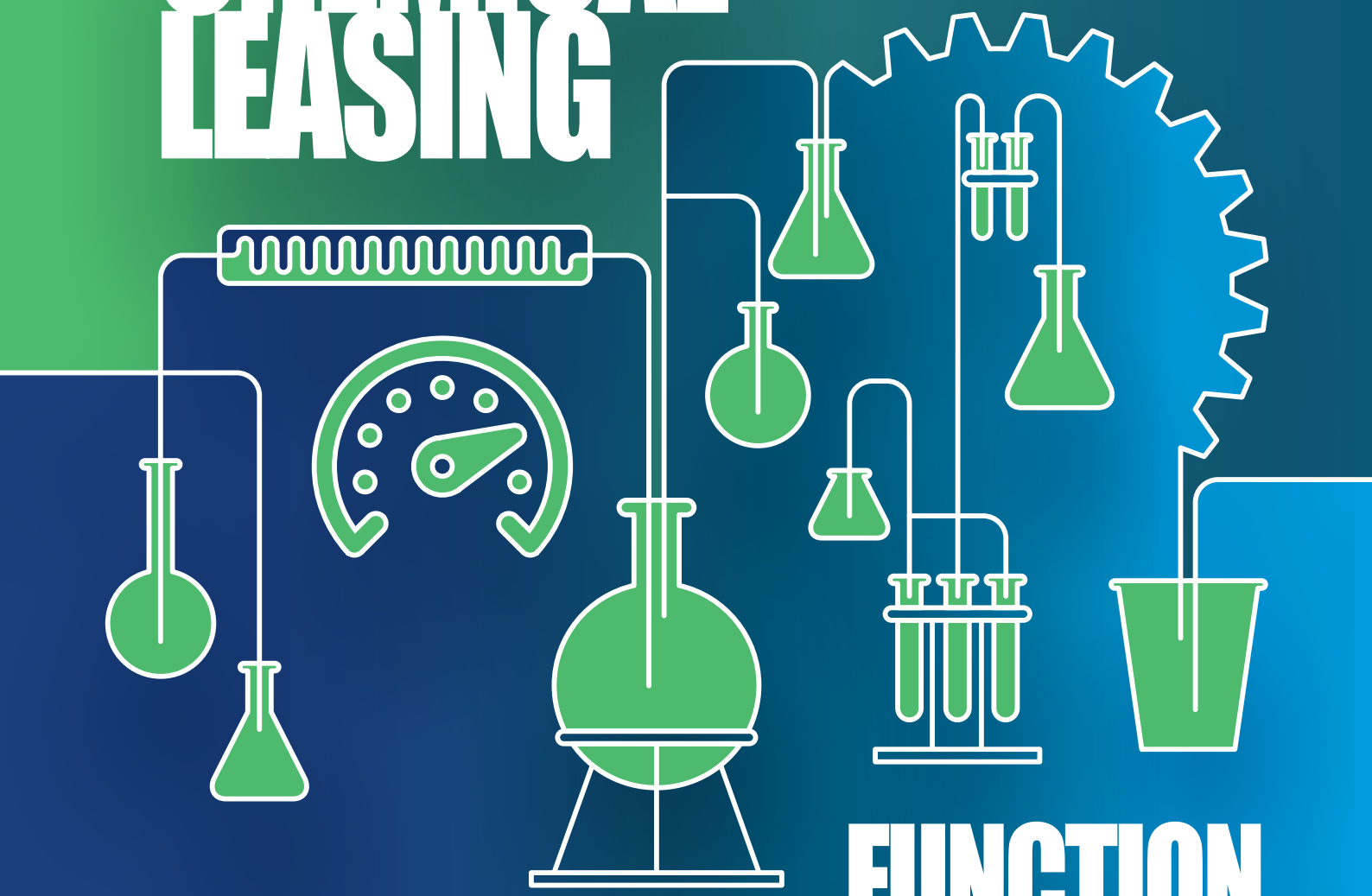
UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Chemical Leasing
A PERFORMANCE-BASED BUSINESS MODEL

CHEMICAL LEASING



FUNCTION TO IMPACT

A performance-based business model for sustainable chemicals management

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

Schweizerische Eidgenossenschaft
Confédération suisse
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Swiss Confederation

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Umwelt Bundesamt

Edited Version 2

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ACKNOWLEDGMENTS

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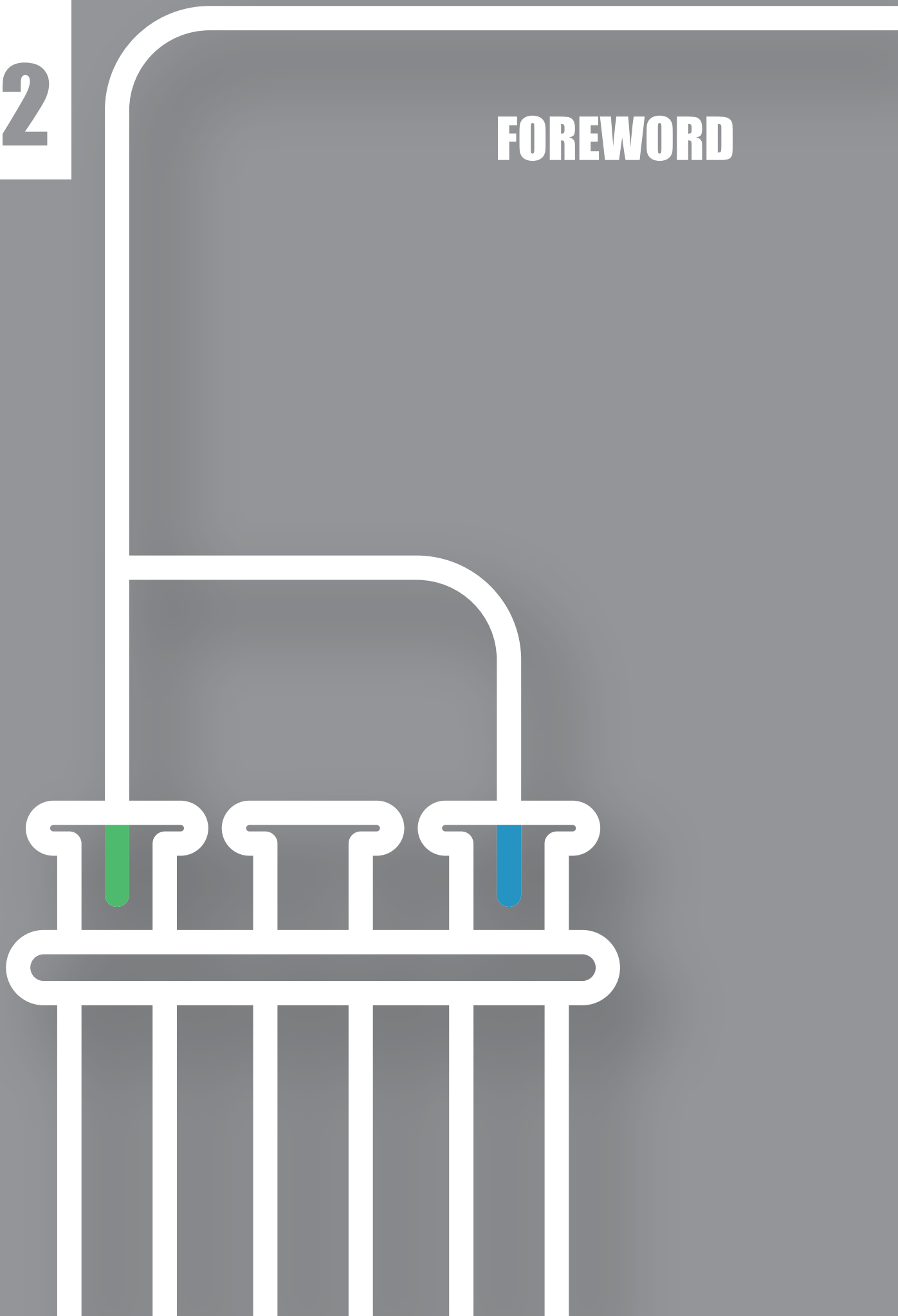
FOREWORD



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AUSTRIA

Globalisation, changing patterns of consumption and production as well as increased environmental concerns create new challenges for companies worldwide. Integrated and innovative approaches for materials management are required to match sustainable economic and environmental objectives and to succeed in the global market. Chemical Leasing creates a novel business environment to tackle these challenges of the changing global context and offers concrete solutions for sound management of chemicals and reduction of emissions to the environment. Under the conventional approach, it is in the interest of chemical manufacturers and distributors to sell as much of a product as possible. This can easily lead to excessive financial, environmental and potentially health-related costs and liabilities. In the Chemical Leasing model, the producers/suppliers sell the performances of the chemical along with the associated specialist know-how, and the ownership of the product itself might even remain with them. So customers are not paying for their chemicals by volume, but rather agreeing on a value-based unit of payment, such as cleaned area in square metres or coated number of bottles. In the Chemical Leasing model, the supplier and the use of the chemical develop a strong cooperation based on trust, exchange of experience, and financial gain as well as accrued environmental benefits.

True and sustainable innovation takes place where you want to create something meaningful. You do not start off with the desire to make money. A true innovation has the potential to make a change in the world, and so it is for Chemical Leasing. This shift of paradigm - "Selling services instead of barrels" - represents the single most important trend for both the producers as well as the users of chemicals. This service-based business model is making obvious how the "circular economy" can be turned into an economic success. It is only within that concept that all partners along the supply chain are sharing one common economic goal: resource efficient use of chemical products.

Austria has been pioneering Chemical Leasing over the last several years. Today hundreds of successful implementations of this business models are operating in a multitude of industrial sectors worldwide. The lighthouse examples are being showcased as winners of the "Global Chemical Leasing Award". This award is unique worldwide. It recognises successful examples of Chemical Leasing implementation, innovative approaches and scientific coverage. It aims at globally enhancing the visibility of Chemical Leasing, at encouraging innovative applications of the concept and at acknowledging contributions to disseminate the business model. The award aspires to contribute to greening of industries, to support sound management of chemicals and inspire companies around the world to engage in Chemical Leasing practices.

The cooperation between our Ministry and UNIDO, which started in 2004, is what really boosted Chemical Leasing to the international stage. Five years later, the German government joined the initiative, followed by Switzerland. These three nations, along with UNIDO, signed a joint declaration to demonstrate their strong commitment to fostering Chemical Leasing and to embedding this business model in their national policies. It is a tremendous success that with the Peru, Serbia, El Salvador and Sri Lanka signing up this declaration is now present on three continents.

Chemical Leasing projects show that basing business relations between producers and consumers of chemicals on the chemical products' performances results not only in environmental benefits, such as reducing harmful emissions and decreasing the amount of waste. It also boosts companies' fitness by streamlining their inventories, improving their working conditions, establishing long-term partnerships based on mutual trust, while at the same time enhancing customer satisfaction and innovation.

Leonore Gewessler

Federal Minister for Climate Action, Environment, Energy, Mobility, Innovation and Technology

GERMANY

The chemical industry is one of the most important industries, not only in Germany but worldwide. It develops innovative solutions, e.g. in the fields of health, environment, nutrition, resource protection and energy efficiency, and stands for added value as well as for the preservation and expansion of jobs. The chemical industry can thus be a motor for achieving the goals of Agenda 2030 for sustainable development. At the same time, many chemicals pose risks to people and the environment, and are present in environmental media worldwide, sometimes far away from their production sites. In addition, the production of chemicals is energy- and resource-intensive and chemical products often cannot be recycled.

In the past, the chemical industry has been successful in reducing emissions and increasing chemical safety in many industrialised countries. To this end, the chemical industry has taken the initiative with the Responsible Care and Global Product Stewardship programmes, not least to restore the image of the industry damaged by chemical accidents and environmental disasters. It is also a result of progressive regulations such as the REACH and the Seveso Directives in the EU or global environmental conventions such as the Vienna Convention on Substances that Deplete the Ozone Layer and its associated Montreal Protocol, or the Stockholm Convention on Persistent Organic Pollutants.

Nevertheless, the pressure to act - especially in developing and emerging countries – to minimise the health and environmental impacts of chemicals is still considerable, while pressures to develop a resource-conserving, low-risk recycling economy in the chemical industry are growing. In the medium term, all actors must strive to ensure that chemicals are produced and used without elaborate safety measures, pose only low risks, consume few resources and energy and make a positive contribution to as many of the Sustainable Development Goals as possible. This is all the more important as production in the chemicals sector has already doubled in the past 15 years and a further doubling is expected by 2030.

On the journey towards sustainability, Chemical Leasing can make a contribution as an environmentally viable and innovative business model. With Chemical Leasing, the production, use and processing of chemicals can be managed with less energy, less raw materials and less auxiliary materials. The efficiency in the use of raw materials, for example, can be increased with Chemical Leasing through economic incentives to save resources. The use of substances that are as harmless as possible facilitates recycling management. Chemical Leasing also reduces energy consumption and waste, because financial profits increase with the most economical use of chemicals.

Germany is convinced by the concept and we would like to continue working together with our partner countries and UNIDO in this area. What's more, Chemical Leasing can help newly industrialising and developing countries to increase safety in the handling of chemicals. This is particularly important in view of the rising production figures in these countries. A broad application of Chemical Leasing in chemical-intensive industries is therefore an important building block for protecting human health and the environment regionally and globally and for achieving the goals of Agenda 2030 for sustainable development.

Svenja Schulze

The Federal Minister for Environment, Nature Conservation and Nuclear Safety, Germany

SWITZERLAND

Switzerland has a long history of chemical production, with the first chemical plants established in the 19th century. Today, the chemicals and pharmaceuticals industry sector generates nearly 5 percent of the country's GDP and is the country's leading export sector (chemical and pharmaceutical products account for 36.7 percent of total Swiss exports by value in 2019). It is an important employer, around 76,000 people are working in the sector in Switzerland.

The Swiss government has a keen understanding of the importance of chemicals and pharmaceuticals for human health and the environment, and the federal authorities have worked cooperatively over decades with these industries to improve chemical safety and to reduce negative impacts on humans and the environment. The country has a robust legislative framework for the control and sound management of chemicals. The government is well aware that chemicals do not recognize national boundaries. We are therefore staunch supporters of a multilateral framework that enhances the sound management of chemicals and waste. Key pillars are the Strategic Approach to International Chemicals Management (SAICM) and the chemicals and waste related conventions, which have been developed over the last decades to minimize negative impacts caused by production and use of chemical products globally. The current discussions on the post 2020 framework for the sound management of chemicals and waste provides a unique chance to strengthen the institutional setting, to enhance the interaction of science and policy, to achieve stronger commitments from all stakeholders and more progress to ensure the protection of the environment and human health.

In 2017, the federal authorities published its Strategy for Chemical Safety. This strategy for the system-wide implementation of chemicals legislation, including

consumer health, occupational health and protection of the environment, has been prepared jointly by five federal authorities. The strategy consists of a series of strategic objectives and specific measures to achieve them. One of these strategic measures is to support projects and initiatives in the field of sustainable chemistry, including UNIDO's Global Chemical Leasing Programme.

We recognize Chemical Leasing as an innovative business model with the potential to improve resource efficiency and to reduce negative impacts of chemicals on human health and the environment, while at the same time generating financial benefits for suppliers and downstream users of chemicals.

Switzerland was pleased to join UNIDO and Austria in their efforts to promote Chemical Leasing worldwide, and together with them as well as with Germany, to sign the Joint Declaration of Intent on Chemical Leasing in Vienna in 2016. We are very pleased that recently even more countries signed the Declaration. Together with all these partners and possibly even more in the future, Switzerland will strive to ensure that a greater uptake of the Chemical Leasing business model occurs not only in Switzerland but around the globe as well.

Switzerland's commitment to Chemical Leasing and to the continuous improvement of chemical safety more generally is to be seen within the framework of the country's efforts to meet the goals of the UN 2030 Agenda for Sustainable Development. This holds in particular for goals 9 and 12, ensuring, for example, increased efficiency in resource use and greater adoption of clean and environmentally sound technologies and industrial processes, as well as the sustainable management and efficient use of natural resources.

Martin Schiess

Head of Air pollution control and Chemicals Division, Federal Office for the Environment of Switzerland

A broad application of Chemical Leasing in chemical-intensive industries is therefore an important building block for protecting human health and the environment regionally and globally and for achieving the goals of Agenda 2030 for sustainable development.

Svenja Schulze

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Martin Schiess

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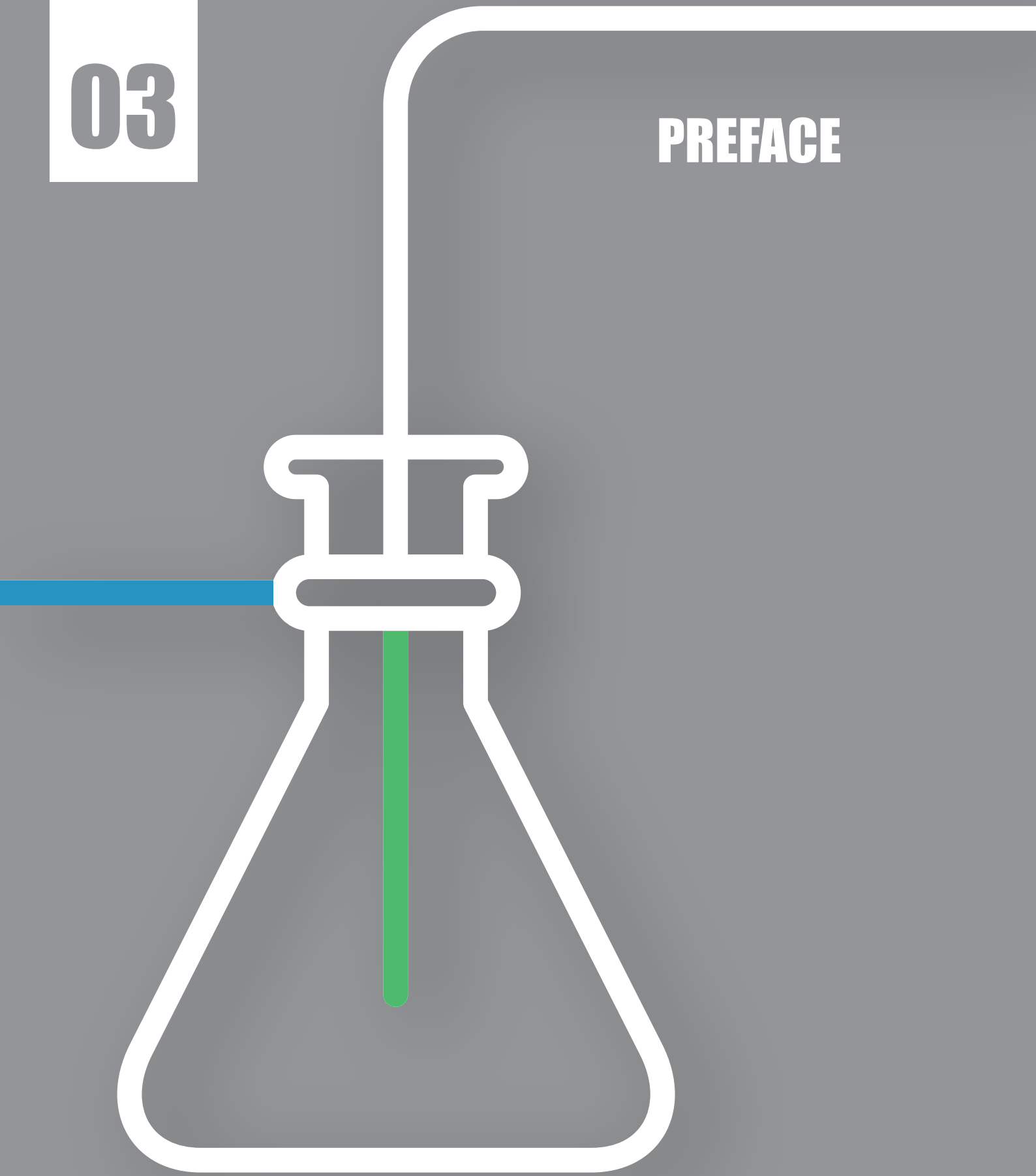
PREFACE



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This publication invites you to look at Chemical Leasing which began as a vision and is now a highly recognised circular economy business model for sound chemicals management.

The chemical industry is one of the world's largest manufacturing sectors and is growing significantly. It is a major employer worldwide, and chemicals find many useful applications, enriching our daily lives. At the same time, if not managed well, chemicals may harm the environment and people's health.

Today's fundamental challenges - the changing patterns of consumption and production, the growing need for material, water and energy, and the resulting negative impacts on our environment - are driving the movement towards new business models, which offer function instead of ownership: for example, clean water instead of purifying chemicals. If we are to meet the current demands and foster prosperity in the world, we need to develop and adopt new performance-based business models such as Chemical Leasing.

Chemical Leasing offers concrete solutions for the sound management of chemicals, the reduction of emissions and for a more efficient use of resources. It thus creates a perfect business environment to tackle challenges in a changing global context. Chemical Leasing shows how performance-based business models that are service oriented and aligned with the idea of circular economy can enhance the economic success of companies and contribute to Inclusive and Sustainable Industrial Development (ISID) and the 2030 Agenda for Sustainable Development.

In 2004, the United Nations Industrial Development Organization (UNIDO) and the Austrian Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) launched the promotion of the innovative business model Chemical Leasing. The German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU), the German Environment Agency (UBA), the Swiss State Secretariat for Economic Affairs (SECO) and the Swiss Federal Office for the Environment (FOEN) have subsequently joint this global undertaken. UNIDO is grateful to these donors and partners for the outstanding support and cooperation in the preparation of this book.

Since the first book "Chemical Leasing Goes Global" was published in 2008 and the first Global Chemical Leasing Award was held in 2010, this performance-based business model has become ever more relevant for national and international policy frameworks and initiatives, while at the same time being more systematically applied by the private sector and academia.

The first book looked at the benefits that could be derived for the economy and the environment from Cleaner Production and Chemical Leasing. This publication offers a broader perspective for both policymakers and practitioners on future sustainable chemicals management services. It analyses global policies, trends and developments and shows how Chemical Leasing can respond to existing challenges and create new opportunities.

Chemical Leasing is a powerful business model, which offers solutions to current and future economic, environmental and social challenges. We need to continue sharing best practices, coordinate common approaches, and replicate success stories. In doing so, we hope to encourage you to adopt similar initiatives so that we jointly move towards sustainability.

LI Yong

Director General of UNIDO

04

HOW IT ALL STARTED

04

Chemicals are used in a large variety of products and processes, that enrich our daily lives. However, if not handled well, chemicals may harm the environment and people's health.

Looking for innovative win-win approaches to stimulate industry into managing chemicals in an environmentally and economically sound manner, the Austrian Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) developed in 2002 the first concept of the Chemical Leasing business model. Subsequently, it initiated several demonstration cases together with industry and launched two national studies to analyse the potential of Chemical Leasing for promoting efficient chemicals management and reduction of chemicals waste.

Two years later, in 2004, inspired by the smart business paradigm shift "Less is More", UNIDO and the Austrian BMK decided to join hands and launched the first global Chemical Leasing project. In close cooperation with UNIDOs National Cleaner Production Centres (NCPCs) in Egypt, Mexico and Russia the first demonstration and training projects were initiated. The Centres in Brazil, Colombia, El Salvador, Serbia, Sri Lanka, Colombia and many others followed over the years.

Chemical Leasing gained international visibility through the Strategic Approach to International Chemicals Management (SACIM), which was signed in Dubai in 2006. Subsequently, the German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU), the German Environment Agency (UBA), the Swiss State Secretariat for Economic Affairs (SECO) and the Swiss Federal Office for the Environment (FOEN) joined the partnership, which was reaffirmed through the signing of the Joint Declaration of Intent on Chemical Leasing in 2016. Followed by the Ministry of Environment of El Salvador, Ministry of Environment of Peru, Ministry of Environmental Protection of Serbia and Ministry of Mahaweli Development and Environment of Sri Lanka that also signed up to the Declaration.

Since 2006, a large number of demonstration cases have been run in different industrial sectors. These have shown the immense potential of Chemical Leasing to bring environmental, social and economic benefits. To further up-scale and promote the business model at global level, different tools were developed: Chemical Leasing toolkit, the Chemical Leasing Sustainability Criteria, the SMART 5 Tool, and the publication of the book "Chemical Leasing goes Global".

To enhance the visibility of Chemical Leasing and to encourage companies around the world to apply the model, UNIDO and its partners launched the first Global Chemical Leasing Award in 2010. The award acknowledges best practices in Chemical Leasing at industry level, as well as in research and innovation. The success of the first award triggered the organisation of three consecutive awards, in 2012, 2014 and 2018. The growing number of applications show measurable reductions of chemicals consumption, accompanied by significant reductions in water, waste and energy, and – just as importantly – significant business advantages. In some instances, the business model has been in place for more than 10 years now, and some companies have shifted their entire business approach to providing chemical services/solutions instead of selling chemical products.

Chemical Leasing, as a holistic and systematic approach, is not only a proven performance-based business model but has also been shown to be an innovative policy tool for sustainable chemicals management. It facilitates partnerships with and among the private sector and its business associations, academia, and government, and it contributes to the Sustainable Development Goals (SDGs).

Chemical Leasing has been recognised as a driver for circularity, resource efficiency and innovation.

