principles for a sustainable business model
II. Principles in terms of state support
III. Principles for target-oriented communications for the dissemination of Chemical Leasing
IV. Principles to ensure smooth cooperation between Chemical Leasing partners

I. Principles for a sustainable business model

In the course of the project, six criteria were developed for the sustainability principle, and their quantification and applicability tested for the case examples.

1. Continuous reduction of environmental and health-related impacts by chemicals and the machines and apparatus used

   Example: Cleaning in the food and pharmaceutical industries

   The comparison with the classic business model shows clear reductions in the number of cleaning cycles and the amounts of solvents and cleaning agents used (up to 30%). Waste water outflow could be reduced by about 25%, and solid waste by about 10%

   Example: The use of abrasives in the metal industry

   Chemical Leasing led to extended operating times for abrasives and to a reduction in air emissions and waste by up to 40%.

2. Improved handling of chemicals in terms of risk avoidance/reduction

   Example: Glass bonding

   Instead of using adhesive to fix components on the construction site, under Chemical Leasing the bonding takes place under defined conditions in a workshop. This clearly reduces the risks of contamination and faulty handling.

3. Avoidance of substitution by higher-risk substances

   Example: Glass bonding

In the course of process optimisation under Chemical Leasing, a 2-component silicon adhesive was replaced by a bonding tape. Auditing of material flows (chemicals, energy, waste, emissions) for the standard process and the imaginary substitution without Chemical Leasing showed no increase in risks or environmental and health-related impacts.

4. Improved energy efficiency in the use of chemicals

   Example: Cleaning in the food and pharmaceutical industries

   Chemical Leasing could lead to indirect energy savings of approx. 25% (via material flow), and direct energy savings of approx. 10% (as a result of fewer cleaning cycles).

5. Transparent sharing of risk and the distribution of economic benefits between the contract partners

   Example: Pesticides

   Initial experience shows that transparency in the allocation of liability and responsibilities is essential for the long-term applicability of the business model between pesticide producer, supplier, producer of equipment, and experts for pest control.

6. Monitoring and systematic registration of key parameters

   Determining monitoring measures with sufficient transparency and acceptable effort was relevant in all pilot projects. A critical aspect was monitoring sensitive data while maintaining confidentiality.

III. Principles for target-oriented communications for promoting Chemical Leasing

Five criteria were developed for the principles for effective, targeted communications to propagate Chemical Leasing:

- Meeting the confidentiality requirements of the partners
- Objective and transparent presentation of experience from Chemical Leasing projects, transferability of experience
- Quantification of environmental and health-related improvements
- High multiplication effect of communications measures
- Precise specification of objects of communications

IV. Monitoring and systematic registration of key parameters

On the basis of the extensive experience of TÜV Süd Management Services, criteria were developed for smooth cooperation between Chemical Leasing partners for the following areas:

- Contractual agreements and framework conditions
- Legal requirements and compliance
- Quality of products and services
- Management principles

In the discussion of the quality criteria, the following comments and proposals were made:

- Provision of information and awareness-raising were regarded as being very important for Chemical Leasing, because the name is not self-explanatory.
- Public funds can help to release certain constraints; other barriers can only be overcome by the Chemical Leasing partners themselves.
- A help list along the lines of the six sustainability criteria could be a practical orientation aid for implementing Chemical Leasing.
- Most of the companies in the pilot projects find a dedicated certification system for Chemical Leasing to be unnecessary; however, with a shift of liability certification would be regarded as helpful.
- TÜV could implement certification for Chemical Leasing without delay if required.
- The approach used for evaluating substitutions should be clear and risk-based. As a start, the classifications from REACH and CLP-VO can be used. The previous examples show that there is no substitution in the majority of Chemical Leasing applications.
- In addition to environmental aspects, constraints on the applicability (e.g. liability considerations, internal aspects, communications) should also be included in the criteria.
- A detailed environmental analysis, specific environmental advantages and specified health aspects are regarded as essential within the framework of the Chemical Leasing implementation. Social components of Chemical Leasing should also be emphasised (e.g. work safety, new jobs).