Petra Schwager

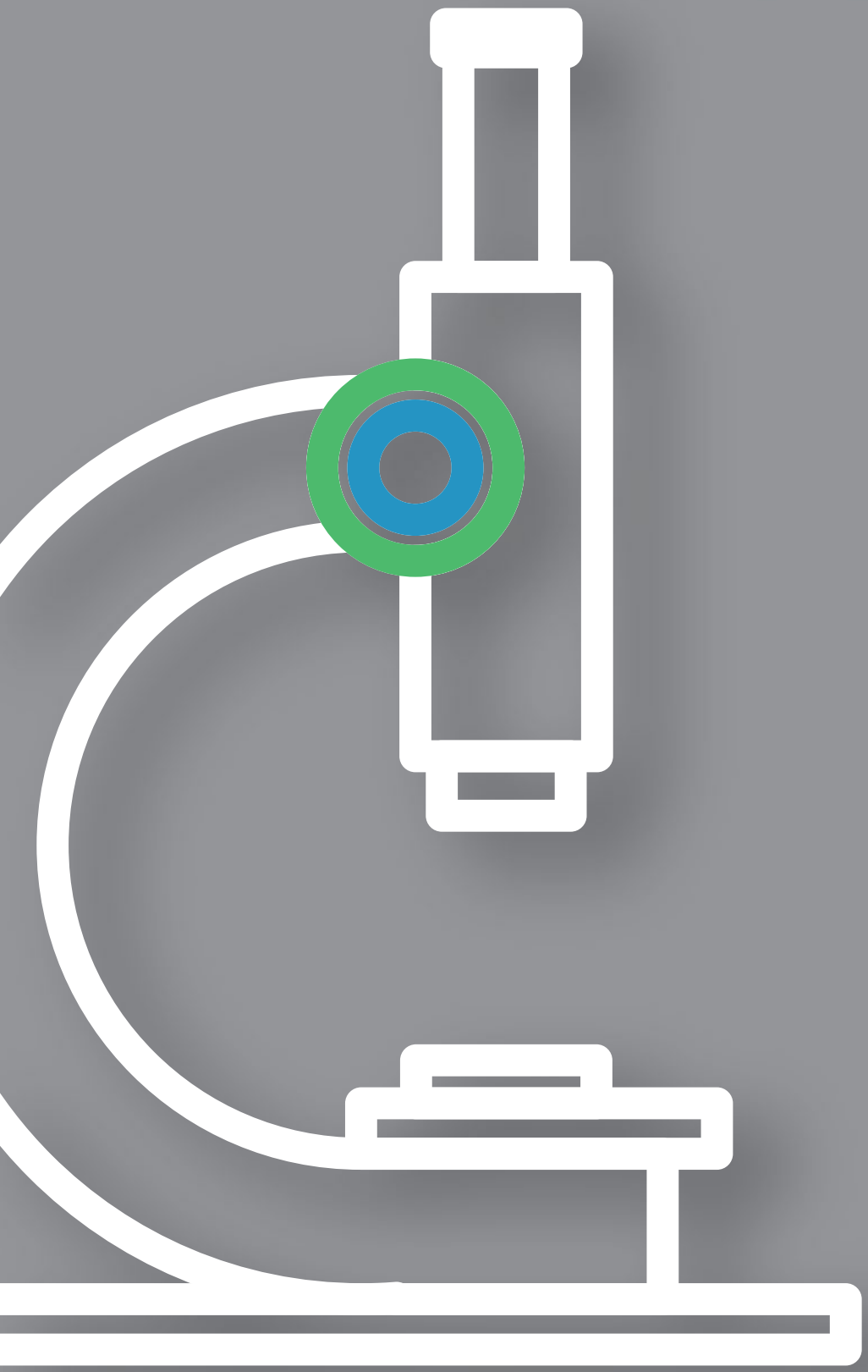
Chief of the Energy Technologies and Industrial Applications Division and Coordinator of the Global Chemical Leasing Programme (2004-2020), UNIDO

Thomas Jakl

Deputy Director-General, the Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK), Austria

05

SUMMARY AND REASONS TO READ THE BOOK



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Companies are facing increasing economic, environmental and social challenges. They have to cope with an ever more rapidly changing business environment, they must comply with ever stricter environmental regulations, they have to respond to ever more demands made of them by the public, their customers and their supply chains. New mind-sets, innovative approaches and tools, new skills, sustainable business models – companies need all of these if they wish to continue to be successful in the decades to come. One of the new approaches available to them is the performance-based business model of Chemical Leasing that follows the idea of Circular Economy.

The book you have in your hands targets different groups of people – companies, the scientific community, academia, consultants, policymakers – who want to learn more about the Chemical Leasing business model. Reading this book, they will discover the great benefits that this business model offers to business, society at large, and the environment. The examples which are presented in the book can motivate them to apply the model and mainstream it in their own countries and industries.

This book is written by practitioners for practitioners. It provides articles, insights and new ideas on how to better use chemicals. It presents the broad range of approaches which there are to the topic. It is designed to be a reference book which readers can always consult.

Over the course of five chapters, the book presents the Chemical Leasing business model in all its different aspects. It covers a broad spectrum of topics, from the global framework within which companies are operating today and the global drivers to which they have to respond, to the very practical methodology and the business case of Chemical Leasing.

Part A lays the foundation for a better understanding of the global framework in which companies are currently operating, and of how innovative business models like Chemical Leasing can help companies deal with many of the challenges they face. This chapter is introductory and serves as a guideline for all readers: company representatives, consultants, researchers and policymakers.

Part B, the "Business Case of Chemical Leasing", lays out in a very practical way how Chemical Leasing can be implemented. Here, practitioners from industry (companies and consultants) show in detail where and how this business model can be applied, review the benefits but also the obstacles of the model, and discuss their personal experiences with implementing Chemical Leasing.

Part C covers the Chemical Leasing toolkit and the methodology, both of which have been developed to support the implementation of Chemical Leasing. Step-by-step guidance is given to support interested companies and consultants in taking their first steps into Chemical Leasing implementation; this has also been prepared by practitioners.

In Part D, key challenges like Climate Change and Resource Scarcity but also new (mega)trends and global drivers like Circular Economy, SDGs, Digitalisation, Green Chemistry, Gender and Inclusiveness, and Change Management are described, along with their linkages to Chemical Leasing and how the latter can contribute to achieve improvements in these fields. It responds to the interests of different target groups. Researchers, NGOs and policymakers, but also business professionals, can find inspiring ideas and useful information that can help them develop sustainable strategies and create benefits in the long run.

Part E closes the book. It brings together a collection of opinions and assessments made by businesses, academia, governments, NGOs and research institutions on the current state and the future potential of Chemical Leasing. In doing so, it shows the way Chemical Leasing and similar performance-based business models could be further developed and applied. Our hope is that the chapter can become a source of inspiration for readers and motivate them to join hands with UNIDO and the other partners and stakeholders and support our efforts to mainstream and scale up this performance-based business concept to the global level.

06

PART A

Business in changing global environment

Driving forces of change and of continous improvement

06

Stephan Sicars

Managing Director, Directorate of Environment and Energy (EAE), Director, Department of Environment

What are the framework conditions in which companies are operating today?

> **Sustainability is becoming the most critical part of any business model: non-sustainable companies are less likely to attract investments, less likely to grow, less likely to survive.**
>
> Stephan Sicars

Companies are operating in a rapidly changing business environment. The framework in which they operate is much more undetermined than it was in the past. So, companies need the capacities to find new ways to be more flexible and resilient to change while continuing to be profitable. None of this is new. But in the changing global context, they now have a greater urgency.

Many of the coming challenges are critical. Climate change is the overarching issue. But among other key drivers for businesses are the need to reduce their resource dependency, the 4th industrial revolution, changes in the global supply chains, the need to moderate income inequality and find gender balance, and address pressures from the trade systems.

On the environmental side, ever greater efforts are being made to mitigate climate change and to reduce its scale. Forecasted increases in demand for resources are dramatic, while the availability of resources is increasingly restricted. More efforts, more energy, will be needed to obtain resources, which in turn affects the environment and impacts the climate situation. The costs of resources are increasing, and access to them is being disrupted much more than in the past. Environmental regulations will certainly be ramped up.

Chapter D of this book addresses in greater detail some of the key global drivers and challenges that companies face today.

Companies must not neglect the increasingly important issue of gender, which typically means ensuring a more balanced presence of women at all the different levels in the workforce, ensuring the availability to companies of more qualified female candidates for their workforce, and so on.

We have the 4th industrial revolution, Industry 4.0. As with every revolution, it has its winners and losers. Industry 4.0 is bringing new tools to companies, with which to optimise their industrial processes and their businesses as a whole. In particular, these new tools support them in the collection and analysis of data. This enables a much closer control over industrial processes. These tools also improve the possibility of learning (through artificial intelligence, among other things), which translates into even closer control of business operations. This is a huge opportunity for companies to improve their profitability and to maintain themselves in a competitive environment.

Summarising, we have a massive amount of technological and political changes coming. A number of global crises are becoming ever more visible and the policy responses to them are imminent. It is becoming much more difficult to forecast how things will evolve. We are

faced with a multi-branched, multi-faceted shaking-up of the existing conditions, and each business will have to find ways to adapt. All this will come about relatively rapidly. Some companies will manage to respond to the challenges, others will not. The risks of the latter outcome are high.

What could help businesses remain competitive?

In order to cope with all the challenges I've mentioned, companies will need to reconsider their business models, and adapt them to the changing environment.

Businesses will need to address all the different challenges simultaneously. Companies must find solutions that avoid worsening the various global trends. These solutions must give them the flexibility they need to respond to the shifting landscape around them (changing competitors, greater regulatory and public pressures, shifts in trade patterns, etc.). All the while, they need to remain profitable. If companies manage to do this, they will be moving in the right direction.

That is exactly the direction that Chemical Leasing supports. It responds to all the different trends I've mentioned – reducing and optimising resource use, reducing climate impacts, increasing the skill level of the workforce, providing opportunities for a greater gender balance, and advancing flexibility.

Chemical Leasing can help companies optimise their processes. This means upgrading the skills of their workers and engineers so that they can operate what are now often more complex processes with less use of resources. This skills-upgrading will of course help workers increase their income.

Service oriented business models like Chemical Leasing allow companies to focus more strongly on their core competencies while reducing their investments. That allows them to be more flexible in their response to external stimuli: legislation, trade, etc. But Chemical Leasing has a big advantage over typical service-oriented business models like outsourcing. In outsourcing, a company describes exactly what needs to take place, then someone else does it without adding much to the process. In Chemical Leasing, on the other hand, a chemical supplier, now a service-provider, ensures that the chemical-using processes are being operated with new know-how and innovation, these being massively beyond what the client can do itself.

Of course, Chemical Leasing requires a lot of effort from the companies involved to make it work. This effort is not only worth it but is actually quite modest compared to the benefits that can be achieved.

Chapter B highlights the main opportunities that the Chemical Leasing business model provides to businesses (optimising investment needs, increasing process efficiency, decreasing production costs per unit produced, etc.). It explains how Chemical Leasing works in practice and what are the main requirements and preconditions for it to be applied successfully.

See Chapter C for more details on the methodological application of the Chemical Leasing business model on a plant level. In addition, the section provides experiences and recommendations on the implementation of the business model.

There is a growing interest in the scientific community, NGOs and governments to advance the sustainability agenda and green and inclusive initiatives.

What is in it for businesses to join this "community" and to follow initiatives such as Circular Economy, SDGs and Green Industry?

The international community is trying to figure out what all the changes coming along mean for our future. Countries are discussing SDGs and other ideas for achieving sustainability, and which paths their countries should follow. In these discussions, great attention is being paid to Circular Economy and Green/ Sustainable Industry. These two topics are predominantly aimed at industry. So, industry is expected to play an important role here.

The fact that industry in general is expected to participate does not necessarily mean it makes business sense for an individual company to do so. Under what conditions would it make sense? The answer lies in the issue of company-specific sustainability. Sustainability is becoming the most critical part of any business model: non-sustainable companies are less likely to attract investments, less likely to grow, less likely to survive. Acting sustainably is now no longer important for companies just in terms of public relations. It is an essential issue to maintain the business itself. Sustainability is something a company requires for its long-term prosperity. As a result, businesses are being encouraged to engage in initiatives which help them become more sustainable, and therefore more worthy of future investments and more worthy of positive public attention. So, I believe that engagement by businesses in such "movements" as Circular Economy and Green Industry, as well as in the larger concept of SDGs, is a very interesting way for them not only to support planetary sustainability, but also ensure their own prosperity. Chemical Leasing supports these global sustainability initiatives.

More details on global drivers and their interlinkages with Chemical Leasing are provided in Chapter D.

What is UNIDO doing to advance the mainstreaming of the Chemical Leasing business model?

Besides the tools that UNIDO has developed over time *(Chapter C)*, the organisation is paying a lot of attention to the development of partnerships on different levels.

More details on partnerships and related experiences can be found in Chapter D.

There are many actors involved in diffusing the Chemical Leasing business model. Governments are looking for responses to urgent challenges: climate change, resource availability, water scarcity, social issues, trade tensions, etc. They want to help companies adapt to the changes that are coming. As for the business community, companies want to optimise their processes and achieve efficiency, sustainability and flexibility. To have Chemical Leasing more widely adopted, these two groups need a facilitator who actually helps make things happen. That is the role of UNIDO. UNIDO also sees a value in bringing the model closer to academia and the scientific community. They have an important role to play in further developing and mainstreaming Chemical Leasing globally.

UNIDO also works on facilitating the uptake of Chemical Leasing, convincing enterprises about its benefits, collecting practical experiences in implementing the business model and bringing these to a wider audience, ranking the capacity for innovation in this field and other critical parameters. In this regard, the Global Chemical Leasing Award scheme is a very useful tool. This award scheme is further stimulating innovation and showcasing best practices.

The scheme is presented in a Chapter C.

In sum, UNIDO is working to facilitate cooperation between all the different stakeholders to move the issue of Chemical Leasing along.

How do you see the future of Chemical Leasing and similar performance-based business models?

Chapter E is devoted to a discussion of the future of the model. Different stakeholders share their experiences and opinions on how the model will continue in its development and how it will impact the industry and the environment.

The future is bright! Since Chemical Leasing strongly addresses some of the most important global challenges, more and more companies are picking the model up, and the groups discussing it are becoming more and more active. In general, the level of interest is increasing, which is logical since the model provides a great solution to so many challenges.

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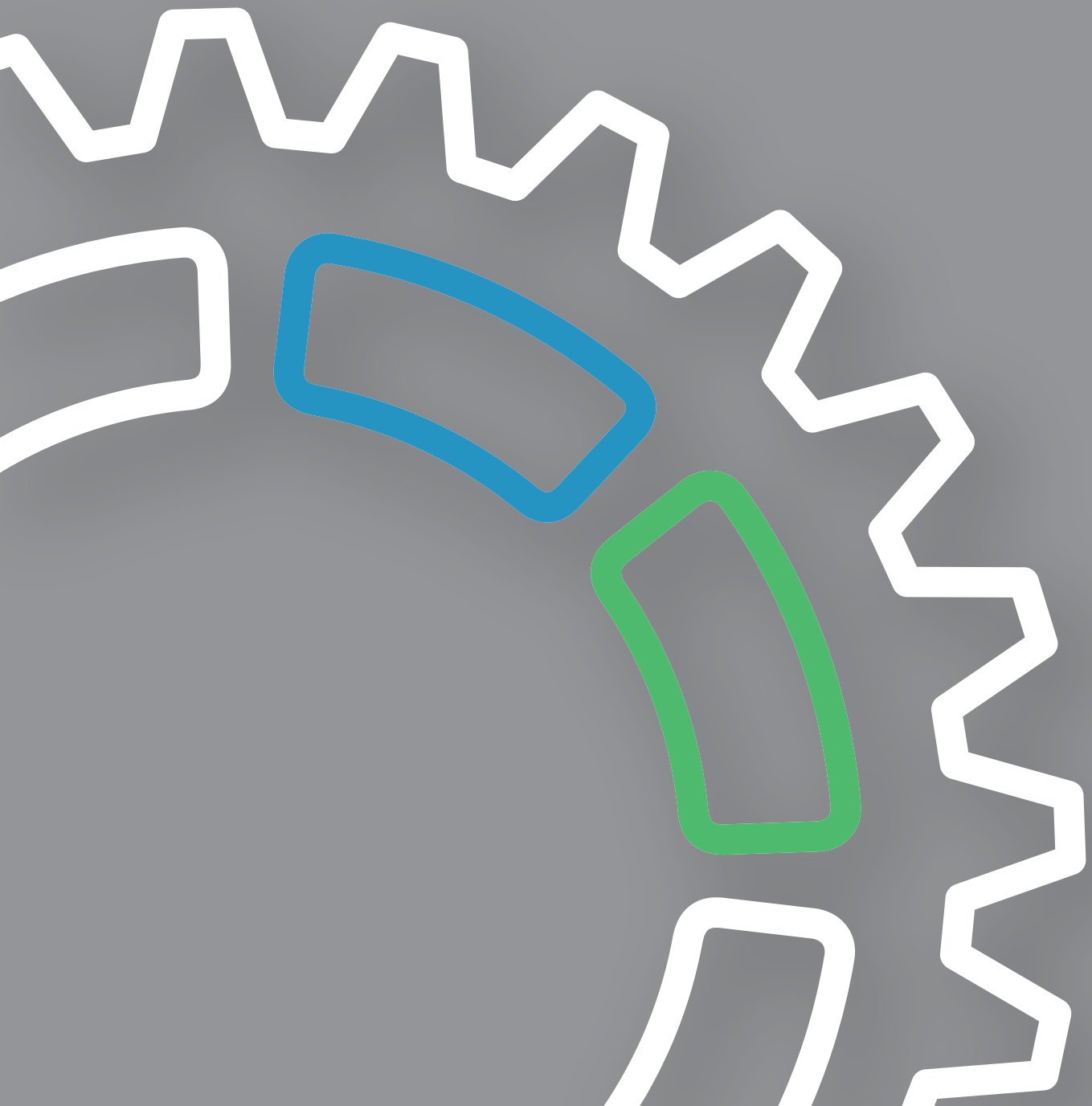
PART B

The business case of Chemical Leasing

The model in practice



07

Part B targets all businesses which deal with chemicals, both users and suppliers of chemicals, as well as consultants who want to broaden their portfolio of services with Chemical Leasing. It was prepared by industry practitioners and consultants who have many years of experience with Chemical Leasing.

The chapter starts with UNIDO's official definition of Chemical Leasing, and then turns to its practice. It responds to practical questions which users, suppliers or consultants might have: what is the purpose of Chemical Leasing, where and when can it be applied, what are the benefits and obstacles, what are the key factors in successful implementation, etc.

The reader can then find a number of recommendations from practitioners in the form of "Do's" and "Don'ts", followed by a section explaining the differences between Chemical Leasing and other business models. The chapter gives an "insider's view" of Chemical Leasing, written by experts who have implemented the model in several companies. The chapter also includes case studies where the reader can see how Chemical Leasing was implemented in different sectors and companies.

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7.1 THE OFFICIAL UNIDO DEFINITION OF CHEMICAL LEASING

Chemical Leasing is a performance-based (service-oriented) business model that shifts the focus from increasing sales volume of chemicals towards a value-added approach.

The chemical supplier 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 user and the supplier is extended and may include management of the entire life cycle.

Chemical Leasing strives for a **win-win situation**. It 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.

7.2 THE BUSINESS MODEL IN PRACTICE

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In this section, we address a series of questions which are frequently asked about how the Chemical Leasing business model works in practice.

7.2.1. WHAT DOES A "PERFORMANCE-BASED" BUSINESS MODEL MEAN?

The shift to a circular economy is leading to companies adopting new business models in which the performance and the service component of products provide the added value to customers and as such becomes the essential part of business relations. Performance-based business models facilitate take-back, reuse, and reycling. Consequently, such models reduce resource consumption, waste and emissions to air and water. At the same time, these models contribute to greater cost-efficiency for businesses.

Let's look at the business of chemicals.

The main interest of chemical users is not to buy and possess chemicals. Rather, they are interested in ensuring that the chemicals they use deliver the best **solutions for their product and/or processes.**

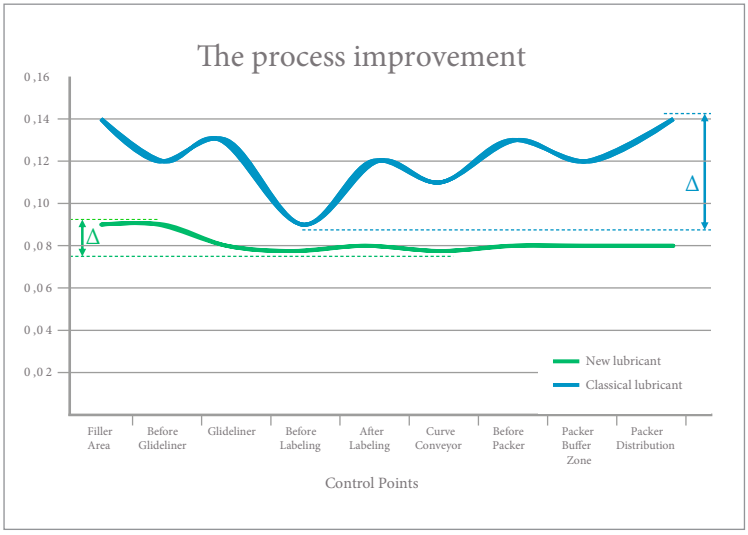
For example, a producer of automotive parts uses solvents to clean and degrease the parts. The company is interested in the cleanliness of the parts (product performance) as well as in the improvement of process productivity (shorter cleaning cycle – higher process productivity) which the solvent can deliver, not ownership of the solvent. In other words, the company is interested in paying for the utility which the solvent delivers and not for the amount of solvent it uses.

Let's take the example of a beverage company and discuss it in more detail. It has a packaging line with a lubrication process. It needs the conveyor belt to operate smoothly and with as little friction as possible in order to keep the bottles from falling over. How to achieve this, keeping in mind that lubrication is not the company's key competence? It could just play it safe, applying large amounts of lubricant chemicals to the conveyor and hoping that overdosing will maintain a satisfactory performance level. However, not only is the company buying more lubricant than it really needs, but it now faces another problem: excessive foam formation: the large amounts of foam produced overflow the catchment tray and fall to the ground. As a result, the company has a slippery floor and increased health and safety risks.

Another option would be to find a chemical supplier with an expertise in lubricants, which can offer a performance-based business relation and establish a payment linked to the performance of the process where the lubricant is applied. The unit of payment in this case could be the number of hours the conveyor works smoothly and without interruptions. This functional payment aligns the interests and motivations of both business partners. Both are interested in process optimisation. The beverage company gets what it ultimately wants: a smoothly operating conveyor belt. The lubricant supplier brings its know-how on lubricating processes, installing the technical measures required to improve the productivity of the lubrication process (for example substituting the original water-based lubricant with a dry (and less hazardous) one, installing a different kind of dosing nozzles and a new dosage system).

This form of cooperation driven by a new business logic leads to process improvement as figure 1 shows and helps achieve the win-win situation for both businesses as well as for the environment and health and safety.

Figure 1. Coefficient of friction before and after the implementation of the Chemical Leasing model[2]



[1] *Subsection 7.2.14.*
[2] *Source: UNIDO Chemical Leasing case study.*

As these examples show, chemical users change their focus from product to performance, paying attention to the utility/function of the chemicals they use. These users are interested in services that support the optimisation of their business processes, help improve their economic, social and environmental performance and achieve better sustainability.

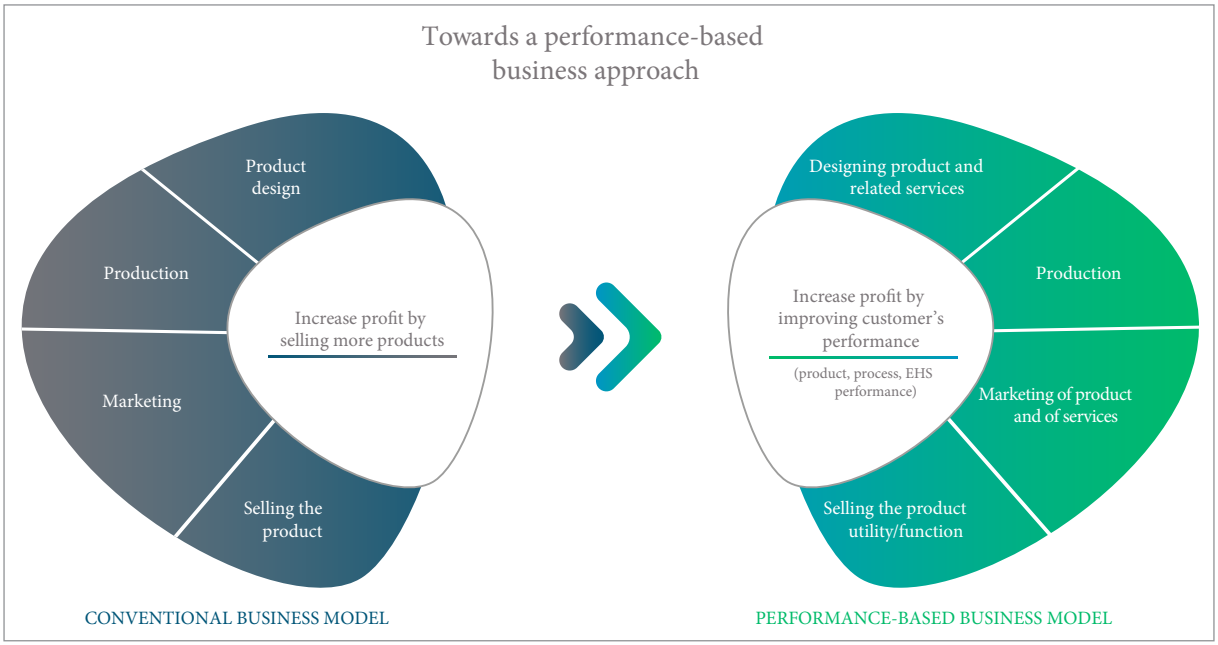
The growing customer demand for sophisticated solutions that support chemical operations and profitability leads to a change of the business paradigm: the utility of a chemical and desired performance of a process/product become the centre of the buying process. The performance to be rendered by chemicals becomes an essential part of business relations, modifying the way of doing business with chemicals.

Performance-based business models (also called "performance-based contracting") are a response to market demand: the customer pays for the utility of the product and not for its quantity or volume.

Chemical Leasing is a performance-based business model for sustainable chemicals management. Performance-based business models related to chemicals can be called and branded differently, even if they are similar to Chemical Leasing.

The two diagrams in figure 2 show the difference between the traditional business model and a performance-based business model. Chemical suppliers are striving to achieve a higher profit and grow their market share, but this target can be achieved differently as follows:

Figure 2. The traditional business model vs a performance-based model



7.2.2. DOES CHEMICAL LEASING MEAN THE LEASING OF CHEMICALS?

Let's start by highlighting the following: **The term Chemical Leasing is the name of a business model and is NOT the same thing as leasing of chemicals.**

In leasing, the chemical remains under the ownership of the chemical supplier, and the chemical user pays only for its use. In contrast, in Chemical Leasing the user pays for the performance of the chemical. Contrary to leasing, the issue of ownership of the chemicals is of little relevance to Chemical Leasing because it does not influence the benefits of the business model.

For Chemical Leasing, the following aspects are of crucial importance to the relationship between chemical supplier and user: process improvement, innovation, and knowledge transfer. In leasing, in contrast, issues of process improvement or innovation or knowledge transfer play little if any role in the relationship between the chemical supplier and the user.

This does not mean that leasing operations cannot be part of a Chemical Leasing business model. Leasing operations can be economically justified in a broader Chemical Leasing business model when expensive chemicals can be recovered, as in the case of catalysts. But even in such cases, we need to be aware that it is highly unlikely that 100 percent of the chemical will be recovered.

7.2.3. WHAT IS THE PURPOSE OF CHEMICAL LEASING?

The Chemical Leasing model aims at a more efficient use of chemicals in the production process by redefining the business relationship between the chemical user and the supplier.

Definitions: The "chemical user" is a company that uses chemicals and the "chemical supplier" is an entity in that company's supply chain such as a manufacturer of chemicals and/or a distributor or trader of chemicals.

The conventional business model assumes that the more the chemical supplier sells, the more the chemical supplier earns. However, in the Chemical Leasing model the chemical supplier does not sell quantities. He or she sells the performance of the chemical. This is the purpose for which the chemical is applied.

For example, the performance of a chemical could be to clean or degrease metal parts, or to protect a surface. Payment is then made according to functional units, that is, the number of pieces cleaned, or the extent of area coated.

Example 1

A producer of automotive parts uses solvents to clean and degrease them. Under the Chemical Leasing model, the company pays the chemical supplier for the functions performed by the chemical, that is, the cleaning of metal parts. It pays per part cleaned to requisite quality levels. It does not pay according to the amount of solvent used.

Example 2

A car producer needs surface protection for its parts. This includes car body pre-treatment, surface activation and the application of a system of coatings, for all of which chemicals are used. Under Chemical Leasing, the company pays per car body protected. It does not pay according to the amount of chemicals used.

Example 3

A hotel needs to wash its laundry. The process uses detergents, disinfecting agents, and softeners. Under the conventional business model, the company would pay the chemical supplier according to the amount of chemicals used. Under Chemical Leasing, the hotel pays per kg of laundry washed to requisite levels of quality.

Picture 1 : *Laundry*

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Example 4

A beverage producer needs to attach labels to its bottles. Under Chemical Leasing, the company pays the chemical supplier for the number of bottles labelled. The company does not pay according to the amount of chemicals used.

Chemical Leasing can be applied in many industries and processes, ranging from the textile industry to car manufacturing and even to agriculture.

Processes that are part of a Chemical Leasing plan are usually non-core processes in the company (e.g. cleaning operations, labelling of bottles in the beverage industry).

7.2.4. HOW DOES CHEMICAL LEASING CHANGE BUSINESS RELATIONSHIPS?

In Chemical Leasing, the supplier no longer measures success according to the volume of chemicals sold. The supplier and the user both benefit because less chemicals are used when payment is linked to the functions performed. By aligning the interests of supplier and user, the volume of chemicals used is reduced, costs are cut, and each party increases its profits.

7.2.5. WHAT MOTIVATES COMPANIES TO CHANGE THEIR WAY OF DOING BUSINESS?

Business decisions are driven by economic interests, as well as considerations of performance, risk, market position and competitiveness. Particular forces and trends can motivate or even drive companies to search for sustainable technical solutions and innovative business models related to chemicals application.

Sustainability policy and environmental strategy. Following market trends, organisations are increasingly becoming aware of sustainability issues and developing their businesses in a sustainable manner. Such companies take care of their image as a "responsible company" and strive to achieve superior performance. The various activities and operations of such a company should be in line with their corporate policy. Chemical Leasing is a tool for the sustainable management of chemicals.

Technical progress in the chemical industry and, in particular, digitalisation is a driving force of change. Digitalisation facilitates the application of innovative business models, enabling companies to operate with chemicals more efficiently, improve control of resource consumption, easily record results and smoothly communicate with partners. It supports the application of the Chemical Leasing business model, in which the accurate recording of data is a key criterion for success.

Regulatory compliance has been recognised as a major driver of effective chemicals management. Many hazardous chemicals are in use in industry. Accidents and health and safety problems can become an important cost factor for the company management. There are growing costs related to safety issues, pressure from workers is growing, and changes to regulations on hazardous chemicals or to health and safety norms make compliance ever more demanding. Non-compliance can be costly and can even be a threat to a company's continued existence. These pressures often push a company to search for innovative business and technical solutions. The Chemical Leasing business model can be just such an innovative solution.

High production costs in a process. High costs are often a key reason for a company to change its business model. Chemical Leasing helps optimise processes, increase productivity, and so reduce production costs.

Resource availability. Depletion of rare chemicals is a serious global problem, with the potential to impact the sustainability and competitiveness of a company. Implementation of the Chemical Leasing model has been shown to be an effective long-term solution.

Public pressure. The use of chemicals has increased dramatically due to economic development in various sectors. Consequently, people are exposed to a growing number of chemicals. As awareness of the risks related to hazardous chemicals grows, so does public pressure to substitute them. In general, final consumers can put pressure on a company to produce a more sustainable product, give better service and ensure business relations are conducted responsibly.

> **"We wanted to make the metal cleaning process more efficient and safer, optimize the consumption of chemical used. For our company, it was critical to find a model that could help us meet high levels of economic performance and environmental sustainability. Chemical Leasing became the solution for us and changed the way we do business".**
>
> Ljilja Mrdja, Chief, Chemistry and Metallurgy Laboratory, FKL, Serbia

Supply chain demand. Many companies are integrated into supply chains, with management having to deal with demands made by their customers. Depending on the power they wield, companies at the head of supply chains may request or even demand that their suppliers follow their policy and apply a new business model.

Competition. Competition and market saturation can be important reasons for a company to seek to differentiate its business from others and improve its performance. Companies strive to find new approaches such as "green" PR and innovative strategies to win clients. Chemical Leasing boosts competitiveness and can help the company grow its market share or even enter a new market niche.

Some real-life cases are given below.

Example 1

Motivation: Legislative pressure, health and safety regulations, and high production costs

FKL, a Serbian metalworking company (rolling bearing factory), decided to implement the Chemical Leasing model because of the extremely high costs of the metal cleaning process and pressure from hazardous waste and air pollution legislation. The result of implementing

the Chemical Leasing business model was a reduction in hazardous waste generation from 62.5 l to 2.75 l per ton of products (a reduction of over 95 percent) and successful compliance with the environmental legislation. Costs were also significantly reduced.

Example 2

Motivation: Supply chain / market demand and the opportunity to enter a new market niche

The Colombian company Kakaraka S.A. and its suppliers Bioara and Cornare were looking for a sustainable solution for egg production without chemicals application to meet consumer demand for healthier products. After entering into a Chemical Leasing contract, the companies jointly carried out research and substituted poultry chemical growth promoters with biological promoters. This meant the eggs and their derivatives were now entirely free of chemicals. The new unit of payment is now USD per number of eggs produced with biological probiotic growth promoter. Chemical Leasing has thus enabled Kakaraka to enter a new market niche for bio products, increase its profits, and improve its image.

Example 3.

Motivation: Lack of resources and market entrance

The upstream oil industry is a significant consumer of chemicals, using them in well construction, well intervention, production stimulation, flow assurance and production stream processing applications. Sinomine Specialty Fluids[3] introduced caesium formate brine to the oil and gas industry as a well construction fluid in the late-90's to mitigate environmental, health and safety impacts, increase oil production and reduce rig time. It was clear from the start that the standard fluid service company business model of direct sales (payment per barrel of chemicals) would not work for this expensive and rare chemical. Consequently, the Chemical Leasing model was introduced, with the unit of payment in this case having two components: a daily fee (USD/bbl/day) and payment for losses (USD/bbl). New processes for caesium formate brine reclamation were developed, thus minimising losses.

7.2.6. WHAT ARE THE ROLES AND RESPONSIBILITIES OF THE SUPPLIER AND USER UNDER CHEMICAL LEASING?

Role of the supplier

In Chemical Leasing the supplier provides not only chemicals but also value-added services. The supplier's responsibility is extended and may include management of the entire life cycle of the chemical.

The supplier provides experience and know-how on operating with chemicals effectively, efficiently and safely. The supplier partners with the user to optimise the way the chemicals are used in the user's plants and prevent excessive use.

The supplier could optimise chemical use by advising on process optimisation and/or on chemical substitution to reduce health and safety and environmental risks.

Role of the user

The Chemical Leasing model allows the user of chemicals to concentrate on its core business while benefiting from the services and know-how of the supplier.

The user is responsible for monitoring the process, recording the amount of units to be paid and respecting the process parameters defined by the supplier.

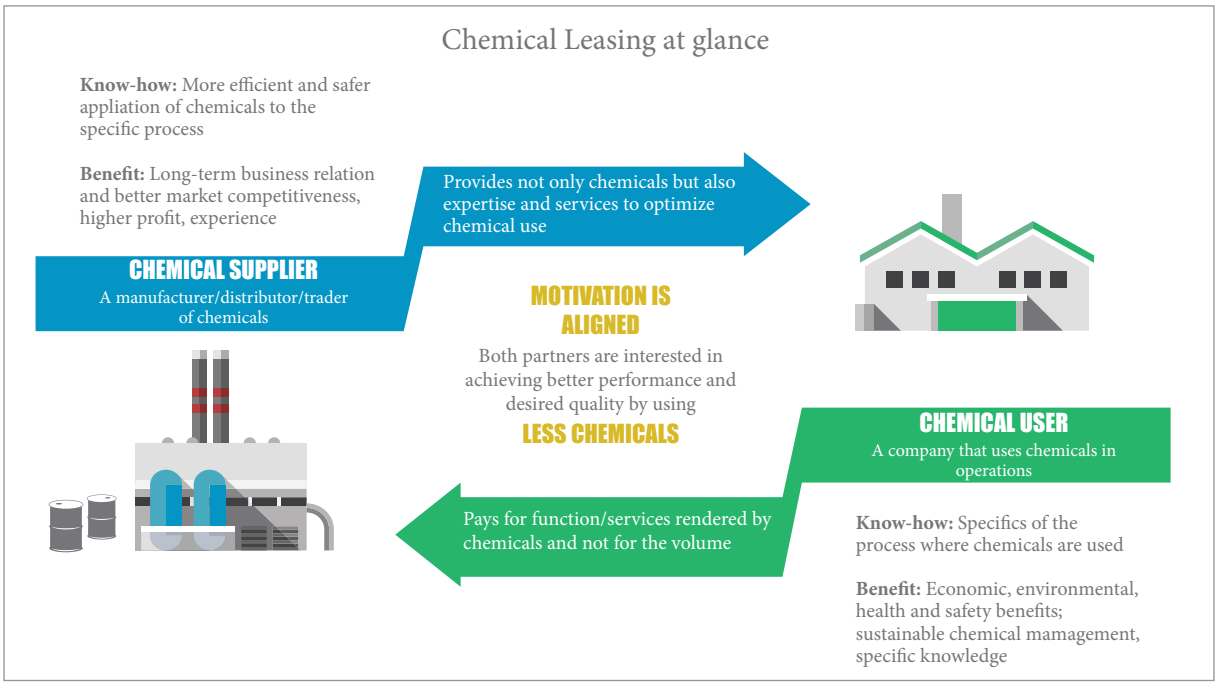
In the event of changes to process parameters and/or equipment failure that may affect chemical consumption, the user is responsible for reporting this to its partner supplier.

Role of other parties

Other parties may be also involved. Their roles are defined on a case-by-case basis. For example, when the supplier and user seek to optimise a process, an equipment provider could be called in to replace obsolete technologies with resource-efficient ones or to introduce equipment for on-site recycling.

[3] *Sinomine Specialty Fluids - formerly Cabot Specialty Fluids*

Figure 3. ***Chemical Leasing at glance***



7.2.7. WHAT ARE THE ESSENTIAL ASPECTS OF CHEMICAL LEASING?

The basis of payment should be linked to the function of the chemicals and not to the quantities used.

Chemical Leasing should adhere to the **following sustainability principles:**

1. Reduction of adverse impacts for the environment, health and safety.
2. Reduction of energy and resource consumption caused by chemicals and their application in the production process.
3. Improved handling and storage of chemicals to prevent and minimise risks.
4. No substitution of chemicals by substances with a higher risk.
5. Generation of economic and social benefits: the contract between supplier and user should enable fair and transparent sharing of the benefits and include continuous improvements as an objective.
6. Monitoring of improvements must be possible.

More information on the sustainability criteria are to found in Chapter C.

7.2.8. WHAT ARE THE BENEFITS OF APPLYING THE CHEMICAL LEASING MODEL?

Chemical Leasing aligns the interests and motivations of the chemical user and the supplier and helps achieve a win-win situation for them and the environment. The life cycle of the chemicals is prolonged, waste is minimised, and resources are used more efficiently.

The Chemical Leasing model encourages partners to exchange experiences and develop strong cooperation. It helps achieve economic, environmental and social benefits.

Benefits for the supplier:

- Greater market share (more clients)
- Higher profits
- Improved competitiveness
- Longer-term business relationships as the supplier and user develop a strong mutual understanding (more foreseeable business)
- Improved technical expertise
- Greater facility in complying with international legislation such as the EU's Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Directive
- Improved environmental profile/image

Picture 2. ***Partners in Serbia***

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Benefits for the user:

- Lower operational and maintenance costs
- Improved productivity
- Increased resource and, in some cases, energy efficiency by optimising the use of chemicals and other resources related to a process
- Improved handling and storage of chemicals
- Reduced risk and improved health and safety conditions (through substitution by less hazardous chemicals, process optimisation, new equipment or improved handling of chemicals)
- Continuous improvement and compliance with international regulations
- Precise calculation of activity-related costs
- Elimination of downtime
- Improved image as an innovative company
- Mitigation of environmental impacts (through substitution, process optimisation, new equipment or improved handling of chemicals)

Example 1

Chemical Leasing applied to a textile production process: reduction of chemical consumption by 30 percent and important experience gained for both partners

Fabricato S.A. manufactures and markets textile products in Colombia and globally. In the process of sizing, different types of chemicals were used. These caused a high wastewater load with organic substances, with gelling and losses occurring due to detachments in weaving processes.

The situation was considerably improved after introducing the Chemical Leasing model (with a unit of payment of USD per warp meter). Fabricato S.A. improved the productivity of its processes, increased the efficiency of raw material use and achieved environmental and economic benefits. Chemicals consumption was reduced by 30 percent. As a result, less chemicals were going to the wastewater plant, reducing biological oxygen demand (BOD) by 99 percent and chemical oxygen demand (COD) by 40 percent. Consumption of water was reduced thanks to reduced cleaning frequency of the weaving machines. Weaving efficiency was increased by 2 percent, worker health and safety was improved thanks to reduced dust emissions, and costs for chemicals were reduced by about 150,000 USD.

©freepik

30 %
CHEMICAL CONSUMPTION REDUCTION

150,000 USD
CHEMICALS COST REDUCTION

CHEMICAL LEASING GOES TO CHINA

In the framework of its Global Chemical Leasing Programme which aims to support and mainstream the application of Chemical Leasing on a global scale, UNIDO organized a number of activities to introduce the business model in China.

The local partners who have shown the commitment and readiness to promote the model in the country are: The UNIDO office in China, the Solid Waste and Chemicals Management Centre, and the China National Cleaner Production Centre.

In 2018, several meetings and trainings were organized for representatives of the Government and the private sector. Both target groups expressed great interest and discussed potential ways of applying the Chemical Leasing approach in China (both on the policy as well as on the business level)

30 %
PAINT CONSUMPTION REDUCTION

70,000 RMB
TOTAL SAVINGS
(6,500 tonnage ship)

Chemical Leasing has been a win-win model for both partners in terms of opportunities, benefits and learning. Fabricato S.A. acquired specific know-how related to the efficient use of chemicals. Its supplier, Quimincol S.A.S., also benefited from this cooperation: the knowledge exchange and greater involvement helped the company hone its skills in the handling of the sizing process. Quimincol S.A.S can now offer process improvement services to other textile companies and promote its "sustainable image" as a supplier that contributes to carbon footprint reduction and sustainable chemicals management. The market position of Quimincol S.A.S has become stronger.

Example 2

@avigator

Chemical Leasing applied to a ship coating process: reduction of chemical consumption by 30 percent and reuse of paint buckets

Zhejiang Feijing New Materials Science and Technology Co., Ltd from China researches, develops, produces and distributes ship coatings. Following its sustainability strategy, the company decided to provide not only paints, but also to introduce the Chemical Leasing business model, thus providing value-added services related to paint applications (with the unit of payment being square meter of protected surface). Implementation of the model brought the following benefits to their average client: paint consumption was reduced by 30 percent; residual paints adhering to the inner wall of the paint buckets was cleaned off with an appropriate solvent and reused; buckets were sent back to the company for reuse; total savings were approximately 70,000 RMB[4] (calculated for a 6,500 tonnage ship).

By introducing this business model and by developing a value-added commercial "package" (functional payment for chemicals + additional service) the supplier increased its competitiveness, improved its market position and significantly improved business relations with its clients.

[4] *RMB - renminbi, the official currency of China.*

7.2.9. HOW CAN CHEMICAL LEASING HELP INDUSTRY TO IMPLEMENT THE CIRCULAR-ECONOMY APPROACH TO CHEMICAL OPERATIONS?

Managing chemicals can be challenging, involving as it does risks such as worker exposure, environmental pollution and accidents, which can damage the environment and human health. Avoiding such risks requires continuous monitoring, process improvement and innovative solutions.

In order to ensure sustainability, industry is increasingly emphasising "circular economy" principles. The circular economy it is not just about recycling, but about increasing product durability, reusing and sharing, and generally promoting the more efficient use of materials and minimising waste.

According to the European Chemical Industry Council (CEFIC), Chemical Leasing is a circular-economy business model and an example of best practices in industry[5].

Chemical Leasing serves as a concrete tool to redefine and reorganise a business in line with circular economy principles.

By aligning the interests and motivations of the chemical user and the supplier, Chemical Leasing helps achieve a win-win situation for them and the environment. The life cycle of the chemicals is prolonged, waste is minimised, and resources are used more efficiently (while Chemical Leasing focuses on reducing the consumption of chemicals, the application of the business model often leads to reductions in the use of other resources such as water and energy). This contributes to the achievement of circular-economy goals.

Below are two practical examples of how the circular economy principles can be supported when companies start applying best practices and innovative business models such as Chemical Leasing.

Example 1.

Sharing and valuing, saving and benefiting

The beverage industry in general is a significant consumer of water, which is used for the lubrication of conveyor belts, among other processes. Lubricants reduce friction in the conveyor belt so that bottles can move smoothly down the production line without falling over.

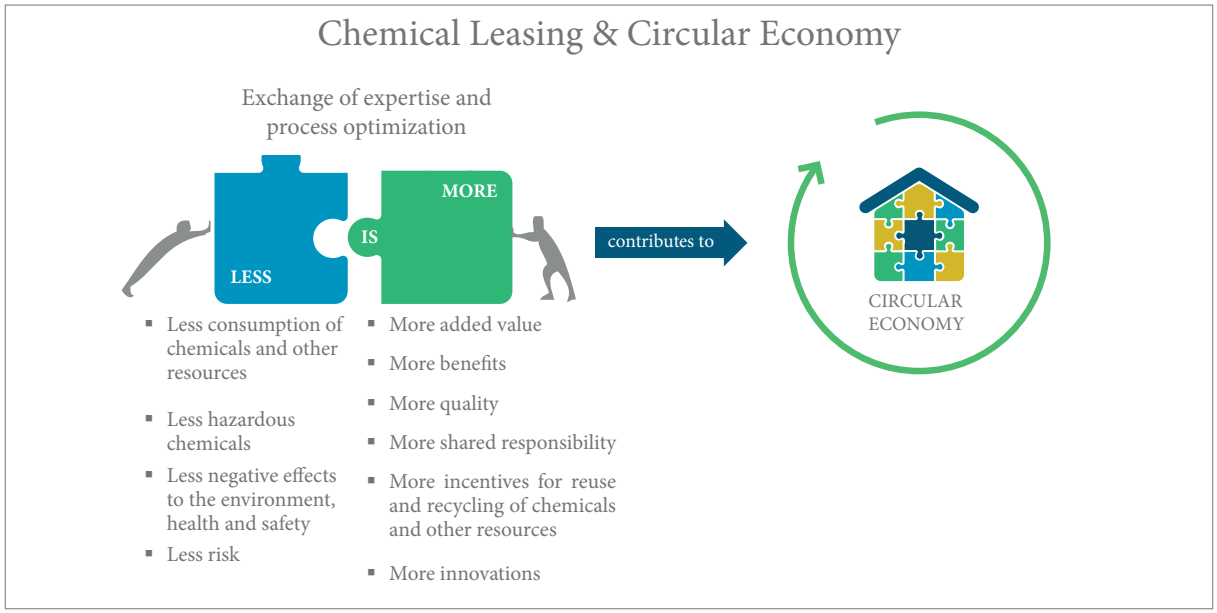
Traditionally, beverage producers pay chemical suppliers per litre or per kilogramme of chemicals purchased. In 2009, a Serbian beverage producer, Knjaz Milos, and a producer of chemicals, Ecolab, partnered to introduce the Chemical Leasing model and changed the paradigm of their business relation. For several PET lines, Knjaz Milos stopped paying for chemicals according to volume and started paying according to the function (lubrication) and to the number of working hours of each conveyor belt, which is linked to the function of the chemical. Supported by its partner, the company also decided to substitute the chemicals applied in the process.

What did this change? First of all, it changed the way the partners did business. They started sharing knowledge and learned to value efficiency, minimisation and collaboration.

Before adopting the Chemical Leasing model, Knjaz Milos had used water-based lubrication on the conveyor belts in the PET lines. This had caused the company

[5] *CEFIC Chemistry CAN report, 2017*

Figure 4. ***Contribution of Chemical Leasing to the achievement of circular-economy goals***



Picture 3. PET Line: Before Chemical Leasing and After Chemical Leasing

Before

After

@Knjaz Milos

many problems: high consumption of chemicals, high consumption of water for dilution of the lubricant and for cleaning, and high wastewater treatment costs.

Under Chemical Leasing, thanks to on-site technical support provided by Ecolab, Knjaz Milos was able to introduce dry lubrication and make enormous savings. For example, it was no longer necessary to use 3,500 cubic metres of water as had been the case for wet lubrication, and consumption of lubricant was reduced by half, from 6,000 to 3,000 kg. Consequently, consumption of a chlorinated chemical for disinfection was reduced. Additional savings were made by virtue of the much-reduced need for transportation of chemicals (both their import into the country and transport within the country), as well as reductions of carbon dioxide emissions. Both partners benefited economically, and the quality of their long-term relationship greatly improved. They shared the mutual benefits and the formula for their success became "sharing - valuing - benefiting".

Less consumption of chemicals by Knjaz Milos led to less use of packaging. Before adoption of the Chemical Leasing model, dosing was carried out manually, and the lubricant was purchased in 25-litre plastic containers. The company consumed 6,000 kg of lubricant per year and therefore generated a considerable amount of plastic waste, amounting to 270 kg per year.

After the Chemical Leasing model was implemented, chemical consumption dropped to 3,000 kg per year. In addition, as the process was automated, the chemical was now purchased in large, 250-litre plastic drums. The net result was a reduction in plastic waste of 100 kg per year (63 percent).

In 2012, both companies received recognition for their excellent cooperation in applying the Chemical Leasing model and received a Gold award at the Global Chemical Leasing Awards ceremony.

Picture 4. Ecolab and Knjaz Milos: Winners at the Global Chemical Leasing Award 2012

©UNIDO

Example 2.

How Chemical Leasing can help a company become a "circular-economy" winner

FKL, a Serbian producer of rolling bearings and bearing units, had to find a way to optimise the consumption of hazardous solvent in its metal-cleaning processes, thus making them more efficient and safer. Together with its suppliers of solvents, SAFECHEM (the producer of the chemical) and Ravago (the local distributor), the company found a win-win solution in Chemical Leasing, signing a contract for this in 2013. The Serbian company now buys the functions performed by the chemical, that is, the cleaned and degreased metal parts, and pays according to the number of working hours of the machine and not according to the volume of solvents used.

Using the Chemical Leasing business model, the partners achieved better performance and the desired quality while using less chemicals. SAFECHEM and Ravago installed a distillation unit on-site for recovering wasted solvent and started using hermetically closed containers to store and transport the solvent during the entire cycle of transportation, dosing, cleaning and recycling. Thanks to these measures, solvent consumption was reduced by a factor of six, from 30 to 5 tons per year. As a result, the metal packaging was also dramatically reduced. Resource efficiency was optimised, and the reuse loop intensified, thus contributing to a circular economy.

For its excellent practice, SAFECHEM was recognised by UNIDO and the international jury at the Global Chemical Leasing Award ceremonies in 2010, 2012 and 2018. The supplier also received the European Responsible Care® Award for 2016 from CEFIC and became an excellent example of a chemical supplier operating in line with the circular economy philosophy.

Picture 5. A distillation equipment

©UNIDO

7.2.10. WHICH INDUSTRIES AND PROCESSES ARE BEST SUITED TO CHEMICAL LEASING?

Chemical Leasing can be applied in many industries and processes, ranging from food processing to car manufacturing and even to agriculture.

Chemical users have their key competence and know-how in the company's core processes. Processes that are part of a company's Chemical Leasing plan are usually non-core, support processes in the company, such as:

- Conveyor-belt lubrication in the beverage industry
- Water treatment
- Cleaning and disinfection in hotels and hospitals
- Surface protection and treatment in metal processing
- Bonding of packaging in the food sector.

It is too costly to have full-time experts for such non-core support processes.

Note: Chemical Leasing can be applied to core processes as well, such as washing in laundries, growing of crops in agriculture or in other industries (see also below for an example from the textile industry).

Table 1 gives an overview of some suitable processes (this list is not exhaustive).

Note that certain processes and chemicals are not suited to Chemical Leasing. Examples are:

- Paint production: The product is defined by a strict recipe in order to get the exact colour and performance. When there is a recipe, you have to follow it.
- Chemicals that are involved in chemical reactions to produce a product: There must be a stoichiometric proportion of chemicals, therefore there is no potential to reduce the number or quantity of chemicals.

In addition, the target process should have potential for optimisation, through changes in the process and/or by chemical substitution.

Table 1. Overview of some suitable processes

Process	Chemicals	Sector example	Possible unit of payment
Lubrication of packaging lines	Lubricants	Beverage, dairies	# of working hours, volume of packed beverage, # of packed bottles
Lubrication of equipment	Lubricants	Different sectors	# of working hours
Cleaning in place (CIP)	Cleaning agents, disinfection agents	Beverage, dairies	# of cleaning cycles
Bonding of boxes	Hot melt adhesives	Food processing and any automated line for bonding of boxes	# of bonded boxes
Bonding of labels	Adhesives	Beverage	# of labeled bottles
Bonding in wood processing	Adhesives	Wood processing	Square meters of bonded surface
Bonding of windows	Adhesives	Civil engineering	# of windows
Bonding in shoe industry	Adhesives	Footwear	# of produced shoes
Cleaning of surface	Solvents, water-based cleaners	Metalworking, other industries	Square meters of cleaned surface, # of working hours (for automated, continuous processes)
Surface preparation (adhesion improvement)	Chemicals for surface preparation (i.e. phosphates)	Metalworking, auto-motive industry	# of items, square meters of prepared surface
Galvanization	Different chemicals for galvanization	Metalworking	# of items, square meters of prepared surface
Surface protection	Powder coatings, solvent and water-based coatings, hot dip zinc	Metalworking	# of items, square meters, # of protected items
Waste water treatment	Chemical for waste water treatment	Different industries	Cubic meters of treated water
Water treatment and disinfection	Different chemicals for water treatment	Drinking water supply	Cubic meters of purified water
Oil and gas drilling	Application of chemicals in the extraction of products from oil wells	Oil and gas	# of working hours
Water purification and oil dehydration	Purifier, emulsion breaker, antifoam	Oil and gas	Kilo barrels of oil with a specified quality
Printing	Printing inks	Printing industry	Square meters of printed surface
Textile dyeing	Dyes	Textile industry	Square meters of colored textile or kg of yarn
Leather treatment and dyeing	Dyes, various treatment chemicals	Leather industry	Square meters of treated leather
Laundry	Detergents, disinfection agents, softeners	Hotels, hospitals, laundries	Kg of laundry
Cleaning of floor surfaces	Cleaning agents	Hotels, hospitals, supermarkets	Square meters of cleaned floor
Dish washing	Detergents, disinfection agents, softeners	Hotels, hospitals	# of cycles (full capacity of dish washing machine)
Laundry, cleaning, dish washing	Detergents, softeners, disinfection agents	Hotels	# of overnight stays
Crop protection	Fertilizers, pesticides	Agriculture	Yield (kg)
Sizing	Chemicals for sizing	Textile industry	Square meters of textile surface treated
Poultry breeding	Growth promoters	Poultry	# of eggs without chemicals
Anodizing	Phosphorus-based chemicals	Metalworking industry	Square meters of pre-treated surface

7.2.11. WHAT ARE THE MOST IMPORTANT FACTORS IN THE SUCCESSFUL APPLICATION OF THE CHEMICAL LEASING BUSINESS MODEL?

For Chemical Leasing to be successful, the following nine elements are very important; the first three are critical.