4. Overview of the German pilot projects and the progress on the final report

The final report on the project is in preparation, and will have five chapters:

- Background and objectives of the project
- Status quo and potential of Chemical Leasing in Germany
- Quality criteria for health and safety, and environmental protection
- Incentives for and the promotion of Chemical Leasing in Germany
- Initiating and monitoring model projects

The following aspects were taken into account when selecting the nine project examples:

- Experience has been gained with implementation
- Contracts exist which include quality criteria
- Potential for widespread application

- High profile/Lighthouse function
- Considerable reduction potential / environmental advantages
- New technology
- Several participants involved
- Multi-level processes
- Export opportunities
- Integration of SMEs
- Chemical Leasing with substitution

The pilot projects cover a wide range of sectors, processes, partner constellations, and sizes of company:

Pilot project 1: Cleaning in the food and pharmaceuticals industries

Pilot project 2: Automotive underbody coating

Pilot project 3: Catalysts

Pilot project 4: Surface coatings

Pilot project 5: Abrasives in the metal industry

Pilot project 6: Glass bonding

Pilot project 7: Sealing beverage cans

Pilot project 8: Pesticides

Pilot project 9: Cleaning and disinfection in clinics and hospitals

An overview of results was presented for Projects 1, 4, 6, 8, and 9. Detailed presentation of the pilot projects, including background, participants, parameters, quantification of effects and experience with quality criteria will be included in the final report.

In the discussion on pilot projects and implementation the following comments were made:

- There is considerable potential for Chemical Leasing in the pesticide sector, including in combination with Integrated Pest Management and against the background of the new EU pesticide laws. Some service-oriented approaches exist already, e.g. production cooperation agreements or Precision Farming, but invoicing is often still based the amounts used. IT was underlined that questions of liability are particularly important in agriculture.
- Veterinary pharmaceuticals (use of antibiotics) were suggested as a further potential field for Chemical Leasing.
- Pilot project 9 “Cleaning and disinfection in hospitals and clinics” was explained in detail by the project partners present. The project involves Schülke & Mayr GmbH, Freiburg University Clinic, Institute of Environmental Medicine and Hospital Hygiene, and Worms Clinic. An initial analysis indicated that potential savings of 5% for general

cleaning agents and 30% for sanitary cleaning agents can be achieved with Chemical Leasing. This would mean potential cost savings of approx. € 100,000 p.a. for the hospital, and an improvement in hygiene levels. The basis for settlement and guarantee levels are being discussed, and implementation will begin when agreement has been reached.

5. Overview of Chemical Leasing events and international activities

New activities and planned initiatives and events to promote Chemical Leasing include:

- **DECHEMA Colloquia**

The annual DECHEMA Colloquia will include a series of talks on Chemical Leasing: 25 March 2010, 3.00 p.m., DECHEMA Haus, Frankfurt/Main, "Chemical Leasing – What can service-oriented business models achieve?"

- **Global Chemical Leasing Award 2010**

The Global Chemical Leasing Award was jointly initiated by the Austrian Life Ministry and UNIDO and will be awarded for the first time in March 2010. The award recognises Chemical Leasing activities/Best Practices in four categories. The deadlines for applications is 31 December 2009; the relevant forms can be downloaded from www.chemicalleasing.com

- **Asia Pacific Roundtable for Sustainable Consumption and Production 2010**

The event is scheduled for 10-12 June 2010 in Colombo, Sri Lanka and includes discussion on chemicals' management and leasing and a meeting of the international working group. More information is available at: www.aprscp.net

- **New Chemical Leasing activities in Europe: Belgium (Flanders), Switzerland**

Currently, potential assessments and information meetings on Chemical Leasing are taking place in Flanders/Belgium and in Switzerland. There is considerable interest in an exchange of experience on Chemical Leasing in Germany.

6. Planned next steps

- A draft version of the final project report will be available in mid-December 2009 for comments.
- The Federal Environment Agency will continue to take part in Chemical Leasing activities after the project has been concluded.