1. The supplier should have experience and excellent know-how in order to be able to recommend chemical and/or process changes and provide value-added services.
2. The unit of payment must be correctly defined.
3. It should be possible to measure, record and demonstrate units of payment.
4. Quality standards must be maintained at a high level.
5. Employees of both supplier and user need to be committed to the new working methods.
6. In most cases, in-depth know-how on the application of the target chemical should not be part of the user's core processes.
7. The supplier and user should enjoy a relationship of cooperation and mutual trust.
8. Benefits should be shared fairly between supplier and user.
9. The legal agreement between supplier and user should clearly define the critical terms, such as technical specifications of chemicals, unit of payment, terms of payment, the liability and responsibility of each party, etc. An example is available at the website.

More information can be found in the section on Dos and Don'ts.

Practical considerations and examples related to the critical success factors:

Factor 1: Excellence of know-how

Suppliers must have additional process expertise to offer the users with respect to the target chemicals. For example, in the case of metal cleaning by solvents, users usually know how to use the equipment, when to change the solvent etc., but do not know the physics and chemistry underlying the process – what happens to the solvent during the cleaning process – and thus how to prolong the cleaning lifespan. Suppliers have this knowledge. They can therefore offer users the capability of optimising the cleaning process and so reduce chemical consumption. In addition, knowing better than users the toxic and hazardous properties of their chemicals, they can offer users new formulations that are less or non-hazardous to the environment and human health.

Example:

Valamar Laundry in Croatia purchased its laundry chemicals from the supplier Ecolab. The supplier has developed laundry chemicals that ensure the required washing quality at lower temperatures. Thanks to a knowledge exchange between the two partners, the process became more efficient and the quantity of laundry chemicals was reduced. Partners selected the unit of payment that corresponded to the key function of the chemical: kilogram of washed laundry.

Chemical Leasing does not benefit only users in terms of knowledge acquisition. It is a two-sided learning process. Often, suppliers gain experience on the workings of specific processes, thus further improving their know-how.

Factor 2: Appropriate unit of payment

It is not always easy to define a unit of payment. For example, in the metalworking industry, there are many different sizes and shapes of metal parts, different types of dirt to be cleaned (for instance, different types of oil used for different kinds of metal processing), so it is not possible to use cleaned surface or number of cleaned pieces as the unit of payment. However, cleaning machines work continuously, and the number of working hours is a solution for a unit of payment that can be measured, recorded and demonstrated.

*Picture 6. **Metal parts of different sizes and shapes***

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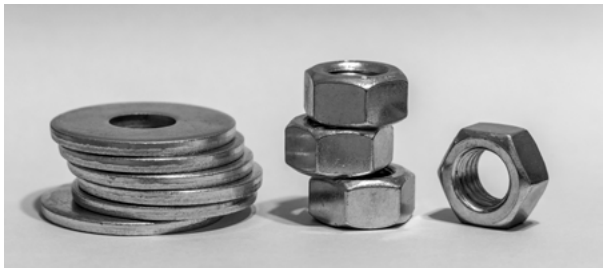

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Factor 3: Constant monitoring of unit of payment

It is important to have a unit of payment which can be accurately monitored, recorded and demonstrated. For example, in the case of conveyor lubrication, the unit of payment is the number of working hours of the conveyor (this corresponds to the function of the chemical, which is to ensure that the belt works smoothly). To control the number of working hours, Ecolab, the supplier of Knjaz Milos in Serbia, installed a counter for working hours (only the supplier can make modifications to the equipment). This counter measures, records and demonstrates the units of payment, the number of working hours of the conveyor.

Picture 7. Conveyor with a counter for working hours

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7.2.12. WHAT OTHER ELEMENTS CAN SUPPORT THE SUCCESSFUL IMPLEMENTATION OF CHEMICAL LEASING?

The implementation of Chemical Leasing can be supported by:

- Trusted third parties. Consultants and experienced industry partners can act as initiators and catalysts for Chemical Leasing projects and can help in case of disputes. UNIDO has successfully taken on this role in a number of international projects. There are also independent consultants and consulting companies working in different countries who can be called upon.
- Partnership with other experts. Process engineers, for example, can help optimise processes, or waste recycling firms can help prolong the life of chemicals.
- Acknowledgment and public recognition of best practices, nationally and internationally. One example is the Global Chemical Leasing Award, which promotes the Chemical Leasing business model and rewards cases of excellence around the world.

7.2.13. WHAT ARE POTENTIAL OBSTACLES TO IMPLEMENTING CHEMICAL LEASING?

Some of the factors that make implementation of Chemical Leasing difficult are listed below:

- Chemical user might perceive the risk of being too dependent on one selected supplier, particularly if long-term contracts are signed or special equipment is installed.
- Developing a sufficient level of trust between supplier and user can be challenging. Although collaboration is a prerequisite for Chemical Leasing, sharing information can present difficulties, especially when confidential data are involved.
- Reluctance from suppliers and users to commit the resources needed for the necessary changes to business practices and business culture. As with any new idea, both users and suppliers can find it hard to break out of their "comfort zone" and move away from the situation which they know, even if it is sub-optimal.

7.2.14. CAN CHEMICAL LEASING BE APPLIED IN THE AGRICULTURAL SECTOR?

In the traditional way of selling chemical products, the agrochemical supplier (pesticide and fertilizer) sells an amount of the products to the farmer, let's say 100 L of pesticide. The farmer has limited knowledge on the proper use of the products and consumes the 100 L for an area of 1 ha. The farmer pays for the 100 L an amount of 1000 EUR. Condireing the production and transportations costs 700 EUR, the supplier makes a profit of 300 EUR.

With Chemical Leasing, the supplier receives the payment for the benefit of the agrochemicals (fertilizer and pesticides), for this case: 1 ha free of pests. Both companies agreed to a payment of 900 EUR per ha free of pests. The supplier has the knowledge on the proper application and provides training to the farmer and assistance to improve the process. The farmer optimized the sprayer and a prepared a precise mixture without overdosing. This required only 30 L of the pesticide. The farmer has an economic benefit as he pays 900 EUR instead of 1000 EUR. The supplier has an economic benefit as he saves 70 percent of his former supply. With production and transport costs of 7 EUR per litre (30 percent margin in the original business) he saves 490 EUR production and transport costs. He receives 100 EUR less from the user, has additional costs for the training of 100 EUR and in this way increases his profit from 300 EUR in the classical business to 900 EUR (income) – 210 EUR (production and transport cost 30 L pesticide) - 100 EUR (training) = 590 EUR. This creates a triple win: supplier (+290 EUR profit), user (-100 EUR costs) and the environment (as 70 percent less pesticide is used).

Example 1.

Wheat field in Serbia: better yield and fair share of profits

The Chemical Leasing model was implemented in Serbia, on a crop of wheat. The field was divided into two. In one section, wheat was cultivated in the same way the farmer normally did it: without soil testing, without permanent rows for the movement of agricultural machinery, using more seeds for planting than is recommended, having unequal spacing between plants, using broad-spectrum pesticides.

Under the Chemical Leasing cooperation, the chemical supplier (a distributor of agrochemicals) provided value-added services related to the use of fertilisers and pesticides. Thus, on the "Chemical Leasing section" of the field, the wheat was cultivated according to agrotechnical measures that included soil testing and fertilisation according to the test results, permanent rows for the movement of agricultural machinery, proper quantity of seeds, approximately equal spacing between plants, and use of specific pesticides at the right time.

In the contract, it was agreed to share the difference in profits at a ratio of 50:50 (whether positive or negative).

[6] *Source: Chamber of Commerce of Serbia in 2014.*

Results:

- Costs for fertiliser use were almost 900 EUR less in the "Chemical Leasing section" than those in the "traditional" field section.
- Yield was 2 percent higher in the "Chemical Leasing section".
- The average yield in Serbia in that year (2014) was 3.9 t/ha[6] compared to the yield in the "Chemical Leasing" field section of 6.8 t/ha
- Profits per hectare from the "Chemical Leasing" field section was about 215 EUR higher (18 percent) than those from the "traditional" field section. As agreed, this profit was shared 50:50 between the partners.

Picture 8. ***Agro project in Serbia***

@UNIDO

AROUND THE WORLD: SRI LANKA

In order to test the application of Chemical Leasing to the agro sector, UNIDO has supported several projects in Sri Lanka. The model was successfully applied to different agricultural products, including potatoes, rice paddy, tea and vegetables. Farmers and chemical suppliers were trained, and approximate savings achieved in 2012-2013 were as follows: costs for agrochemicals applied declined by 40 percent for the potato crop, 55 percent for the paddy crop and 31 percent for the carrot crop. These reductions mirrored the quantities of pesticides applied (estimations by National Cleaner Production Centre - Sri Lanka).

Picture 9. ***Agro projects in Sri Lanka***

@NCPC Sri Lanka

@NCPC Sri Lanka

7.2.15. WHY CAN CHEMICAL LEASING BE CONSIDERED AN INNOVATIVE BUSINESS MODEL?

Different authors define innovation as "a multidimensional and transformational change that brings added value", "new knowledge", and "better performance".

- "Innovation is change that creates a new dimension of performance." (Peter Drucker)
- "The introduction of transformational change into inherently stable systems from which a user derives meaningful value." (Andrew Marshall)
- "The introduction of new products or services that add value to your business." (Kevin McFarthing)
- "Innovation is the process of making changes, large and small, radical and incremental, to products, processes, and services that results in the introduction of something new for the organisation that adds value to customers and contributes to the knowledge store of the organisation." (O'Sullivan & Dooley)
- "The transformation of knowledge into new products, processes, and services" (Porter & Stern)
- "Change that creates value." (Doug Williams)

Adopting the Chemical Leasing model is a business innovation. It changes the paradigm from "the more you sell, the more you earn" to "less is more". It refashions the business relation between the supplier and the user of chemicals, aligning their interests. Transforming the way of doing business with chemicals helps improve existing processes, optimise chemical consumption, etc. In addition to its environmental, health and safety benefits, Chemical Leasing reinvigorates a business, creating added value and boosting growth and productivity.

Implementing Chemical Leasing is "out-of-the-box thinking", involving a re-think about how the business relation can be linked to the function of a chemical instead of to the amount of that chemical. This open-minded approach stimulates new ideas and solutions that lead to technical and business innovations and further improvements.

In addition, technical progress (for example, the Internet of Things) can give a further boost to the implementation of Chemical Leasing and help its spread around the globe.

Example: Henkel and the Internet of Things

Henkel, a company which has already built up an experience in the application of the Chemical Leasing business model, has demonstrated that Chemical Leasing and innovation go hand in hand.

Recently, the division of Henkel that provides chemicals to the food and beverage sector developed and patented an optimisation system for water-based labelling processes based on the Internet of Things (IoT). This innovation leads to higher efficiency and quality in labelling processes. The system can be seen as an excellent tool to enable successful Chemical Leasing implementation in the sector. The reason is simple: it helps to achieve one of the critical conditions for successful Chemical Leasing implementation - the ability to measure, record and demonstrate units of payment, ensuring correct billing. Thus, in companies where this optimisation system is in place, it is much easier to implement the Chemical Leasing model.

This innovative solution is currently being tested in several plants in different countries. For clients that decide to apply the Chemical Leasing model, the unit of payment would be the volume of beer produced (hectolitres).

Henkel's IoT system:

- Allows for the monitoring and control of the multiple parameters of the labelling process and gives the plant the ability to react to changes in real time.
- Enables absolute tracking (traceability) of the labelling procedure and sets off alarms when it does not perform correctly.
- Is a powerful analytical tool that provides a statistical overview of each batch and detects where process improvements can be made.
- Decreases the reaction time, enabling maintenance of the process to be undertaken within stable and desired limits.
- Decreases the risk of complaints arising from insufficient adhesive coating weight and water condensation since the root causes for these problems are easier to identify.
- Enables feedback from the operator: information about any disruption observed during the labelling process is raised in a "manual alarm" section. This covers all abnormalities that are not "pre-defined" (e.g., issues with labels or specific machine parts).

Dejan Odadzic

Key Account Manager Labelling Europe at Henkel

> **Henkel recognises Chemical Leasing as a business model that provides the highest level of connection between the end customer and the supplier, applicable in a wide variety of different daily sales activities.**
>
> Dejan Odadzic

What has been your experience with Chemical Leasing? How does it help Henkel and its clients become more competitive?

Henkel recognises Chemical Leasing as a business model that provides the highest level of connection between the end customer and the supplier, applicable in a wide variety of different daily sales activities. Chemical Leasing is creating a much stronger customer-supplier bond, implying a need for the implementation of additional checkpoints (even systems) for chemical consumption tracking. All of this activity is resulting in overall, absolutely sustainable production quality increases.

Chemical Leasing and innovation: do they go hand in hand?

Absolutely yes! We can even say that in the case of adhesive consumption in the food sector, the implementation of Chemical Leasing cannot be carried out without innovations to the current model. Henkel has developed a tool called HOSS (Henkel On-line Support System) in order to further support and monitor the adhesive application process.

The Internet of Things: what is it about and what does it mean for Chemical Leasing?

Today we have multiple sites worldwide where daily usage of chemicals is occurring. There is a need to monitor online usage. This need drives the story in only one direction: the Internet of Things.

How can Henkel's innovative optimisation system for water-based labelling processes help mainstream the Chemical Leasing business model? Can it also be applied to other processes?

As an idea or principle, HOSS (Henkel On-line Support System) is applicable to almost any type of production, regardless of what the product is. The system collects, stores and computes data, and informs all stakeholders about any abnormalities the moment they occur, enabling instant reaction. In addition, it generates a huge database for further big data management and statistical analysis.

What is your view about the future of Chemical Leasing in the Henkel business portfolio and in industry in general?

I'm absolutely sure that this business model will be further replicated (and even requested) by our clients.

When you decided to introduce the Chemical Leasing model, what were the key challenges you faced and how did you overcome them?

The key moment for the introduction of this business model (besides raising the level of understanding within both parties involved, buyer and supplier) was monitoring. Without the possibility of online, 24/7 monitoring, the model cannot be implemented very efficiently.

Why did you participate in the Global Chemical Leasing Award, and how would you describe your experience?

UNIDO Chemical Leasing projects have been recognised as very important for the industry, so the Award itself is not only an acknowledgment of the best projects, it also encourages outstanding innovations that provide best-in-class support for customers. What I found really impressive was the diversity of the cases presented during the Award where Chemical Leasing as a business model has been implemented.

What is the attitude of Henkel clients to the new paradigm (pay per unit of function, instead of per unit of volume)?

Right now, we believe that, after dealing with various technical issues (such as consignment stock) and raising awareness of the business model, customers are likely to actually insist on this model wherever possible.

7.3 DOs AND DON'Ts IN THE SUCCESSFUL APPLICATION OF CHEMICAL LEASING

Reinhard Joas

International expert on Sustainable Chemicals Management, environmental technologies and innovative business models, Managing Director of CS3, Germany

Successful application of Chemical Leasing will generate a triple win situation:

- The user will bear less costs, which will lead to higher profits and better competitiveness, as well as improved health and safety conditions for the workers.
- The supplier will see higher profits, combined with a closer relationship with its customers.
- The environment will benefit, with less resources consumed, resulting in lower emissions and/or reduced waste

However, Chemical Leasing requires both technical and administrative changes in processes, creating challenges for the partners involved. The following checklist of "Dos" and "Don'ts" has been generated based on experiences over the last 15 years. It is broken down into "Dos" and "Don'ts" that apply to both user and supplier, those which apply only to the supplier and those which apply only to the user. It provides general guidance to suppliers and users of chemicals who intend to implement Chemical Leasing. As each application of the business model has its own particularities, the checklist cannot cover all individual situations.

Table 2. ***Do and Dont´s***

DO	DONT'S
I. Both, Supplier and User	
1. Respect each other's special knowledge and experiences	1b. Forget to have clear rules for liability and product quality
2. Share fairly the financial benefits	2b. Have an unclear or insufficiently precise description in the contract of the unit of payments and how benefits are to be measured
3. Use digitalisation for intensified collaboration and data exchange	3b. Use short term contracts
4. Use existing experiences (e.g., UNIDO's)	
5. Ensure joint monitoring of overall chemical consumption as well as consumption per unit of payment	
6. Define how units of payment will be measured, recorded and demonstrated	
7. Define acceptable variations in chemical consumption per unit of payment (i.e. ±1 percent)	
8. Collaborate on a proper handling of chemicals and accident prevention measures	

II. Supplier-specific	
9. Include provisions for any increases in the costs of raw materials via the use of index-based prices	4b. Disseminate user-specific confidential data and information
10. Collaborate with machine and equipment suppliers	5b. Forget to have clear rules for the misuse of chemicals (e.g., unjustified high consumption)
11. Consider the use of non-hazardous chemicals as far as is possible	6b. Substitute chemicals with higher-risk substances
III. User-specific	
12. Allow the supplier's experts access to all relevant parts of the production process	7b. Forget to include clear rules governing confidentiality and Intellectual Property protection
13. Train the accounting staff on the new procedures	8b. Agree to a contract without the possibility of negotiating adjustments
14. Include R&D staff in discussions on reduced chemicals consumption	

The Do's explained in more detail

For both the supplier and the user

Chemical Leasing requires a more intensive collaboration between the user and supplier of chemicals as well as mutual trust. This is addressed in (1), (2), (5), (6) as fundamentals for a successful sustainable business model.

Digitalisation offers new possibilities for the exchange of process data. The user can share information online with the supplier for certain processes and the supplier can – based on this knowledge – provide better guidance to the user on a more efficient use of chemicals (3).

Experiences with the adoption of the Chemical Leasing business model are publicly available for more than 100 cases. These could be invaluable to any user or supplier setting up a new case of Chemical Leasing. (4) These cases can be accessed via the website www.chemicalleasing.org or by contacting UNIDO[7].

There are always some acceptable chemical consumption variations in the processes due to slight changes of the process parameters. It is important to agree on these variations (percentages) to avoid possible misunderstandings between the partners. Consumption out of these bounds indicates issues in the process that should be investigated and reported to the supplier (7).

Safe and efficient handling of chemicals is a pre-requisite for their sustainable use. It serves not only to prevent accidents but also to improve productivity. The user should request support from the supplier on this topic that goes beyond providing a material safety data sheet, and the supplier should agree to sharing his knowledge with the user (8).

Specific to the supplier

Cost increases in the chemicals which the supplier delivers are basically not reflected in benefit-oriented pricing which is applied for Chemical Leasing. In cases where the costs of chemicals have a major impact it is recommended to adapt the financial conditions of the contract with index-based systems (9).

In a number of applications, efficiency of chemicals consumption depends on the use of appropriate machinery and equipment. In these cases, it is essential to extend the collaboration to other partners and involve them in the business model (broader Chemical Leasing concepts) (10).

The sustainability criteria for Chemical Leasing demand that any alternative chemicals proposed by the supplier are non-hazardous chemicals if this is at all technically and economically feasible (11).

[7] *ChemicalLeasing@unido.org*

Specific to the user

As already mentioned, Chemical Leasing only works well if there is an intensive collaboration between user and supplier. For this purpose, the user should allow the experts of the supplier access to relevant processes in order for them to be able to properly bring to bear their expertise for improvements (12). Typically, there is a working group of experts from the user and the supplier that generate the ideas for improvements. It is recommended that the user include any R&D staff (at least part-time) in this working group (14).

With benefit-oriented pricing, processes in accounting change significantly. Therefore, it is essential for the user to adequately train its accounting staff on the new system (13).

The Don'ts explained in more detail

For both the supplier and the user

Product quality, and the liability which may arise from suboptimal product quality, are both major areas of concern for both user and supplier of chemicals (1b). If the optimization of the chemical consumption leads to a situation where the final product no longer meets the required quality specifications, then regularly the question arises as to who is responsible for the deficits and who is responsible for compensation and the necessary improvements. The same applies if problems in the production process itself occur or environmental damages happen that are caused by the optimization of the chemical consumption. Therefore, it is recommended to clearly address these topics in the contract.

Benefit oriented pricing is the major driver in a Chemical Leasing business model. However, it is also a major challenge to define a measurable benefit. Therefore, it is very important that both the user and supplier give this issue sufficient time and attention and not start the contract with an unclear definition of the benefits and how they are to be measured (2b).

Short-term contracts typically do not work well with Chemical Leasing as the collaboration and the optimisation need time to develop properly (3b).

Specific to the supplier

The intensified collaboration between user and supplier of chemicals which a Chemical Leasing business model necessarily requires raises major concerns for the user with respect to the protection of the confidentiality of its internal data to which the supplier becomes privy. Therefore, it is essential that the supplier respects the confidentiality of such information and does not disseminate it (4b).

The potential misuse of the chemicals which are supplied to the user are a major area of concern for the supplier (5b). Therefore, it is recommended to clearly address these topics in the contract. Misuse is understood to mean that the user consumes the chemicals which are delivered for purposes other than those that are covered under Chemical Leasing contract (an extreme example would be the user selling on part of the received chemicals to third parties). Such unforeseen consumption would cause losses on the supplier side as he/she receives payments not for the amounts of chemicals consumed but for the benefits generated in defined processes.

The sustainability criteria for Chemical Leasing demand that the chemicals which the user currently uses are not substituted by substances with a higher risk (6b).

Specific to the user

With the intensified collaboration between user and supplier which Chemical Leasing requires confidentiality of internal data and protection of intellectual property becomes highly important for the user. In the contract, these topics should not be missed (7b).

Chemical Leasing generates added value because of more efficient processes with reduced chemicals consumption. In many applications, it is difficult to predict the exact amount of chemicals that will be saved once the processes are started. An inflexible contract might then not adequately reflect the actual added value generated (8b). It is recommended to prepare contracts with the possibility of re-adjustments.

7.4 COMPARISON OF DIFFERENT BUSINESS MODELS

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Chemicals are part of many industrial processes and products. Managing chemicals in a company is a challenge, since unlike other materials chemicals require specialised procedures and data at every stage in the lifecycle, and in most cases chemicals management is not part of the core competencies of a company. It is not only the proper use and handling of chemicals that is a challenge. Controlling the cost structure can also be difficult as it includes not only the purchase costs of the chemicals but also the costs for the chemicals' management (from procurement until recycling or disposal). Companies generally have little idea about the real costs to them of managing these highly regulated materials.

Because of this lack of understanding of the true costs of chemicals, selling chemicals by volume leads to overconsumption and, as a result, to increased costs, and adverse impacts on economic sustainability, the environment and to human health.

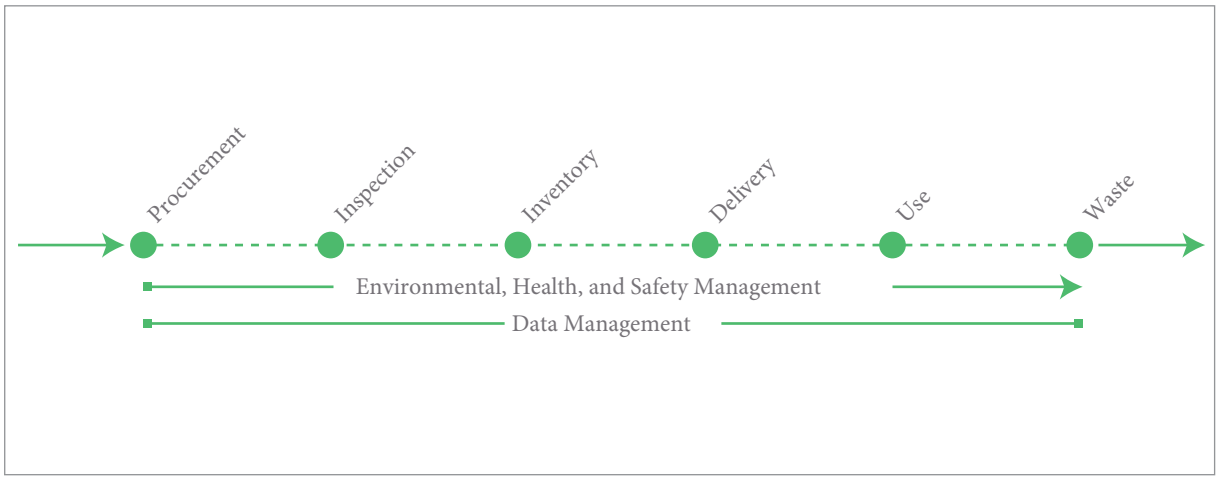
In the 1990s, a shift in the role of the manufacturer or supplier from a provider of just a product to a provider of both a product and a service started to take place. This shift should enable sustainable development, since a service-oriented economy is based on a performance-driven approach: the customer pays for the performance of the product, e.g. the degreasing of metal parts, rather than for the product itself, e.g., the degreasing solvent. Not only does payment of the services supplied by chemicals have an important potential for reducing the environmental and health impacts of chemicals, it can also lead to more competitive ways of doing business. We present below some alternative product-service business models, which have been used in recent years in commercial operations involving chemicals. The differences between these and Chemical Leasing are presented in Table 3.

When a chemicals user is deciding which of these various business models to implement, many factors need to be considered. The management, for example, can decide that they want to have only one service provider to manage all their chemicals (in this case, Chemical Management Services would be an option). In some situations, it could be strategically important to keep the knowledge about processes and chemicals on site (in which case Chemical Leasing would be an option). In other situations, this would be not a priority (in which case "outsourcing" could be an option).

Classical leasing

The term Chemical Leasing is the name of a business model and is NOT about the leasing of chemicals, although it may include leasing operations. In classical leasing, the focus is on financing and the supplier remains the owner of the chemical. The user pays an agreed fee for the use of the chemical and there is no technical cooperation between partners. Leasing of chemicals can be applied to chemicals that are not consumed in a process, such as solvents in cleaning processes.

Figure 5. ***Chemicals life cycle***[8]



[8] Source: http://www.chemicalstrategies.org/implement_whatiscms.php

Outsourcing

Companies outsource non-core activities to free up cash, personnel, time, and facilities so as to be able to concentrate on their core activities. When a process is outsourced, the responsibility for this process is transferred to a third party. Transferred processes are mostly located outside of the original production site, but when it comes to processes involving chemicals, they are usually located on the user's site. Examples are wastewater treatment plants or car body painting shops.

In most cases, process optimisation is not part of an outsourcing contract. There is no knowledge sharing about the process between the partners, and the users typically do not know which chemicals are applied. The contract is not only about the costs for the chemical but includes also the fee for workers, equipment maintenance and cost of other resources such as energy and water.

Note: Unit of payment in Chemical Leasing and outsourcing could be the same (i.e. in water treatment: cubic meters of treated water).

Chemical Management Services (CMS)

CMS involves a strategic, long-term relationship in which a customer contracts with a service provider who supplies and manages the customer's chemicals. In CMS, the supplier offers a series of chemical-related services, like purchasing, monitoring of emissions, storage and disposal, risk management and quality control. CMS in general focuses on all the chemicals in a company that has taken the decision to implement this model.

The joint aim of the supplier and the customer of these services is the continuous reduction of the chemical's lifecycle costs and risks, the reduction of the environmental impact and in general the optimisation of the processes. These chemical services are often performed more effectively and at a lower cost than companies can do by themselves, and the provider's compensation is tied primarily to quantity and quality of services delivered, not the chemical volume.

The main difference between Chemical Leasing and CMS is that Chemical Leasing focuses on raising the efficiency of using chemicals – although further services might be offered in addition to that - whereas CMS offers a number of services that could theoretically include Chemical Leasing but does not have to.

Take Back Chemicals

Royal Haskoning DHV has co-developed a new business model called Take Back Chemicals for closing material cycles in the chemical related industries.

This business model is similar to Chemical Leasing but is applied only to chemicals that are not consumed in a process and can be returned for recycling. The focus is therefore on non-core uses of chemicals, such as cleaning, some processes where catalysts are used, or water purification. The unit of payment is based on the chemical function.

Unlike classical leasing (to which it has affinities) but like Chemical Leasing, cooperation and knowledge sharing between partners are crucial for the success of implementation.

Table 3. Differences between Chemical Leasing and Other Business Models

Business Model	Scope	Cooperation between parties	Payment	HSE requirements	Process improvements and chemical substitution	Innovations
Chemical Leasing	Specific process (one or more in a company) at the company site.	Exchange of know-how and experiences between partners. Shared goals, User runs the process.	Based on chemical performance and function, includes chemical and sometimes equipment leasing.	HSE have to be improved.	Process is improved. Chemicals substituted by others with similar or less hazard. Recycling can be included.	Acceleration of process innovation and creation of added value for all partners.
Outsourcing	Specific process,usually one in a company, at the company site or outside.	User just pays for the service. Does not run the process or is otherwise involved in it.	Based on services provided – includes chemicals, work, maintenance, other resources.	There are no HSE requirements. User has no information on chemicals that are being used in the process.	There is no request for process improvement. Chemicals could be substituted by more hazardous ones.	There are no requirements for innovation.
Chemical Management Services	Management of all chemicals in use, at the company site.	Service provider takes overall activities related to chemicals (purchase, quality control, storage). Shared goals.	User pays for a menu of different services.	Service provider usually provides HSE management related to chemicals.	Process improvements and/or chemical substitution are usually not included in the contract.	There are no requirements for innovation.
Take-back chemicals	Specific process (one or more in a company) at the company site.	Exchange of know-how and experiences between partners. Shared goals. User runs a process.	Based on chemical function.	HSE is usually improved.	Process is improved, waste chemicals are recycled.	Acceleration of process innovation and creation of added value for all partners.
Classical Leasing	Specific chemical that is not consumed in a process.	There is no technical cooperation between partners.	User pays leasing fee.	There are no HSE requirements.	There is no request for process improvement. There is no chemical substitution.	–

7.5 TWO CASE STUDIES: UGANDA (BEVERAGE) AND COLOMBIA (TEXTILE)

7.5.1 CASE STUDY I

FABRICATO S.A & QUIMINCOL S.A.S (COLOMBIA)

Process: Sizing in Textile Industry

1. Background information

The sizing process consists of the optimal preparation of the warp to guarantee its adequate functioning in the weaving process. The yarn is covered by a film that preserves its elasticity, protects against fibre-fibre and fibre-metal abrasion, protects the yarn against tensile forces, allows easy removal of sizing chemicals (de-sizing), and improves flexibility and good adhesion.

2. Introduction

Fabricato S.A. manufactures and markets textile products in Colombia and globally. It offers fabrics for clothing products, including denim, casual, and knit products, as well as institutional products.

In the process of sizing, different types of chemicals are typically used. These cause high organic loads in the wastewater, caused by gelling and losses due to detachments in weaving processes.

To resolve this, the company started looking for solutions with its supplier of sizing chemicals, Quimincol S.A.S. They succeeded in finding a solution and decided to go beyond the classic business model. The companies sought to be true strategic partners, where mutual benefits prevail as a motivator for new developments and technologies. The companies recognised that the Chemical Leasing business model would improve process productivity, increase the functionality and efficient use of raw materials and mitigate environmental impacts, as well as generate economic benefits for both sides.

3. Key changes and results

The key change was chemicals substitution, followed by laboratory-, pilot- and production testing to find the best technical solution.

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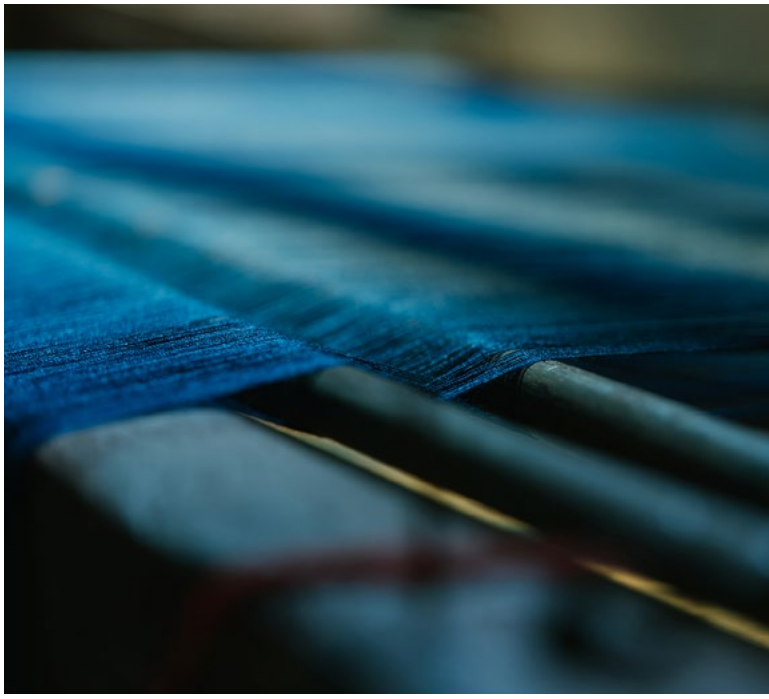


3.1 Unit of Payment

Before Chemical Leasing	USD per kg of chemicals
After Chemical Leasing	USD per meter of warp

3.2 Technical Measures Tested and Implemented

Before the two partners adopted the Chemical Leasing business model, modified starches, polyvinyl alcohol, acrylates, fatty acids and different additives were used. Once the Chemical Leasing business model was implemented, these were substituted by low-solid synthetic polymers.

63%
reduction in chemicals consumption (sizing process)

3.3 Results Achieved

Before Chemical Leasing	After Chemical Leasing
Environmental benefits	
Consumption of chemicals for sizing processes per year was 561 tonnes	Chemicals consumption in the sizing process was reduced by 63 percent (to 210 tonnes)
16 chemicals were in use	2 chemicals are in use
Consumption of auxiliaries (caustic soda and peroxide) in the subsequent preparation steps and in the sizing process was 962 tonnes	Consumption of auxiliaries was reduced by 27 percent (to 701 tonnes)
Biological Oxygen Demand (BOD) in the wastewater from the sizing process of: ▪ thin yarns: 49,196 mg/l ▪ thick yarns: 44,698 mg/l	BOD in the wastewater from the sizing process of: ▪ thin yarns: 13.75 mg/l, a reduction of 99.97 percent ▪ thick yarns: 12.5 mg/l, a 99.9 percent reduction
Chemical Oxygen Demand (COD) in the wastewater from the sizing process of: ▪ thin yarns: 102,429 mg/l ▪ thick yarns: 84,570 mg/l	COD in the wastewater from the sizing process of: ▪ thin yarns: 68,794 mg/l, a 33 percent reduction ▪ thick yarns: 37,372 mg/l, a 55.8 percent reduction
Sizing with 10 percent of solids for thin yarns	Sizing with 5.5 percent solids for thin yarns, which leads to less loading of wastewater caused by chemicals in the de-sizing processes
Sizing with 4 percent of solids for thick yarns	Sizing with 2.5 percent solids for thick yarns, which leads to less loading of wastewater caused by chemicals in the de-sizing processes
Economic benefits	
	Savings are about 150,000 USD per year for chemicals (for sizing and auxiliary chemicals)
	Optimisation of storage space due to the reduction in volume of sizing raw materials
Losses due to detachment in weaving because the film based on starches is more brittle	Less losses due to detachment in the weaving process
High cleaning frequency of weaving machines	Better productivity and less consumption of water due to less cleaning frequency of weaving machines
Weaving efficiency about 82 percent	Weaving efficiency about 84 percent
	Long-term cooperation with the supplier for mutual benefit
Social benefits	
Frequency of loading of 4 packages of 25 kilograms per preparation	Loading frequency reduced to 1.6 packages of 25 kilograms per preparation. This leads to reduction of workload on this operation by 60 percent
Dust emissions into the working environment	Improved health and safety at work due to less dust emissions

7.5.2 CASE STUDY II

CENTURY BOTTLING COMPANY LTD (UGANDA)

Process: Lubrication of Conveyor Packaging Belt

1. Background information

The beverage industry in general is a major consumer of water, which is used primarily for cleaning. Conveyor lubrication and returnable glass bottle washing are important processes in the beverage hygiene index. This is because the quality of the product largely depends on how thoroughly the bottles are cleaned before filling them. In addition, production costs from the amount of energy and water consumed is highly dependent on the quality of conveyor lubrication which also affects the efficiency of the line. In all these processes, chemicals that have an adverse impact to the environment and human health are used.

2. Introduction

Century Bottling Company Ltd is a franchise of Coca Cola International Ltd. The company has an annual production capacity of about 140,523,000 litres of beverage.

In order to remain competitive, the company decided to implement the concept of Chemical Leasing to reduce costs and adverse impacts on the environment and human health in some of its operations.

3. Key changes and results

In cooperation with its supplier, Diversey Eastern and Central Africa Ltd, the company has implemented measures that have led to higher profitability and a reduction in adverse impacts to the environment and human health.

3.1 Unit of Payment

Before Chemical Leasing	Uganda Shillings per kg of chemicals
After Chemical Leasing	Uganda Shillings per litre of produced beverages

3.2 Technical Measures Tested and Implemented

For conveyor lubrication, timers were installed on the returnable glass bottle conveyors and PET conveyors to regulate flow of conveyor lubricant, and a pump was installed on the PET conveyor lines to supply and monitor usage of dry lubricant.

For bottle washing and final rinse, the company introduced an annual bottle washer descaling, and protection in final rinse after bottle washing to help in the breakdown of heavy metals like lead, especially from the Applied Coloured Label (ACL) attached on the returnable glass bottles.

Adoption of a dry lubricant

25% savings in operating costs

3.3 Results Achieved

Before Chemical Leasing	After Chemical Leasing
Environmental benefits	
High chemical usage in conveyor lubrication - 0.0205 kg of chemicals per litre of beverage produced	Reduced chemical usage in conveyor lubrication, to 0.0145 kg of chemicals per litre of beverage produced
High consumption of water in two bottle washers due to descaling being done only once every three years, as well as overflows from the final rinse tank due to poor and irregular cleaning of the sieves	Reduction of water consumption by 63,504 m^3 per year due to a proper maintenance of sieves and nozzles and regular descaling once a year
Conveyor lubrication on PET lines and returnable glass bottle conveyors was done with s lubricant that was diluted in water	Reduction of water consumption by 1,152 m^3 per year due to adoption of a dry lubricant
Energy consumption for conveyors lubrication and bottle washing was high	▪ Energy consumption for conveyors was reduced by 465,700 kWh/yr ▪ Energy consumption in bottle washing was reduced by 230,000 kWh/yr
	▪ CO_2 emissions were reduced by 437.5 tons/yr due to lower energy consumption
High wastewater load caused by chemical and organic substances BOD5 – 40.2 mg/l COD – 192.5 mg/l	Lower wastewater load caused by chemical and organic substances BOD5 – 37.9 mg/l COD – 75.3 mg/l
Economic benefits	
High operating costs for conveyor lubrication, bottle washing and final rinse processes	Total economic savings are 35,000 USD/yr. This represents a saving of 25 percent in operating costs
	Long-term business partnership with the supplier
Social benefits	
Limited technical capacity in the application of chemicals.	Company staff has been trained on proper chemicals management and use for the processes where Chemical Leasing is implemented

7.6 CHEMICAL LEASING IN A CONSULTING PORTFOLIO: EXPERIENCES OF A CHEMICAL LEASING CONSULTANT

Ana Maria Evangelho Oestreich

Consultant on Eco-efficiency, Circular Economy and Chemical Leasing, Brazil

Ana Maria Evangelho Oestreich, a Brazilian chemical engineer with an MSc in environmental sanitation, has been a consultant for Chemical Leasing in Brazil and Latin America since 2012. She obtained recognition from UNIDO for her efforts to promote Chemical Leasing in Brazil, winning the silver award in the category of public relations of the Chemical Leasing Global Award.

What are the potential benefits of adding Chemical Leasing as a service to a consulting portfolio? And how best to sell Chemical Leasing as a service?

There is a long way to go towards consolidating consultancy in Chemical Leasing in Brazil. In early 2012, most companies did not understand how Chemical Leasing works, although some companies had already implemented certain aspects of Chemical Leasing using other names. Users of chemicals wanted cost reductions, while suppliers were interested in long-term contracts, especially with "high volume chemicals consumers". Even after eight years of efforts in Brazil, the consulting market for Chemical Leasing is not yet consolidated. However, interest in Chemical Leasing is growing, because it is linked to Circular Economy and to the Sustainable Development Goals, which are of greater interest to companies today. The Chemical Leasing Global Award has also been a relevant factor in increasing the interest of companies and research institutions in the subject. One single post made on LinkedIn led to 557 views in a week!

Today, there are a very few consultants in Brazil with a comprehensive understanding of Chemical Leasing who can apply the UNIDO toolkit. In general, they are specialists in chemical safety, green chemistry, circular economy and cleaner production, with a good understanding of the concept of Chemical Leasing. I recommend to start promoting Chemical Leasing as a consultancy service with training courses to companies, researchers and other stakeholders.

With the growing recognition of the Chemical Leasing business model, the consultants who include it in their portfolio have more opportunities in the environmental consulting market in the areas of:

- teaching and training;
- submission of projects to awards and national funds for innovation;
- integration with research and development groups;
- evaluation of industrial processes, with the objective of reducing waste and consumption (water, toxic substances, among others);
- technical support for development and monitoring of Chemical Leasing projects.

Including Chemical Leasing in my services portfolio has opened up opportunities for me in academic and governmental areas, for teaching, and for evaluating projects. Brazilian authorities also recognise me as a Chemical Leasing expert.

What are the requirements for being a Chemical Leasing consultant?

One of the most important requirements of a Chemical Leasing consultant is to understand the needs and requirements of the company using a chemical and the market segment supplying that chemical. The consultant with a background in engineering (chemical, environmental or industrial engineering) can help

a company identify areas suitable for Chemical Leasing. In cooperation with suppliers, they can help the company reduce its costs, comply with environmental legislation and achieve internal environmental goals. Likewise, health and safety requirements must be fully observed. So, familiarity with health and safety regulations and chemicals management tools are necessary requirements for Chemical Leasing consultants. To be able to make suggestions on business models, payment units or performance-based contract models, specific marketing knowledge may be required.

Usually, contracts that involve the provision of services or supply of chemicals involve relatively high costs for a company. So these contracts are not drawn up by external consultants, but by the company's legal department or by law firms that the company regularly hires. However, the Chemical Leasing consultant, with their experience in environmental management, chemicals management, safety and health, can make suggestions that can be included as attachments to the contracts. Since it is internal or contracted lawyers who are elaborating the contracts, it is important that they understand the concept of Chemical Leasing, because those contracts include the safeguards to protect the company.

The ability to bring together and integrate different interest groups is helpful in the quest to bring different departments in a company together and getting their understanding and commitment. Not only the relevant operational areas, but also departments like purchasing, environmental management, and quality control must be involved in the implementation of a Chemical Leasing business model. A Chemical Leasing consultant must have good communication skills. The consultant is normally responsible for the awareness raising and training of internal personnel and suppliers.

The consultant is also frequently a speaker in seminars and will be holding meetings with academia and the authorities.

What are challenges in searching for potential Chemical Leasing cases? What are the solutions?

The ideal potential Chemical Leasing case is the one in which the partners properly understand the concept and their roles in it and see a mutual benefit in the business relationship: economic but also environmental. Economic benefits are, in general, the driving force to change the business model.

> **Including Chemical Leasing in my services portfolio has opened up opportunities for me in academic and governmental areas, for teaching, and for evaluating projects.**
>
> Ana Maria Evangelho Oestreich

In general, it requires some time for both parties to establish a partnership. On the user side, the companies may feel insecure about this business model, as they often first confuse Chemical Leasing with outsourcing. For the supplier, it is of great importance to have salespeople with a technical background, who can understand the needs of their customers and follow up on the use of the products being offered. Once the parties are convinced of the benefits of Chemical Leasing, the biggest challenge is to establish the unit of payment and demonstrate how the units are to be measured. A pilot project can be a good start to implement Chemical Leasing. This has low risks for both parties: the supplier has time to better understand the user's requirements; the user has time to adjust and keep the process more uniform.

In some cases, there are technical and economic barriers to the implementation of Chemical Leasing. Chemicals perform differently depending on whether obsolete or state-of-the-art equipment is being used, or they require specific conditions like temperature or humidity. In addition, the analysis of the investments required must consider the payback period but also other external costs, such as environmental risks, penalties or market requirements.

As Chemical Leasing becomes better known and more companies apply the business

model, an increase in the supply of new technologies, equipment, research resources, technical and legal consultancy and logistical support services can be expected.

In my opinion, one of the main ways to overcome legal, technical, economic and social obstacles is to make information available and to disseminate success stories. Certainly, in the case of Brazil it is important to have national success stories. As Brazil has a big market for all kinds of products, it is common for companies to look closely at national trendsetting organisations or at what their competitors are doing. In the competition for market share, production costs and image are very relevant.

The last step, once there is a solid understanding of the economic, social and environmental benefits of Chemical Leasing, is for governments to include it in their policies, creating incentives and subscribing to international mechanisms.

Seminars, training programs, company case studies, special awards like the Global Chemical Leasing Award, sustainability reports, are some of the activities which will disseminate Chemical Leasing and overcome barriers to it becoming a standard business model.

You developed the first case of Chemical Leasing in the tourism sector. What was your experience in introducing the model to a hotel? What are the particularities of working with a hotel on Chemical Leasing? Do you see a good potential for replication in the tourism sector?

It is important to remember that a hotel uses more than 30 different chemicals: furniture polishes, detergents, insecticides, floor waxes, pool products, glass cleaners, dishwashing and laundry powders, flavourings, among others. Monitoring chemicals consumption is totally infeasible for a hotel manager without the support of the supplier. Accidents with chemicals are frequent and they can damage clothes, equipment and installations, as well as cause injury to the staff.

In addition, the consumption of chemicals is a significant portion of a hotel's operating costs. The benefit of Chemical Leasing shows up in the monitoring of consumption, and in the training of employees to ensure the least possible impact on health and the environment. Last but not least, it brings cost reductions from less product losses, damages and accidents.

The first attempt to develop the Chemical Leasing model with a group of small inns at Búzios beach in Rio de Janeiro failed. My team found a number of barriers to a successful implementation of Chemical Leasing: lack of standardisation of cleaning processes in these hotels, low profit margins, and the low skill levels of their staff.

The Windsor Atlântica Hotel case study was a golden example, but also challenging for a consultant. When we met with the hotel management, we discovered that they already had a performance-based relation with Ecolab, but they had never linked the contract with the hotel's environmental management and did not document any of the environmental as well as heath protection benefits.

The identification of suitable indicators and their monitoring, and the comparison of their results with other small, well-managed companies, convinced the hotel chain to introduce the Chemical Leasing business model into the group. The 2014 Global Chemical Leasing Award played an important role, not only because of the recognition they received with their gold award. The whole process of preparing the application forms involved the hotel staff in the monitoring of economic, social and environmental indicators related to the Chemical Leasing contract, showing how the business model positively impacted the environmental and the quality control management. The gold medal was the "cherry on the cake" and turned on the lights for other hotel units in favour of Chemical Leasing.

The tourism industry is an ideal sector for Chemical Leasing because it needs efficient and economic technological options in the field of cleaning. Large hotels, big restaurants or the cruise ship industry, to name just a few, are excellent potential customers for Chemical Leasing as they require a steady purchase of chemicals throughout the year and need swift and efficient service.

7.7 Chemical Leasing – Estimation of Market Potential and Acceptance Analysis. A sector study in Austria

Sabine Jung-Waclik, Andrea Kurz

Key researchers, Brimatech

Background and research questions

Chemical Leasing (ChL) was first introduced by the Austrian Environment Ministry in 2003[9]. A year later, in 2004, the Ministry supported the launch of UNIDO's global programme promoting ChL. Despite Austria's strong and continued support for the global programme, little information has been available about how well Austrian companies know ChL and the degree of implementation of the model in Austria. Thus, in 2018 the Austrian Environment Ministry commissioned a study in order to assess the relevance of ChL and similar business models to Austrian companies, the current status of ChL implementation, and the challenges Austrian companies face in implementing ChL.

Methodology

The study was undertaken in three steps.

1. 11 personal, qualitative expert interviews were conducted with representatives from eight different policy and research institutions involved in ChL consulting, the regulation of chemicals, research related to ChL and to the optimization of chemicals, as well as with representatives from chemical industry associations.

2. These interviews served as a basis for an online survey. 58 participants took part. The questionnaire was circulated among the Austrian chemical, food, and metalworking industries.

3. 34 personal, qualitative interviews were undertaken with representatives from 24 companies in three selected ChL application fields, namely:

   - Catalysis, in the cement and steel industry, as well as in refineries.
   - Cleaning of tanks and pipes in the food industry, e.g. in breweries, dairy factories, fruit juice production.
   - Industrial water preparation, water recycling and wastewater treatment.

[9] *Jakl et al. 2003 „Chemikalien Leasing. Ein intelligentes und integriertes Geschäftsmodell als Perspektive zur nachhaltigen Entwicklung in der Stoffwirtschaft"*

Potential application fields and estimate of relevant companies and quantities of chemicals used

Table 4.

Potential fields of application	Estimated number of relevant companies	Estimated quantities of chemicals used, tonnes/yr
Catalysis	100	50,000
Cooling / lubricating	250	20,000
Pickling	250	15,000
Textile equipment	250	10,000
Cleaning/ degreasing		
▪ solvent, halogenated	400	11,000
▪ solvent, chlorine-free	150	1,000
▪ aqueous	1,600	2,000
Water treatment (process water)	150	1,000
TOTAL	**3,150**	**110,000**

Promising application fields and the market potential for ChL in Austria had been assessed in a previous study. This earlier assessment was reviewed during the 11 expert interviews and updated. Table 4 lists those sectors which are perceived as being the most promising for the implementation of ChL. The table also includes an estimate of the number of relevant companies in Austria and the respective quantities of chemicals used.

Note that these are rough estimates that could be further refined in follow-up in-depth quantitative analyses.

Overall awareness and acceptance

The online survey provided first insights about awareness of the ChL model (is ChL known?) and its acceptance (is ChL implemented?).

1) About one third of the 58 survey participants knew about ChL.

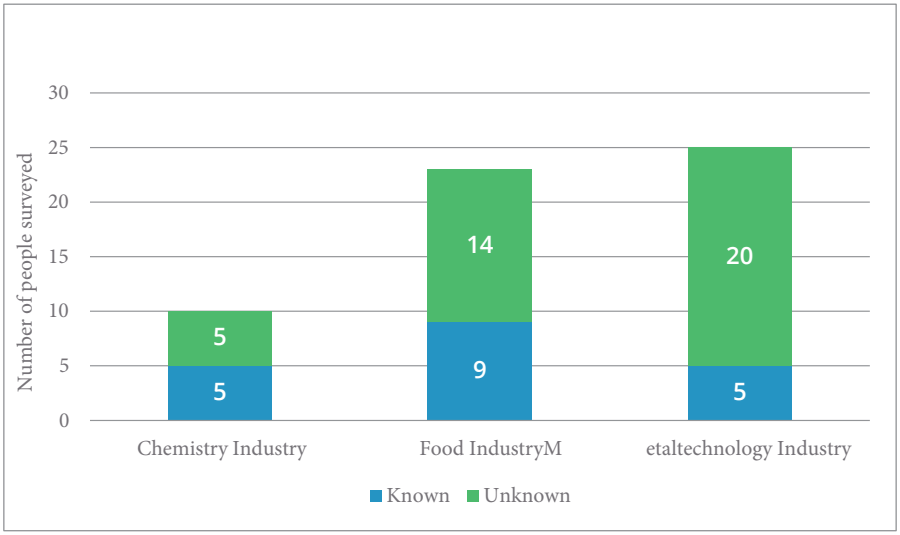
2) Chemical suppliers do not often offer ChL to the chemical users. Where it has been offered to survey participants, a little over half are using it.

3) More companies might be willing to implement ChL, but they would require more information before taking the decision.

Acceptance and awareness in selected application fields

In the qualitative interviews, more in-depth information was collected about the drivers and barriers for offering and implementing ChL or other function-based business models in selected application fields.

*Figure 6. **Answers to the question: "Do you know the function based business model known as 'Chemical Leasing'?"***



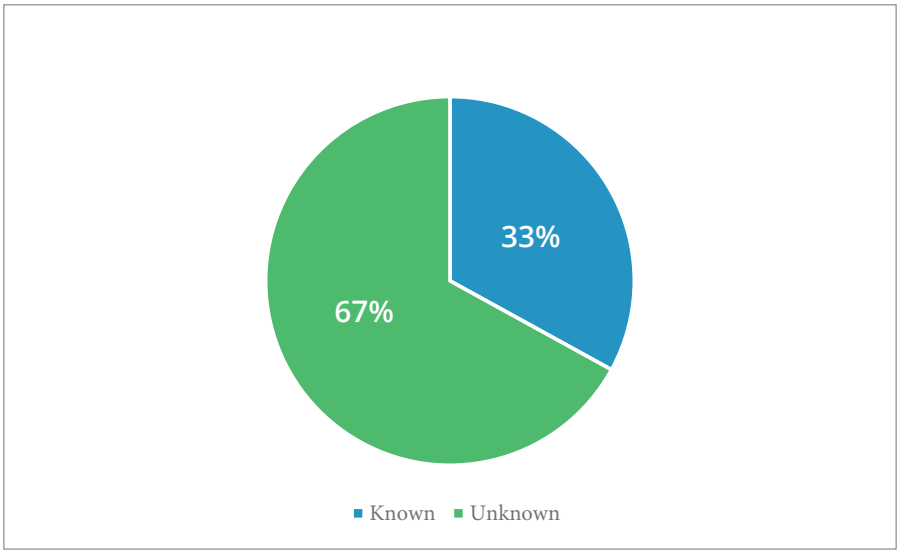
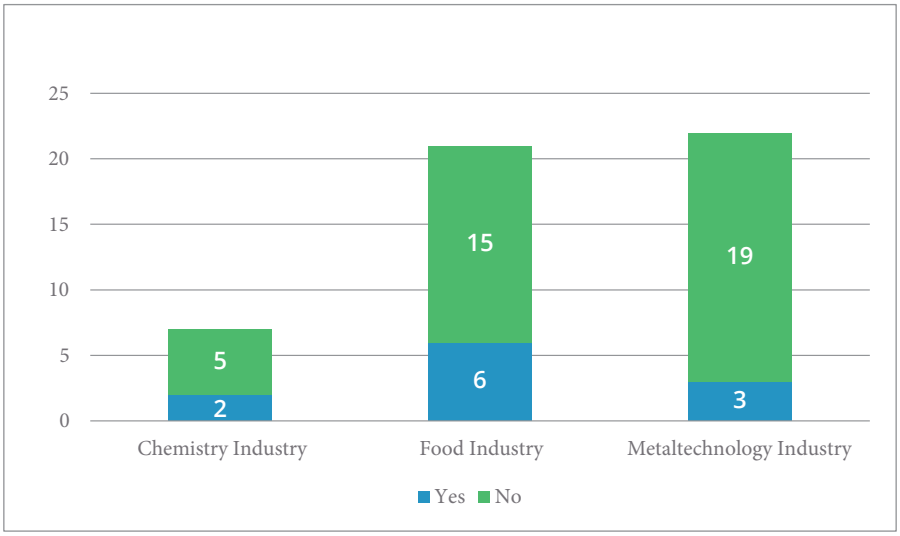


Figure 7. Answers to the question "Is ChL offered to you by your chemical supplier?"



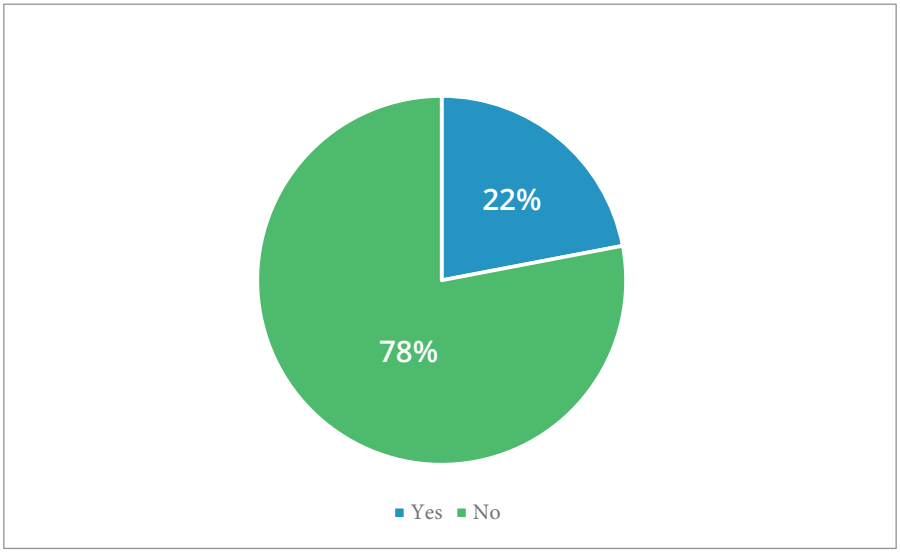


Figure 8. Answers to the question "Do you source chemicals based on a Chemical Leasing contract?"

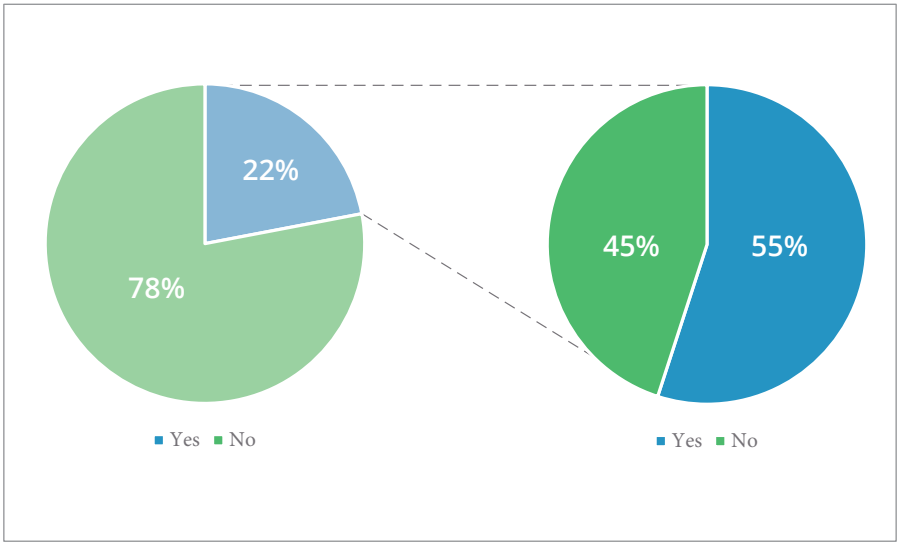
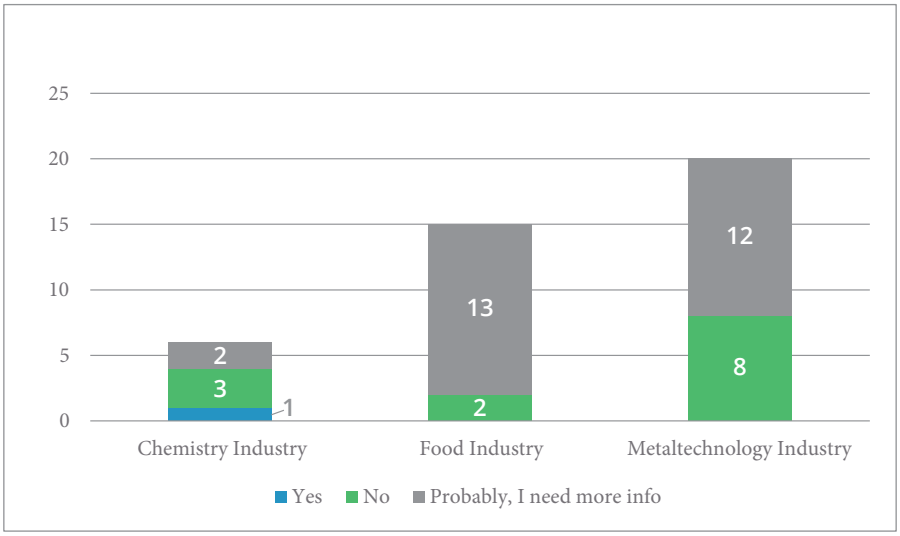
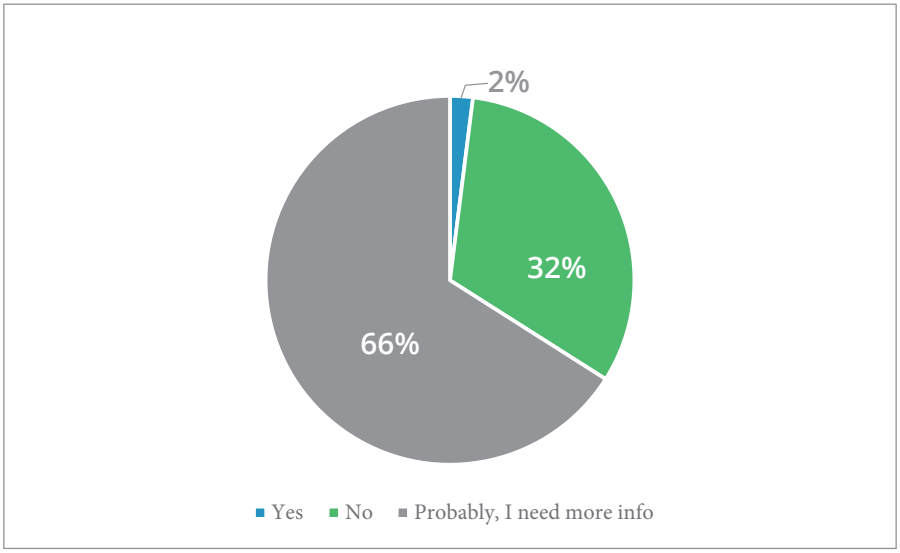


Figure 9. Answers to the question "Would you like to source chemicals via a ChL contract?





Application field 1: Catalysis in the cement, steel and petrochemical industry

ChL is potentially applicable to the regenerable catalysts used in the cement and steel industries for Selective Catalytic Reduction (SCR) denitrification of exhaust gas, and in the petrochemical industry for hydrodesulphurization, reforming catalysts, or hydrocrackers. Currently, ChL is not implemented in any of the companies interviewed.

<u>Savings potential</u>

The interviews showed that it is not clear at the moment if savings in catalyst use could be achieved in these three industries with the implementation of a function-based business model like ChL. The potential for economic savings could be in waste management costs, if new solutions for recycling the catalysts were to be found. Recycling methods are currently not available / known for catalysts used in SCR.

Barriers for implementing ChL

Currently, ChL is not offered by suppliers of catalysts. The interviewees felt that the suppliers are primarily interested in selling the catalysts, not in offering their services or functions. In addition, neither suppliers of catalytic active elements nor plant manufacturers perceive themselves to be stakeholders in ChL and are currently uninterested to cooperate in providing such a service. Users of catalysts also assume that suppliers of catalysts lack know-how, as they are not involved in the day-to-day operations at the chemical users' sites. Furthermore, companies are reluctant to change processes that work well.

As to organizational barriers, the implementation of ChL in large companies using catalysts needs the involvement, consent, and cooperation of different departments (e.g. production, purchasing, maintenance, and the like), which is difficult to achieve.

With respect to ChL and recycling, it was pointed out that market prices of catalysts will be a decisive factor in the decision to implement ChL. In addition, recycling is not yet technically feasible for all catalysts and applications. Suppliers consider catalyst regeneration/ recycling too expensive or too risky due to the variations in the market prices of catalytic substances such as the noble metals.

Since numerous processing factors influence the performance of catalysts, suppliers have been reluctant to implement ChL models without access to control units and data monitoring. Here, Industry 4.0 and data analytic tools could help.

Drivers for implementing ChL

Most interviewees, particularly those in the cement industry, showed interest in ChL and were open to holding detailed discussions with their suppliers of catalysts. More information about ChL is required by most stakeholders. New regulatory frameworks and guidelines regarding emission values for the cement industry are currently under development at the European level. This might drive a modernization of the industry (e.g., SCR installations as best available technologies), and eventually the applicability of ChL could be reappraised. The creation of industry / sector specific solutions will be particularly helpful for small companies; large companies usually have a dedicated department for process optimization. Industry 4.0 is often perceived as a driver for ChL. Sensors and data exchange are a prerequisite for optimizing the amount of chemicals used. In many companies, sensors measuring performance parameters are already installed and can be used for information exchange when implementing ChL – but then confidentiality agreements need to be in place.

Application field 2: Cleaning of tanks and pipes in the food industry

ChL is implemented in at least 50% of the Austrian breweries producing more than 250,000 hl/yr. At least one of the large mineral water producers has implemented ChL, respectively a similar model. According to the interviewees, ChL is not implemented in the fruit juice and concentrate industry, due to the high variability in production and different cleaning requirements for each batch.

Savings potential

It was reported that ever since business models similar to ChL were implemented, expenditures for chemicals have been decreasing continuously. Nevertheless, it is not always clear if this downward trend is attributable to the implementation of the new business models or to the optimization of production processes in general. Furthermore, the economic savings are not always related to a reduction in the amount of chemicals used. It is perceived as crucial to analyse for possible reductions not only in chemicals but in all input factors: water, energy and raw materials. For suppliers, providing advice or consulting services about the optimized use of chemicals is an important element in their CRM (Customer Relationship Management).

Several comments about the ChL model seemed to show misunderstandings of, or poor applications of, the ChL business model:

- "ChL does not always lead to a reduction in chemicals, particularly if specific performance indicators (e.g. hygiene requirements) determine the amounts used"; the ChL model should not be applied in such situations.
- "It would be more important to focus on switching to environmentally sound substitutes for chemicals currently employed in cleaning"; the search for environmentally sound substitutes should be part of all ChL contracts.
- "ChL actually led to a higher consumption of chemicals, because the user felt they were no longer responsible for the efficient use of the chemicals" (reported by a producer of cleaning agents); the ChL contract should always clearly define the respective responsibilities which both the user and supplier of chemicals have for the efficient handling and use of the chemicals.

These comments suggest that more explanations need to be given to both chemical users and chemical suppliers about the ChL business model and how best to apply it. The correct implementation of ChL requires the fulfilment of certain sustainability criteria which prevent the unwanted effects described above.

Some interviewees reported that they felt other business models were more relevant because they brought about reductions not only in the volume of chemicals but also in the volumes of other inputs like water, energy, raw materials.

Barriers for implementing ChL

Manual cleaning processes are common in this sector. It is not possible to verify the efficient use of chemicals in these cases. Furthermore, it is difficult to implement ChL, even if the degree of automation is high, when products and thus the related cleaning processes vary a great deal.

Drivers for implementing ChL

A high degree of automation facilitates data collection on the volume of chemicals employed and thus the implementation of ChL. In addition, ChL works best where cleaning tasks recur regularly with little variation in the substances to be removed. The size of the company is seen to be another driving factor for ChL, i.e. large companies with significant use of detergents have a greater interest in adopting ChL. On the other hand, industry/sector specific solutions enables the transfer of knowledge from one company to another, so suppliers who have identified savings potential can offer these solutions to smaller companies. ChL is appropriate for specialized products (specific formulations, specialty chemicals) employed in ways that can be enhanced by a certain degree of consulting, a service not possible for basic chemicals sold as commodities. Industry 4.0 was perceived as a driver for ChL ("sensors are a precondition") by nearly all interviewees. It is a prerequisite for quick and fair failure analysis, which is crucial for taking countermeasures and for liability issues.

Application field 3: Industrial water preparation, water recycling & wastewater treatment

Water is an indispensable prerequisite in industrial production, employed in large quantities in many sectors. Water treated in industry includes the water used in the plant (steam, boiler and ultrapure water) and wastewater. Numerous chemicals are used, e.g. corrosion inhibitors, scale inhibitors, coagulants and flocculants, biocides and disinfectants, chelating agents and ion exchange resins. ChL was reported to be mainly offered for flocculants, flocculation enhancers (polyelectrolytes), ion exchange resins, and granular activated carbon.

Business models offered by companies selling water treatment equipment / plants often include an Operation & Maintenance contract making them more open to involvement in ChL. Other business models that are applied are BOT-models (Build-Operate-Transfer) and BOOT-models (Build-Own-Operate-Transfer). An interesting case of a ChL-like business model is the Total Water Management scheme developed, tendered and implemented by a large Austrian company for all their plants.

Savings potential

Savings potentials are in the consumption of FeCl3, polyelectrolyte, antiscalant, and granular activated carbon (filters). Chemicals account for 10% of the operating expenses and have a savings potential of around 20%. A precondition for optimization is the close monitoring of the amounts of chemicals employed. ChL models and similar business models can be seen as a driver for innovation, as they spur a constant reduction in consumption through improved chemicals or new technologies.

In the first years of operating a plant contracts often foresee fixed payments per volume of water treated, thus the plant operator directly benefits from savings in chemicals or energy.

Barriers for implementing ChL

Where the chemicals are pure commodities, there is usually little savings potential. Margins are low and consultancy services cannot be realized. Thus, a product portfolio comprising specialty chemicals is preferable. In Austria, industrial wastewater is often treated in combination with municipal wastewater. Community procurement rules traditionally refer to amounts of chemicals, prohibiting ChL. Users usually do not face technical hurdles for ChL. Rather, due to the novelty of the concept, barriers are often psychological.

Drivers for implementing ChL

Users of chemicals prefer service-based contracts that cover the whole industrial process. The products and services offered need to cater this demand. Besides technical guidance, commercial and legal consultancy is important, as the contracts tend to be comparably complex for the purchaser. Proprietary rights, service level agreements, and liability provisions need to be considered.

ChL and other business models

The following business models were perceived similar to ChL by the interview partners:

- **TCO** (Total Cost of Ownership)-business models: analysis of all costs involved in the purchase, operation and maintenance of a given asset during its lifetime. It comprises total process analysis at the customer's site in order to optimize not only chemicals but also water, energy, working hours, etc. The interviewees understood TCO models to be an umbrella term for ChL, flat fee, lump sum payment agreements and all-in packages.

- **TC** (Target Cost)-business models: billing is based on the amount of chemicals used, but a cost framework is jointly agreed and consumption is regularly analysed together.

- **BOT** (Build-Operate-Transfer), BOOT (Build-Own-Operate-Transfer) business models; variations of these models are becoming increasingly common in plant engineering. Under a BOT contract, an entity grants a concession to a private company to finance, build and operate a project for a period of time, hoping to earn a profit. After that period, the project is returned to the entity that originally granted the concession. Under BOOT contracts, the contractor owns the project during the project period.

- **Total Water Management business model**: comprises the treatment and reprocessing of water for operational processes and wastewater treatment. The use of chemicals is optimized together with energy and disposal costs. A contribution to employee safety is made.

- **Lump-sum payment agreements**, flat-fee, all-in packages: refer to a pricing structure that charges a single fixed fee for a service, regardless of usage.

Conclusions & Recommendations

The online survey and interviews showed that industry's interest in new business models like ChL is growing. The following conclusions and recommendations were drawn from the interviews and survey about measures needed to maintain and support this interest:

- Convincing potential providers of ChL to offer a function-based business model. Many users of chemicals are interested in ChL and willing to further analyse implementation options but there is a lack of ChL offerings. This could be overcome by promoting benchmark processes and consulting about successful approaches taken in similar segments.

- Companies (both potential users and suppliers of chemicals) require more information about the model, in order for them to gain a better understanding of ChL and its implications for their specific company. They require information on the technical implementation, commercial provisions and legal execution of ChL. Companies primarily ask for consulting in the form of company visits, seminars and workshops. In addition, policy measures in the form of legal guidelines and funding programmes would help create a "common playing field" for all stakeholders.

- Further discussions and information exchange are needed among relevant stakeholders, regarding, e.g., the identification of relevant processes, detailed implementation options, and forms of data exchange. Chemical users expect chemical suppliers to make concrete and attractive ChL offers. At the same time, users have to support knowledge / data exchange and to ensure that the whole organization implements the same standards (in the case of large, international companies).

- The creation of industry/sector specific "ChL solutions" would be particularly helpful for small companies, as they are often "overburdened" with the handling of chemicals. Such knowledge transfer from one company to another regarding savings potential is expected to benefit customer loyalty.

- Focus should lie on the sustainability of the entire process, including not only savings of chemicals but also water, energy and raw materials. Considerations regarding saving potentials should also involve training of workers and monitoring of implementation.

- ChL needs cooperation – not a shift in responsibility from chemical user to chemical supplier: chemical supplier AND chemical user must bear the responsibility of saving chemicals.

- Data exchange: for a successful implementation of ChL, it is necessary to define and monitor trackable

and comprehensible process parameters for the clarification of liability. It is therefore crucial to clearly define interfaces and confidentiality agreements.

- The use of / substitution with environmentally friendly "green" chemicals is often perceived to be more important than using less chemicals.

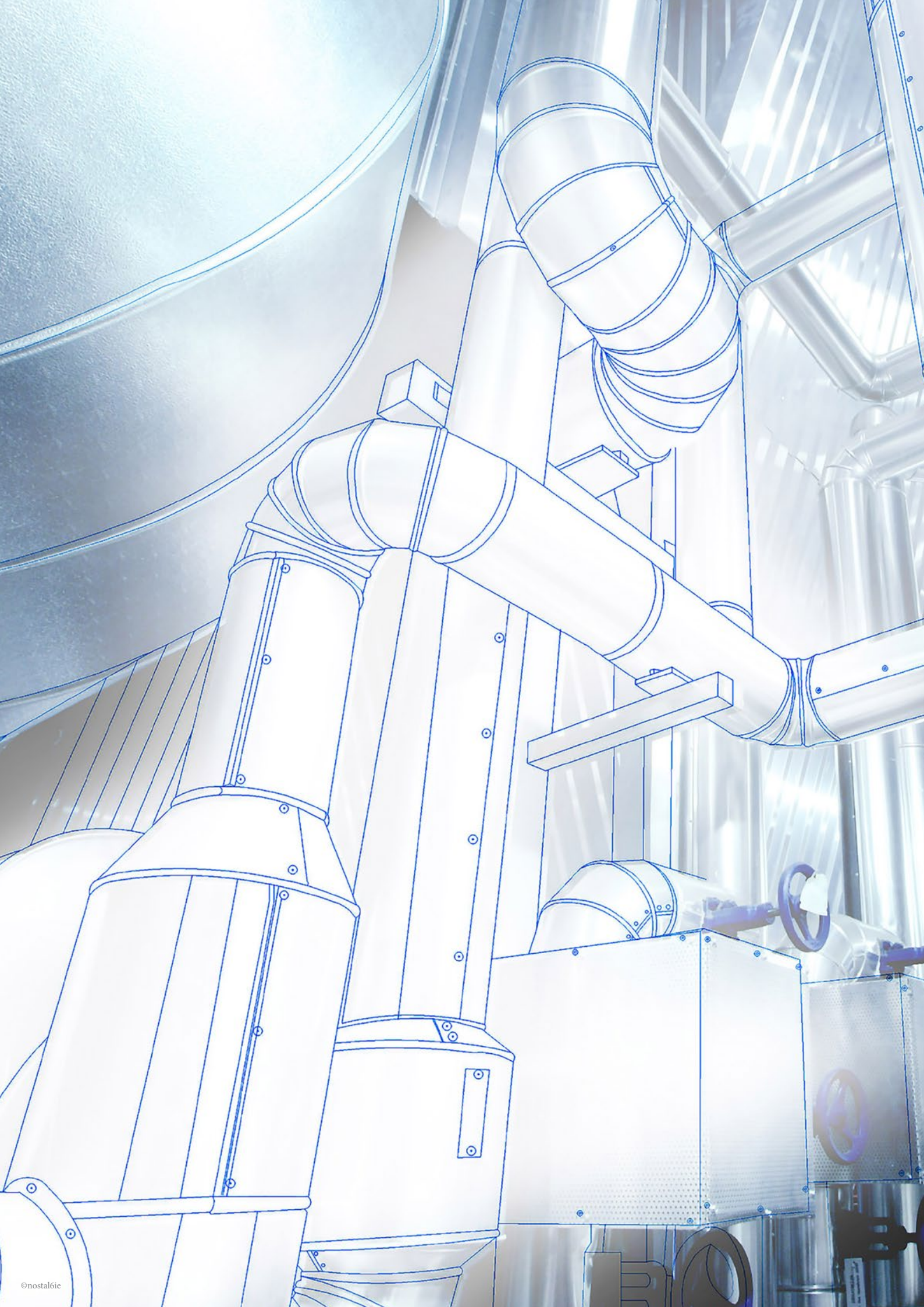
- Reconsideration of regulatory framework conditions to encourage ChL: new regulatory framework conditions (e.g. lower emission thresholds, wastewater charges, analogies or linkages with CO_2 emissions trading) are specific incentives for companies to implement more sustainable business models like Ch-Finding new solutions for the recycling and reuse of chemicals will benefit ChL models. Funding and supporting recycling technologies and related research would accelerate the transition to a circular economy e.g. in the field of regenerable catalysts, where scarce and critical materials are used.

- Market dynamics can work against ChL, e.g. when world market prices are volatile for recycled products, or prices for basic chemicals are low. When promoting ChL, it is recommended to focus on specialty chemicals and formulations, where prices and margins are high.

- Reconsideration of public procurement rules in Austria, which can hinder the implementation of sustainable business models like ChL: e.g. when it comes to communal wastewater treatment, where tenders are required to ask for price per quantity, public procurement rules do not allow the implementation of ChL and similar models.

- It is important not to think of national solutions only, not least to increase market volume. The creation of national and international networks will be very helpful in future.

The authors appreciate the valuable input and feedback received from all the stakeholders involved in this analysis. The study was conducted for and financed by the Austrian Environment Ministry 2018/2019.



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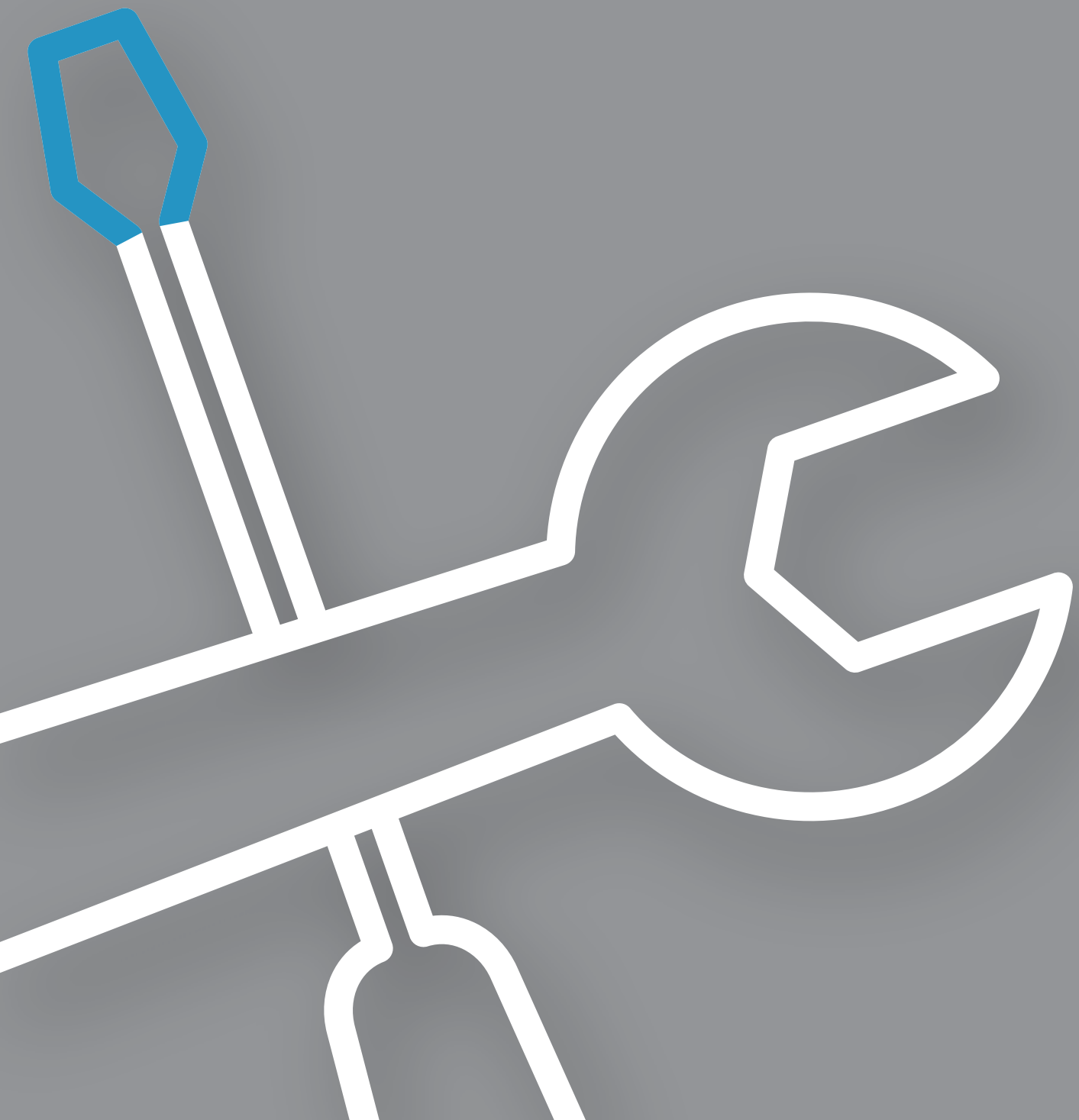
PART C
Chemical Leasing tools & methodology



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Part C highlights different instruments that UNIDO, together with its partners, has developed to support the implementation of Chemical Leasing. The Chemical Leasing toolkit and, in particular, the methodological aspects of applying the Chemical Leasing business model at company level are addressed in detail here.

Companies which want to apply the model are invited to follow the step-by-step approach that has been developed by UNIDO's experts. This information is complemented with an expert's recommendations and with a concrete example of how the methodology has been applied in a Serbian company, as well as with legal and liability aspects that have to be considered.

To better highlight and assess the benefits brought about by Chemical Leasing tools, indicators and sustainability criteria have been developed in the form of a checklist and an IT Tool. These are also presented in this chapter.

At the end of the chapter, the reader will learn about the Global Chemical Leasing Award that can be considered a tool to promote and mainstream the application of the business model globally.

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8.1 UNIDO CHEMICAL LEASING TOOLS

UNIDO has developed a number of tools to support the implementation and promotion of Chemical Leasing. These include the Chemical Leasing toolkit, the Chemical Leasing website, the Chemical Leasing Facebook group, books, articles and webinars. A worldwide network of consultants, many trained by UNIDO, is available to advise on how to apply the model. The UNIDO Chemical Leasing Helpdesk was established to answer questions and give out additional information – it can be reached by email: chemicalleasing@unido.org. The Global Chemical Leasing Award is another tool that was developed in 2009 to bring together experiences and raise the awareness on Chemical Leasing and best practices around the world.

8.2 CHEMICAL LEASING TOOLKIT: OVERVIEW. A STEP-BY-STEP APPROACH

The internet-based Chemical Leasing toolkit provides guidelines, materials, best practice case studies and lessons learnt from the work in UNIDO's Global Chemical Leasing Programme. The toolkit is designed as an interactive online tool that aims to help industry and policy professionals to become more knowledgeable about the Chemical Leasing business model and its effective and efficient use in practice. The toolkit enables users to kick-start the implementation of Chemical Leasing at company level. It also supports policymakers in understanding how best to approach Chemical Leasing in the policy arena.

The guidelines of the toolkit describe how to (1) assess a company's potential for optimising the use of the chemicals it uses, (2) develop and implement the Chemical Leasing business model together with a chemical supplier and other potential partners, and (3) evaluate and monitor the results.

An outline of the approach is presented below.

STEP 1. Preparation

The aim of this step is to identify opportunities for implementing the Chemical Leasing business model in a company.

- **Task 1** - Identify potential chemicals and processes
- **Task 2** - Pre-assess the chemicals and processes
- **Task 3** - Pre-define units of payment

STEP 2. Development and implementation

The aim of this step is to develop the Chemical Leasing model, define and test options, and sign the Chemical Leasing contract with a partner

- **Task 4** - Create an internal working group
- **Task 5** - Establish a core Chemical Leasing team
- **Task 6** - Collect data and define the baseline
- **Task 7** - Define measures to optimise chemical use and processes
- **Task 8** - Test the identified options
- **Task 9** - Establish a Chemical Leasing contract

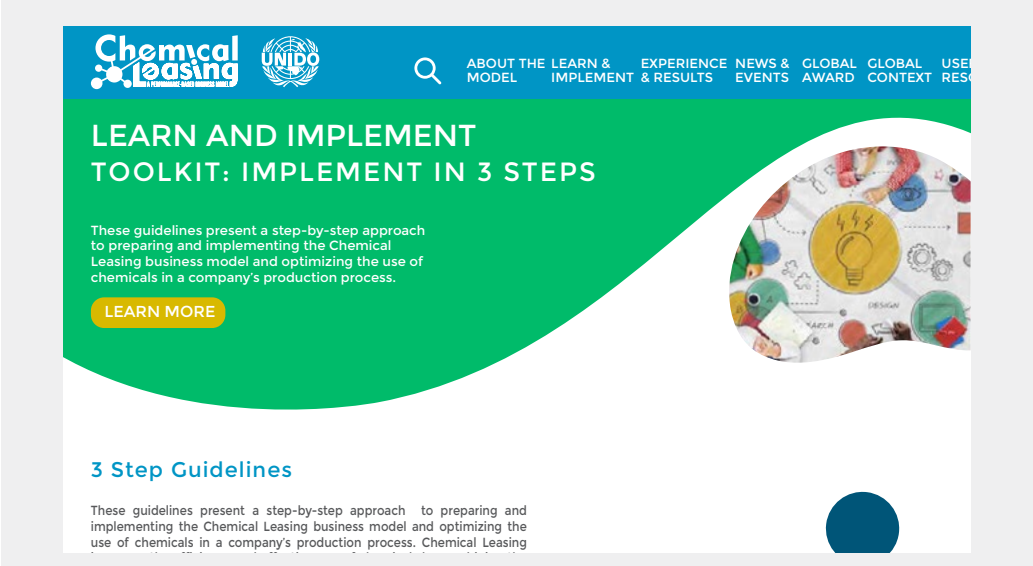
STEP 3. Monitoring and evaluation

The aim of this step is to monitor, document, and evaluate the results. Here you might also decide to extend the scope of the Chemical Leasing model to other production lines or business areas of the company.

- **Task 10** - Monitor, document and evaluate results

The detailed guidelines can be found here:
www.chemicalleasing-toolkit.org

Picture 10. Chemical Leasing website and toolkit



8.3 WORKING WITH THE METHODOLOGY

8.3.1 EXPERIENCE OF A CHEMICAL LEASING CONSULTANT FROM SERBIA

Vojislavka Satric

International expert on Chemical Leasing and Sustainable Chemicals Management, Serbia

You were involved in the development of the methodology. Why is it so important to follow a given methodology when developing a Chemical Leasing model? In which cases is the methodology a "must"? What problems does it help avoid?

The methodology is crucial. Any approach that is not systematic leads to unpredictable results and costs. This methodology was the result of trial and error over the years of implementing the Chemical Leasing business model.

A systematic approach to Chemical Leasing implementation follows a logical approach: first, a company analyses its processes, chemicals and costs, then it sets priorities and selects the most suitable processes and chemicals for the model's implementation.

Then it is necessary to define a unit of payment in line with a chemical function – that is the core of Chemical Leasing. If the user and supplier agree on a unit of payment which can be easily measured, recorded and demonstrated in order to avoid any disputes on the number of unit of payments to be paid, the implementation process can continue.

To assess possible savings and the results of optimisation (chemical substitution and/or process changes), a baseline has to be established, and the proposed changes must be tested. If everything is fine, the contract can be signed following some guidelines which we also give.

I think that the methodology is a "must" in all cases. It helps avoid wasted time and money. If you start with a process that is not suited to Chemical Leasing implementation, it will be just a waste of time and resources. If you don't define a good baseline, you cannot assess the optimisation results.

> **The methodology is crucial. Any approach that is not systematic leads to unpredictable results and costs.**
>
> Vojislavka Satric

Who is the methodology applicable to?

It is applicable to both user and supplier as they work as a team. For each step, examples are provided to help companies implement the methodology.

What recommendations would you make to companies that are interested in introducing Chemical Leasing?

Teamwork is essential: the production, development, quality control, legal and financial departments should all be involved. It is necessary to work together within the company, as well as with the supplier, to achieve the best results.

Are all the steps of the methodology obligatory or can companies skip some of them?

All the steps are obligatory, but in some cases – when, for example, new equipment is introduced – testing is not possible before Chemical Leasing implementation.

Implementing the methodology for Chemical Leasing in a given process can take months. Why does it take so long? Can it be shortened?

The most time-consuming step is testing. It's not always easy to find the right time for testing; it's not possible during high season or when there are big orders. You

have to wait for a suitable time to do it. Sometimes it's necessary to do several testing campaigns. Other steps are not so demanding. If the implementation team is dedicated, they can be completed within a reasonable time.

What can help companies stay the course and achieve results?

One of the most important things is management support. If they understand the potential of Chemical Leasing for optimisation, savings and further improvements, the model is guaranteed to succeed.

How do you see your role in supporting companies implementing this methodology?

My experience in the model's implementation can help companies choose the right process (the right chemical), assess the results of optimisation, and properly define the unit of payment. My assistance can make the implementation process smoother and more efficient.

Take us through your experience in applying the methodology in a specific company

Sure. Let me take you through my experience with FKL. This is a Serbian metalworking company that produces ball bearings and cardan shafts.

8.3.2 METHODOLOGY APPLICATION ON A COMPANY LEVEL

STEP 1. Preparation

Task 1 - Identify potential chemicals and processes

There are two main processes in the factory: metal processing and metal cleaning. For metal processing different kind of oils are in use, while for metal cleaning the company uses a solvent with hazardous properties. The supplier of these chemicals was a distributor, who in turn purchased the chemicals from the producers. Together with the company, we considered both processes as possible candidates for Chemical Leasing implementation.

Task 2 – Pre-assess the chemicals and processes

The company uses many types of oils for different operations. After holding discussions, we concluded that in this particular case the oils were not suitable for the model's implementation. On the other hand, it became immediately clear that the cleaning process was an excellent candidate for the Chemical Leasing business model. FKL had many problems there and metal cleaning was a bottleneck in their production.

Task 3 – Pre-define units of payment

Possible units of payment were amount of cleaned surface or number of parts cleaned, but in this case these were not applicable because FKL produces many different sizes and shapes of metal parts. As FKL works three shifts seven days a week with two cleaning machines that work continuously, a flat monthly fee (EUR/month) was proposed as a practical unit of payment and was accepted by both partners. If there was a change in working hours, the fee would be changed accordingly.

STEP 2. Development and implementation

Task 4 – Create an internal working group

An internal working group was established. It consisted of people from production, the laboratory and the purchase department. Later, when the contract was being drawn up, the legal department joined.

Task 5 – Establish a core Chemical Leasing team

The team working on the implementation of the Chemical Leasing model involved the members of the company's internal working group and a representative of the distributor who supplied the chemicals as well as a consultant from the National Cleaner Production Centre.

Task 6 - Collect data and define the baseline

The team collected relevant data from previous years and concluded that:

- 30 t per year of the solvent were consumed;
- Solvent from the cleaning machines had to be changed every week;
- Hazardous waste production due to cleaning process was 25 t per year;
- Solvent made up around 95 percent of the hazardous waste;
- The quality of cleaning was not good enough;
- Machine parts corroded and had to be changed often;
- Workers were exposed to solvent as operations with solvent were carried out manually.

Task 7 - Define measures to optimise chemical use and processes

In cooperation with both the distributor and the producer of the solvent, it was agreed to introduce the following measures to respond to these issues:

- Introduction of a distillation unit for solvent recovery;
- Supply of chemicals for solvent testing and adjustments to prolong the solvent's lifespan;
- Undertaking the solvent operations in a hermetically closed system;
- Workers training

Task 8 - Test the identified options

In this case, testing was not possible until the distillation unit had been installed, but the expected results were presented to management to obtain their approval for further steps. Approval was granted.

Picture 11: ***Machine parts corroded***

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Task 9 - Establish a Chemical Leasing contract

Chemical Leasing contracts between FKL, distributor and supplier were signed. The contracts defined the roles and responsibilities of the partners, the unit of payment, and other issues.

STEP 3. Monitoring and evaluation

Task 10 - Monitor, document and evaluate results

After the new distillation unit was installed, and solvent and accessories supplied, the workers were trained and monitoring started.

Solvent consumption and waste generation were monitored over several years. The results are presented in Figure 10.

There was a sharp reduction in both the amount of solvent being used and hazardous waste being generated. This has resulted in large direct economic savings because of lower solvent purchase costs and lower costs for hazardous waste export. In addition, there were a number of other benefits. Worker safety was improved: as the system is now closed and the solvent transfer managed via hermetic connections by pumping, the workers are now protected from solvent vapours. Also, maintenance costs have been reduced since there is no corrosion of machine parts anymore. As a result, productivity is higher because cleaning time is shorter, more parts can be cleaned per cycle, and there is no downtime due to refilling of the machine and changing of machine parts changing.

Picture 12: ***Workers training***

@NCPC Serbia

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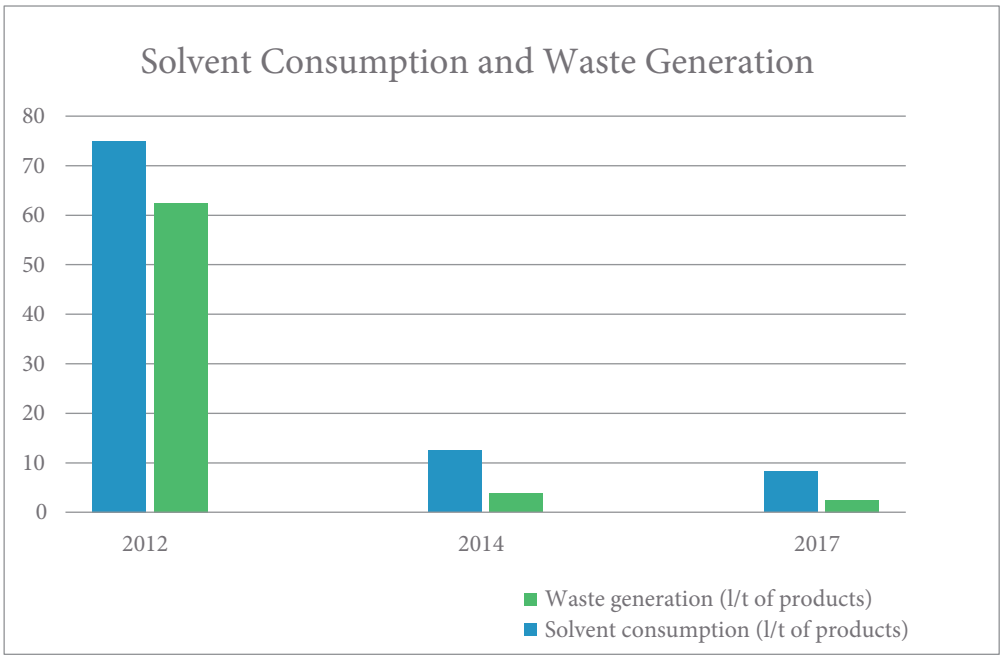
Figure 10. ***Solvent Consumption and Waste Generation at FKL***



8.3.3 THINGS TO BE CONSIDERED (LEGAL, LIABILITY ASPECTS, ETC.)

Steffen Saecker

Business Director, SAFECHEM Europe

How is liability dealt with, if, for instance, due to the under-consumption of chemicals, product quality is not sufficient (parts are not clean enough) or if damage to parts occurs as a consequence?

With performance-based contracting it is essential that both partners agree on how to deal with the important issue of liability. In our case, we do not consider Chemical Leasing as an outsourcing of the entire process and it is up to the user to control the cleaning process. We support them through advice and the use of special additives for optimisation, but the liability for the cleaning result remains with the customer.

Who has to pay for additional expenses due to contamination of the spent solvent (which goes back in the SAFE-TAINER)?

First, a good understanding of the initial situation and the processes being used by the customer is of great importance. Here, data from the past combined with the experience of the customer's operations manager can be helpful in estimating the optimisation potential. Thus, the Chemical Leasing scenario can be planned. Should there be additional work due to an unexpected degree of contamination of the spent solvent, we analyse the solvent in our laboratory and usually (but not necessarily) we bear the costs.

How is unjustified over-consumption by the user prevented? (the user consumes too much chemicals as he is not interested in under-consumption in a pay-per-use scenario).

The question addresses the potential case of "moral hazard" in a Chemical Leasing contract. While the business model is based on the equal interests of the supplier and the user in ensuring the optimisation of the process, the customer can theoretically decide to over-consume due to the pay-per-use scenario. In practice, however, we rarely see this. Nevertheless, the case of excessive over-consumption can be covered in the contract.

SAFECHEM Europe GmbH is a chemical supplier that positions itself on the market as a provider of services and solutions for the safe and sustainable use of solvents in metal surface cleaning, textile cleaning, and asphalt analysis. It was established in 1992 and has offices in Düsseldorf and Shanghai. Its full-service offering includes the closed-loop SAFE-TAINER™ System for the safe and emission-free supply and take-back of solvents. Committed to the principles of Responsible Care® and Product Stewardship, SAFECHEM has developed and applied innovative business models like COMPLEASE™ (which is in line with the principles of Chemical Leasing) to optimize the balance between environment, economy and social responsibility. In close cooperation with a network of responsible chemical distributors, SAFECHEM serves over 5,000 customers worldwide. It also offers comprehensive expert knowledge about the cleaning process, trainings on solvents, and laboratory analysis via its CHEMAWARE™ Knowledge Services platform.

How is the IP of the user protected?

Well, of course, we treat the data and information of all our customers as confidential. Most of the time, we don't need to have insight into what is critical IP from the user's perspective. For particularly sensitive applications, confidentiality agreements may be helpful.

How is the IP of the chemical supplier protected?

Again, IP issues usually do not arise as product compositions or similar issues do not need to be disclosed. Theoretically, the customer could of course try to turn his back on the business model of Chemical Leasing after successful process optimisation. In practice, however, we don't face such situations: customers appreciate that experts are available for problem solving and optimisation is of course a continuous process.

> **... customers appreciate that experts are available for problem solving and optimisation is of course a continuous process.**
>
> Steffen Saecker

8.4 SUSTAINABILITY ASSESSMENT TOOLS AND INDICATORS

SMART 5 – an instrument to evaluate sustainability performance of Chemical Leasing business cases

Christopher Blum

Sustainable Chemistry Scientific Officer at UBA, German Federal Environment Agency

Summary

Several years of experience have shown that Chemical Leasing leads to economic, social and environmental benefits. However, further development of the existing sustainability criteria is needed to better highlight the benefits of applying this business model. As a result, further criteria as well as qualitative and quantitative indicators for the internationally agreed sustainability criteria of Chemical Leasing were added to two instruments for the assessment of benefits due to implementation of the business model:

- A basic checklist, with which users can qualitatively evaluate the relevant parameters.
- SMART 5, an instrument enabling users to capture specific quantitative values and generate a summary of the achievements.

Why have an IT-tool for Chemicals Leasing?

Chemicals management is a key crosscutting element in achieving Agenda 2030 for sustainable development. Chemicals bring many benefits to society. At the same time, chemical releases cause air, water and soil pollution throughout their life cycle. This often leads to harmful effects on the environment and health. The World Health Organization estimates that 1.6 million deaths in 2016 could be attributed to chemical exposure. Low-income countries bear the heaviest burden here. Global chemical sales doubled in the period 2000-2017. As they will almost double again in the period up to 2030, the challenges continue to increase. These challenges can be addressed by Chemical Leasing. Its features of reduction of negative effects on health and environment, of social and economic benefits and of circularity enable this business model to contribute to sustainable development.

The sustainability criteria for Chemical Leasing show Chemical Leasing practitioners the aspects they need to consider in order to achieve basic as well as ambitious sustainability goals.

The sustainability criteria for Chemical Leasing make an important contribution to the quality assurance of Chemical Leasing applications. They help to define and differentiate the business model from other service models that, for example, do not focus on reducing negative environmental and health impacts. In practice, it has also been shown that the criteria require a more extensive description to allow for a verification of their fulfilment. Therefore, the German Environment Agency commissioned partners to develop sub-criteria and indicators for the sustainability criteria for Chemical Leasing in the form of an indicator checklist as well as an IT-tool called SMART 5.

The main target group for SMART 5 are companies that use Chemical Leasing. The instrument will motivate them to adopt sustainability criteria as an objective as well to reach compliance with them. The variety of topics covered by the indicators is challenging. In large companies, the necessary data entry often requires the involvement of different departments. One solution is to identify one central person who can answer most of the questions on their own, and specific support staff for any remaining questions. In larger companies especially, this should include persons who have access to data on industrial accidents or economic benefits (for example, from obtaining new customers through the use of Chemical Leasing).

The indicator checklist

The indicator checklist allows for a standardised review of the observance by Chemical Leasing of the sustainability criteria. This helps companies maintain the business model at a high standard in their operations.

The indicator checklist allows companies to undertake a first screening with regard to the relevant indicators as well as to screen the trends in these indicators over time. The checklist provides an overview of the five sustainability criteria, their respective sub-criteria and indicators, and hence the necessary data which need to be collected to measure the indicators. One part of the checklist is shown in Table 5 as an example.

The completed checklist allows companies to get an overview of what data is necessary for SMART 5 and draws attention to possible non-fulfilment of individual criteria and the existence of conflicting goals.

The checklist also helps those companies which are interested in Chemical Leasing but have no experience and possibly have concerns about the verifiability of benefits and the level of fairness between business partners, as it provides an overview of the quality assurance required for Chemical Leasing business models.

Table 5. Part of the indicator checklist

Criterion 1 "Reduction of adverse impacts" with sub-criterion "Pollutants emitted into the air" and related indicators

Sustainability criteria	Sub-criteria	Indicators for Chemical Leasing	Screening	Comment or specification
1 Reduction of adverse impacts for environment, health, energy and resource consumption caused by chemicals and their application and production processes	Pollutants emitted into the air	Nitrogen oxides (NOX)	☐ decreased ☐ equal ☐ increased	
		Ammonia (NH3)	☐ decreased ☐ equal ☐ increased	
		Sulphur dioxide (SO2)	☐ decreased ☐ equal ☐ increased	
		Non-methane volatile organic compounds (NMVOC, e.g. benzene)	☐ decreased ☐ equal ☐ increased	
		Particulate matter (PM2.5/PM10)	☐ decreased ☐ equal ☐ increased	
		POPs (persistent organic pollutants)	☐ decreased ☐ equal ☐ increased	Which one(s)?
		Heavy metals (e.g. mercury)	☐ decreased ☐ equal ☐ increased	Which one(s)?
		Other emissions into the air	☐ decreased ☐ equal ☐ increased	

The SMART 5 tool

Motivations for using SMART 5

SMART 5 intends to motivate companies to comply with sustainability criteria. Companies can use the tool to highlight the manifold benefits of Chemical Leasing for the environment, energy efficiency, resource conversation and health. In addition, companies can use it to document its economic aspects such as costs, profits and business connections as well as social aspects such as the qualifications of the skilled personnel involved in the model. As a result, companies also have the opportunity to demonstrate to the public their achievements in terms of sustainability in a provable and targeted manner.

Particular examples of where there could be a strong incentive for a company to use SMART 5 to demonstrate its compliance with sustainability are:

- Submission of an application for the Global Chemical Leasing Award
- Request for a "Conformity Declaration Certificate" for Chemical Leasing (e.g. through UNIDO)
- Review of existing service-based business models with regard for compliance with Chemical Leasing
- Demonstration of contributions to the Sustainable Development Goals of the 2030 Agenda.

Features of SMART 5

SMART 5 was created in Excel. Companies can understand and use it without the need for external individual support.

SMART 5 has been designed to be universally applicable to all applications. The instrument enables easy documentation of the data collected to monitor individual sustainability criteria. Not all indicators will be relevant for any particular application. As a result, SMART 5 uses selection menus that facilitate setting a focus within the instrument. Therefore, it is possible to display additional input options during processing and state if an indicator is not relevant. Such superfluous indicators can be masked out. Politically important keywords (e.g. POPs emissions) are present in the instrument, although they will only be of importance for some users.

SMART 5 is structured in three sections. The first section contains a short description of the instrument and an explanation of the procedure.

The second section contains the data collected by the user. Here, the first sheet provides the opportunity for a short characterisation of the company and the project. In the five subsequent sheets, information is requested with respect to the sustainability criteria and their respective sub-criteria and indicators. Data entry for each criterion is facilitated by drop-down selection menus and the possibility for entering figures or comments.

In the third section, an automatic summary of the data which has been inserted is generated as a "factsheet", which can be exported. The factsheet shows at a glance the availability of data and the company's performance with respect to the five sustainability criteria. This provides a direct feedback to companies regarding the status of the sustainability measurements they have implemented. The factsheet is also the basis for potential further action, such as sharing of the results. The factsheet can be generated with an anonymous project short title. This allows the data and results to be shared confidentially.

Uniform data collection and structured data analysis are important requirements for the quantitative assessment of the state of Chemical Leasing. Reliable data from existing applications in companies also enables the user to determine and document compliance of individual projects with the sustainability criteria, to compare different projects and to find further opportunities.

The data documentation requires only two steps from the user:

1. A short characterisation and annotation of the project.

2. Entry of the relevant data for the sustainability criteria.

An example of part of SMART 5's Excel sheets is shown in Figure 11.

Interpretation of the results

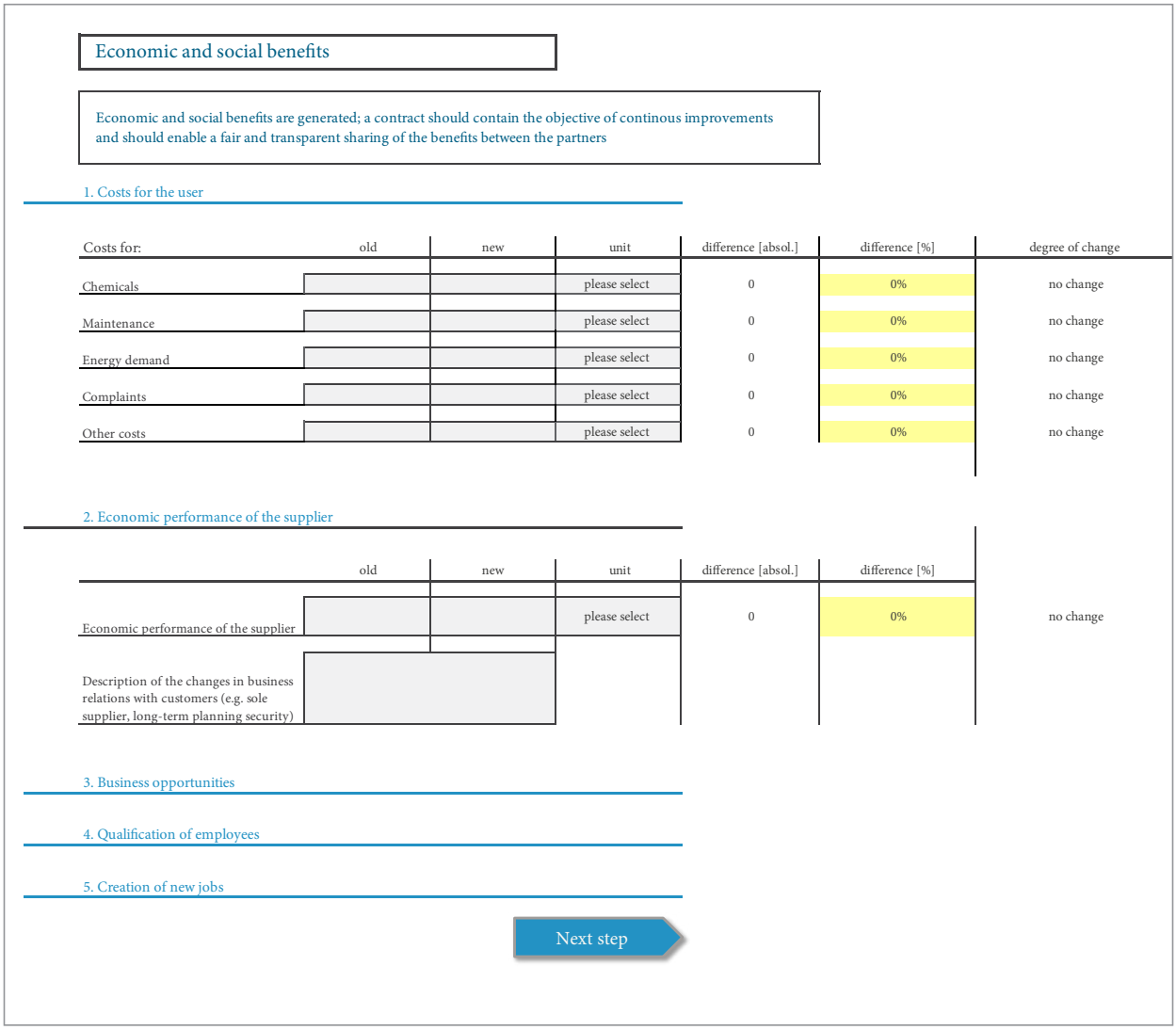
Whereas the intention of the 2030 Agenda is quite clear, namely, to achieve sustainable development in all areas, the measures undertaken by industry might produce contradictory results. In cases where indicators and sub-criteria all improve or remain the same, a positive assessment of the overall criterion in terms of fulfilling sustainability is easy. However, there may be Chemical Leasing applications where individual indicators and sub-criteria improve while others do not. For example, by introducing Chemical Leasing, a company could have reduced its emissions to wastewater, but the amount of solid waste could have increased. In SMART 5, this is indicated by a colour code on the related indicator.

In the event of such conflicting results, a consideration of the overall goals is necessary, and a decision has to be reached whether, for the specific case in question, the overall balance is still positive. This requires an interpretation by the user (or the evaluating institutions, e.g. in the case of the Global Chemical Leasing Award).

Sector extrapolation

How big are saving potentials for a certain industry sector? What benefits can Chemical Leasing generate? These are questions of great interest, to which the SMART 5 tool can contribute. The answers would help significantly to mainstream Chemical Leasing. In order to shed some light on this issue, the project to develop SMART 5 also conducted extrapolations for certain industry sectors in Germany.

Figure 11. SMART 5 data entry sheet for criterion 4: Economic and social benefits[10]. Bonding of paper and cardboard packaging



Economic and social benefits

Economic and social benefits are generated; a contract should contain the objective of continous improvements and should enable a fair and transparent sharing of the benefits between the partners

1. Costs for the user

Costs for:	old	new	unit	difference [absol.]	difference [%]	degree of change
Chemicals			please select	0	0%	no change
Maintenance			please select	0	0%	no change
Energy demand			please select	0	0%	no change
Complaints			please select	0	0%	no change
Other costs			please select	0	0%	no change

2. Economic performance of the supplier

	old	new	unit	difference [absol.]	difference [%]	
Economic performance of the supplier			please select	0	0%	no change
Description of the changes in business relations with customers (e.g. sole supplier, long-term planning security)						

3. Business opportunities

4. Qualification of employees

5. Creation of new jobs

Next step

[10] *Source: UBA, 2015.*

Bonding of paper and cardboard packaging

Assuming transferability from the relevant Serbian case study, the analysis of the potential for the bonding of packaging (solely paper and cardboard packaging and excluding plastic or composite materials) has shown that in Germany 3.75 kg of adhesive per tonne could be saved with Chemical Leasing. Given that about 5,500 kt of bonded packaging materials are produced every year in Germany (reference year 2012), and assuming that 10 percent of the total amount of bonded cardboard and paper packaging is processed as in the Chemical Leasing case study, this would result in a total reduction in the use of adhesives of approximately 2.08 kt per year. The savings in adhesive production result in further environmental benefits due to the reduced use upstream of materials and energy. In terms of greenhouse gas emissions, savings of around 8,300 t CO_2eq can be estimated (UBA, 2017b, p. 89f.).

Cleaning in hotels

A UNIDO study (2015) considered the potential for Chemical Leasing in hotels. Using as a reference the case of 17,000 rooms in Brazilian 4- and 5-star hotels, it was calculated the savings potential for water consumption and CO_2 emissions with regard to detergents for dish-washing and laundry cleaning to be 2,012 m^3 of water and almost 50 t of CO_2 per year.

The estimation in Germany was based on 950,000 rooms in German hotels. Assuming that the Chemical Leasing model was adopted by 10 percent of the German hotels, this could save more than 37 million litres of detergent per year if the quantities used and the reductions in detergents correspond to those of the case study (1.4 or 0.3 litres of chemicals per room and day, reduction of 80 percent). This reduction would result in savings in indirect greenhouse gas emissions of 2,670 t CO_2eq per year (through reduced detergent production), cost savings of approximately 33 EUR million per year, and reduced emissions to wastewater of over 2 tonnes of phosphorus equivalents per year (UBA, 2017a, p. 91f.).

Lubricating assembly lines

The use of Chemical Leasing for the lubrication of production lines in the filling of PET bottles in Germany was examined. The calculations were based on the assumption that the savings achieved in the Serbian case study could also apply to the plants in Germany, that around 10 billion PET bottles are produced annually in Germany (GVM, 2016, p. 16 and UBA, 2017b, p. 93) and that the conditions from the case study are transferable to 10 percent of the German production. Under these conditions, there is a saving potential of approximately 41.4 t of lubricant and approximately 1,200 GJ of energy per year in the supply chain, without consideration of the impacts of the substitute (in the case study, no information is available about the composition or environmental effects of the dry lubricant.) Substituting dry lubrication in the lubrication process will result in potential reductions of more than 30,000 m^3 of water and 12,000 kg pollutant emissions per year. Waste reduction is estimated to be around 36 t per year.

These extrapolations have to be handled with care, since they are based on expert judgement due to the unavailability or inaccessibility of data sets. For example, it had to be assumed that the company and the application for which data was obtained is representative of the industry and the savings potential can also be generated in companies with similar requirements.

There are three main issues that create uncertainties in estimating the industry potential:

- A Chemical Leasing application cannot be transferred directly to a similar process in other companies but must always be tailored to the specific needs of the partner companies, the process, and other (e.g. country-specific) framework conditions. Existing applications can therefore only give indications of further possible applications.
- In terms of economic benefits, a quantification has uncertainties because the service-related approach changes the framework conditions in the companies. Contracts are often agreed upon for longer terms and orders and business relations are characterised by greater stability. Therefore, a simple before-and-after comparison is possible but does not reflect the overall economic benefits (see also UNIDO 2015, p. 5f.).
- For many applications, data exists for a before-and-after comparison. For other case studies, this comparison cannot easily happen, because either no baseline scenario is available, or the application has changed dramatically through Chemical Leasing.

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8.5 GLOBAL CHEMICAL LEASING AWARD

The Global Chemical Leasing Award was launched in 2009 and held in 2010, 2012, 2014, 2018, 2021 by UNIDO with the direct support of the Austrian, German and Swiss governments.

The Award is considered as an efficient communication, awareness raising and motivational tool. The Award intends to showcase commitments to innovative and sustainable management principles and to provide practical insights for industry, policymakers and academia. It acknowledges best practices, innovative approaches and ideas related to Chemical Leasing and similar performance-based business models for sustainable chemicals management. It promotes the development and application of "smart" service-oriented business concepts and seeks to inspire companies and individuals around the globe to rethink how they operate with chemicals.

The Award provides the following benefits for participating companies and individuals:

- Recognition from the international community. The award gives companies, researchers, academics, and creative individuals an excellent opportunity to present themselves and what they stand for to a wider audience.
- PR. Best practices are picked up by media and social networks, inspiring more companies and individuals to adopt these innovative solutions.
- A platform for knowledge exchange and discussion on topics related to performance-based business models and sustainable chemical management.
- Showcasing of creative ideas, best practices and innovative solutions to reduce environmental impact, boost profits, and create social benefits.
- Evaluation by an international jury. This will help convince customers, partners and the public of your trustworthiness.
- Self-assessment. Preparing the application provides a great opportunity for a company to assess its organisation/target processes and to prepare an action plan for further improvement of its performance.

Ever since the first Award ceremony in 2010, UNIDO has received an increasing number of submissions from all around the world. Among the companies that have successfully participated in previous rounds of the Award are SAFECHEM, Ecolab, Cabot, AkzoNobel, Henkel, Ikea, Coca Cola and General Motors.

More information: at www.chemicalleasing.org

Testimonials from the Award 2018

Inspiring! This experience I will take for my whole life.

Mirela Siqueira
Environmental Coordinator, Groupe PSA

For my country, Colombia, it was such a memorable moment: our companies got two awards for the excellent Chemical Leasing projects demonstrating great results in terms of sustainability and proper handling of chemicals.

Paula Hoyos Cadavid
Chemical Leasing consultant

This is the most beautiful event I have ever seen. A wonderful reward for the hard work done. An incentive to further develop the dissemination of Chemical Leasing in Brazil.

Ana Oestreich
Chemical Leasing consultant

Picture 13. Global Chemical Leasing Award Ceremony 2018

@ UNIDO

09

PART D
Global drivers

09

Part D addresses in detail key challenges and responses that were already tackled in Part A. This chapter is a collection of different articles, interviews and quotes that shed light on the key drivers in the global environment that have influenced and stimulated the development of Chemical Leasing and have created favourable or challenging conditions for its implementation.

The contributions were provided by consultants, researchers and representatives of governments and NGOs, and address topics like Climate Change, Resource Scarcity, Circular Economy, SDGs, Digitalisation, Green Chemistry, Gender and Inclusiveness, Change management, CSR, and Innovative partnerships.

International chemicals policies and regulations that affect business operations with chemicals are also briefly discussed.

The discussions will address the following questions: how do these drivers affect industry; how do they influence the implementation of Chemical Leasing and how does Chemical Leasing fit a given framework and could contribute to the achievement of various goals.

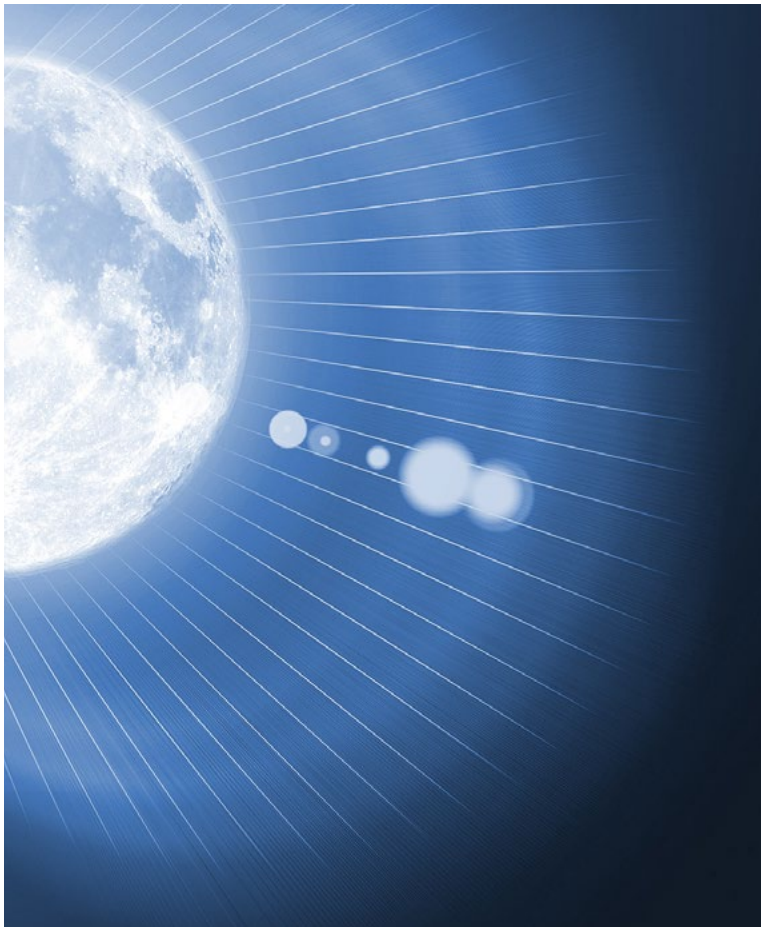
The chapter closes with interviews and quotes from academics and scientists on if and how academia and the scientific community can support the further development, uptake and mainstreaming of Chemical Leasing.

9.1 GLOBAL CONTEXT: CLIMATE CHANGE AND RESOURCE SCARCITY. THE CHEMICAL LEASING BUSINESS MODEL AS AN EFFICIENT TOOL TO ADDRESS THESE CHALLENGES.

Thomas Jakl

Deputy Director-General, the Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK), Austria

The debate on "combatting human influence on climate change" is in full swing. At last, measures are not only being discussed and weighed against each other, but, hopefully, will increasingly also be taken, in order to make do with the material flows of the ecosphere, as well to make the shift to solar energy. While the topics of transport, agriculture, nutrition and energy supply are hotly debated, little if anything is said about the basic characteristics of our economic systems. In key industrial sectors, economic success continues to correlate



with increasing product sales. This is true even for sectors in which purchasers have no interest at all in the actual product, but rather in what the respective product can do for them.

Performance rather than product

No-one buys electricity or natural gas because they find the product interesting. What is interesting is the service which those products render – the provision of energy in the form of light, heat, or power. Neither processing companies nor consumers are interested in "owning" the detergents or paint they use. These products provide services: clean surfaces or painted walls, for example. Attempts to make these services the core of business models have been around for some time. These approaches seem to have difficulties taking off unless subsidised or otherwise supported. The conversion of business models requires both effort and trust on the part of both business partners. Both producers and users of a product need to give their partners insight into internal processes that have so far been kept confidential. The partners need to agree on a unit of services rendered (cleaned surfaces, duration and intensity of lighting, number of coated specimens, etc.), as well as adapt their internal processes. Selected cases show that opting for service-based business models (such as Chemical Leasing) can be well worth the effort. The rewards will be enhanced productivity, more productive processes and longer customer retention, over and above dramatic reductions in resource consumption.

Economic leverage for resource efficiency

If an energy supplier succeeds in providing the customer with the desired request for lighting with less energy (i.e., less of the supplier's product), the supplier's profits will grow. If a supplier of chemicals manages to perform the agreed service (cleaned parts, coated surfaces) with lesser amounts of chemicals, this will turn into greater profits for the chemicals supplier. It is in this field that over the last 15 years, upon an originally Austrian initiative in co-operation with UNIDO, dozens of businesses worldwide have established the approach known as "Chemical Leasing." In this way, the production and release into the environment of thousands of tonnes of chemicals has been avoided while productivity has increased. These were chemicals that did not need to be synthesised, processed and disposed of – a tremendous amount of resources and thus CO_2 emissions saved.

No form of "green economy" or "circular economy" will be able to function without turning the fundamental characteristic of efficient use of resources into an economically motivated goal along the entire value chain. The preliminary draft implementations plan for the European Commission "New Green Deal" reported by the weekly "Politico" contained a proposal to establish a fund to finance "Chemical Leasing" start-ups. Even though Brussels officially distanced itself from the paper, it would be great if this idea saw the light of day.

Go for it! Getting resource-efficiency into business models – society requires it!

It would be valuable if this core demand of "decreasing resource consumption" – the true key to the climate and energy problem – were discussed at a dialogue of Austrian industries. Citizens recognise the need to strengthen the country's industries, but they could link public efforts to do this to a requirement that industries make resource efficiency a central "end in itself" rather than something that fails to pass the factory gate. This "targeted transformation" might be society's prime request regarding any future industrial development. The Austrian Assessment Report 2014 (AAR2014) of the Austrian Panel on Climate Change (APCC) points in this direction: "New business models (…) are key elements of transformation". Most of all, they point to the transformation of energy-selling enterprises into "specialists on energy provision services."

If an energy supplier no longer offers "electricity" but instead offers "light," the company's primary economic goal will be to produce this service – lighting – with as small an amount of energy as possible. A producer of electric light bulbs will no longer sell light bulbs but offer "lighting", in a partnership with an energy provider. Thus, every participant has an interest in achieving the service of "lighting" on the basis of an optimum use of energy and light bulbs, rather than selling as many light bulbs and as much energy as possible. Equally, in a resource-efficient industry, a producer no longer sells their product but rather the performance (service) of the product and does so in partnership with the user.

Industry as well as the entire subsequent value chain, including trade, must become part of these business models and question existing paradigms. If industry is a player in the new business model, value is created through performance (service) rather than the sale of products. Providing the service offered on the basis of an optimum use of resources will thus be in the economic interest of all partners involved (including the producing sector).

Technological trends such as digitalisation or 3D printing are putting additional pressure on industry as a whole by dramatically increasing the demand for efficient use of materials. Even the construction and minerals industries will not be able to do without service-based approaches and will have to make the shift from offering construction materials alone to providing entire building and construction concepts in co-operation with planning and

construction businesses. This is the only way for them to turn the pressure on resource efficiency to their own economic advantage. As long as companies continue to maximise their profits via product sales alone, conflicts of interest will remain unavoidable. Companies' active willingness to question existing business models in terms of optimum resource efficiency is a necessary condition for a social contract on strengthening future industrial development.

9.1.1. CHEMICAL LEASING AS AN EXCELLENT CONTRIBUTOR TO CO_2 REDUCTION

Reinhard Joas

International expert on Sustainable Chemicals Management, environmental technologies and innovative business models, Managing Director of CS3, Germany

Chemical Leasing is a business model that aims to reduce the consumption of chemicals. With benefit-based pricing this is in the economic interest of the supplier and of the user of chemicals. Reduced consumption can be achieved in many ways. It might be a result of

- Better training of the user (e.g. use of cleaning agents in hotels)
- Additional measurements that enable more accurate doses of applied chemicals (e.g. in wastewater treatment)
- Better equipment and machines that optimise application of chemicals (e.g. well-maintained sprayers for plant protection products)
- Stabilisers that enable longer use of chemicals (e.g. cleaning of metal surfaces)
- Internal recycling and refreshing of chemicals (e.g. galvanic treatment)

In practice, reduced energy consumption is not a priority in the optimisation efforts of users and suppliers of chemicals. It might even happen that some of the measures described above consume slightly more energy (e.g. machines with internal recycling and deep cooling of solvents).

So, where is Chemical Leasing's contribution to CO_2 reduction targets?

The answer can be found if not just the process where chemicals are used is considered, but also the supply chain. It is obvious that a reduced consumption of chemicals leads to a reduced production (or a reduced growth in production) of chemicals. This is an intrinsic effect of the business model.

From a supply chain perspective, the production of chemicals is nearly always connected to huge energy consumption. One fact to demonstrate this: In Germany, the energy consumption of the chemical industry accounts for 22.6 percent of the energy consumed in industry and for 6.7 percent of the total energy consumption.

In most Chemical Leasing cases, reductions of chemical use between 20 percent and 80 percent were achieved, with an average of around 30 percent. From these figures, it is obvious that Chemical Leasing contributes significantly to CO_2 reduction.

The following example highlights the correlations.

Chemical Leasing is being applied in Colombia for the cleaning of contaminated water resulting from oil exploration. After agreeing on benefit-oriented payment, the user and the supplier together optimised the water treatment processes. This resulted in a higher energy demand of about 10 MWh per year due to additional pumps etc. On the other hand, consumption of water treatment chemicals could be reduced by 113 t per year.

The energy that is saved in the supply chain - because smaller amounts of water treatment chemicals now need to be produced - is equivalent to about 500 MWh per year. This exceeds by far the additional energy that was required for the process optimisation. The total impact of Chemical Leasing in this case is a CO_2 reduction of 14.5 percent of the total energy consumed in the process.

Conclusion: Chemical Leasing is an excellent contributor to CO_2 reduction and helps to avoid climate change. In most cases this is not recognised by the involved supplier and user, it only becomes obvious when one uses a supply chain perspective. Chemical Leasing should be promoted not only by policymakers responsible for chemicals policy, but also by those responsible for climate change policy.

9.2 DIGITALISATION: THE NEW DRIVER FOR CHEMICAL LEASING

Petra Schwager

Chief, Energy Technologies and Industrial Applications Division, Coordinator of the UNIDO Global Chemical Leasing Programme (2004-2020)

This article introduces the large range of opportunities that digitalisation offers to enable companies to change to Chemical Leasing. It specifically outlines how digitalisation supports better monitoring of the performance of chemicals services.

A key element for a successful Chemical Leasing business model is an accurate monitoring and measurement of the benefits. For this, both the chemicals provider (or chemicals service provider) and the user need to define and use performance indicators. The value of the service provided by the chemical becomes the basis for payment and for calculating the Chemical Leasing fee. A few examples to illustrate what the unit of payment in a Chemical Leasing contract would be are: Euros per number of metal pieces cleaned, in a metal working company; Euros per label applied, in a bottling company; Euros per m2 of surface area coated with powder coating chemicals, in an automobile factory.

Without adequate measuring and monitoring systems in place, remuneration of performance is not manageable. This has been a challenge for the uptake and mainstreaming of Chemical Leasing, especially in developing countries and transition economies.

The latest technological advances in bridging physical and digital applications, the so-called "internet of things", is considerably boosting the opportunities for new performance-based solutions. Different kinds of low-cost but highly efficient sensors, connected to diverse internet platforms, are enabling manufacturers around the globe to connect a wide range of services much more effectively with diverse technologies and platforms. These smart connected products permit remote monitoring and provide companies large amounts of data on their products, their performance, and their use. This brings a new set of possibilities for performance-based solutions that can be tailor-made to meet the needs of a specific customer.

Blockchain technology is also expected to further boost Chemical Leasing. It provides protocols of transactions that are verified by a network of computers before being recorded and approved. This technology creates much higher levels of trust among business partners and delivers secured information that is not controlled by single users. In turn, this allows for a reduction in business and the risks in Chemical Leasing contracts that often result from outcome uncertainties. Consequently, this nurtures long-term business partnerships and equal sharing of benefits, all stemming from the more efficient use of chemicals.

Furthermore, "on-demand" or "shared economy" thinking raises fundamental questions about ownership of products, putting instead functionality and benefits at the core of a business deal. Customers are increasingly raising the questions: What is the result I want to achieve? Do I really need to purchase this expensive piece of equipment that is only being used four per cent of its time? Why would I want to buy chemicals if can just as easily purchase the solution which those chemicals offer me?

The digital revolution is creating enormous opportunities for new approaches that shift from the traditional product-oriented philosophy to performance-based business thinking. This offers a unique chance for creative outcome-based solutions and for accelerating the adoption of Chemical Leasing.

To change a business model is a fundamental strategic decision for a company. Digitalisation makes such a strategic decision easier, by greatly broadening the range of options for companies in many industrial sectors to switch to Chemical Leasing and other performance-based business models for sustainable chemicals management.

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9.3 MAKING THE CASE FOR CHANGE

Ylva Gilbert

Business Director, Gaia Consulting Oy

Introduction

Ever since circular economy concepts and business models for resource efficiency were first developed in the late 1970s, the concepts have been gradually building up momentum, and today are becoming common terminology (Ellen McArthur Foundation, 2019). The attraction of changing the concepts about how businesses create value by taking into account resource efficiency and sustainability aspects is firmly grounded in robust cases of making more with less, which include better financial returns as well as less negative impacts on the environment, people, and societies. Positive tangible business benefits also include:

- Investment advantages: Nearly 75 percent of investment professionals take a company's sustainability into account when deciding to invest or not. (CFA Institute, 2017; RobecoSAM, 2019). The added value of sustainability has also been made more accessible to investors through, for example, the development of transparent Principles for Responsible Investing since 2005 (UN PRI, 2019).

- Agility to meet the future needs of transforming marketplaces: Meeting environmental challenges are identified as one of the five foreseen megatrends, or global macro forces, that will transform not only businesses, but the marketplaces they operate in and the societies we all live in (see inter alia OECD, 2016; Willis Towers Watson Investments, 2017). Sustainability aspects are therefore already contributing to transforming the competitive landscape (see also inter alia Nidumolu, 2009; UNIDO, 2016; OECD, 2017).

Performance-based business models present ways of doing business that inherently support making more with less. These models link the seller's revenue to the performance (or functionality) the buyers receive. Based on the preventive Resource Efficient and Cleaner Production (RECP) concept, UNIDO has undertaken a sustained effort since 2004 to accelerate uptake of such a performance-based business model: Chemical Leasing (UNIDO, 2016). Chemical Leasing firmly links performance to revenue. It is also a prime example of how sharing specialist expertise and services can be an integral part of a performance-based sustainable business model. Chemical Leasing embodies the principles of sustainable chemicals management and is based on a combination of optimisation of chemical functionality, enhancing resource efficiency and reducing negative health, safety and environmental impacts (UNIDO, 2018). All of these aspects require considerable expertise. Such expertise tends to reside within the chemical industry rather than with users, especially in areas where chemicals are used for supporting functions such as cleaning, painting, maintenance, lubrication and many others. Nevertheless, despite a convincing theory (UNIDO, 2018) and numerous successful pilots (UNIDO, 2016), few companies have adopted Chemical Leasing as a company-wide, preferred business model for selling or buying chemicals. Thus, whilst much has been achieved in the past 15 years, it is also true that there are not exactly droves of companies scrambling to adopt Chemical Leasing – and the business model is still far from mainstream.

Better performance but slow uptake

Performance-based business models enable companies to work towards both business and sustainability targets by providing, in varying degrees, better performance using less resources. The combination can increase agility and contribute to maintaining or building competitiveness in future markets. As performance-based business models allow companies to tap into the technical expertise residing within the Chemical Industry, one could reach the conclusion that such business models would be particularly appealing to companies which do not have core chemical expertise in-house. Added value could be gained directly by introducing business models where the supplier is paid based on delivery of better performance, increased resource efficiency, and positive, measurable impacts on health, safety, and the environment. Yet, despite excellent pilots and attractive arguments for change, the uptake of performance-based business models for chemicals has been slow. This indicates there must be operative barriers that hinder upscaling and mainstreaming. To accelerate uptake, the more common barriers need to be identified and addressed, including the apparent organisational reluctance to undertake organisation-wide changes, even after successful trials.

Organisational sustainability maturity and business model concepts

Organisations have different levels of organisational "sustainability maturity", which reflects how sustainability is incorporated into business decisions. Changing business model requires considerable maturity in this respect. A decade ago, a Harvard Business Review paper (Nidumolu, 2009) summarised how sustainability as a concept within an organisation evolves as organisations move through five distinct stages of change:

1. Viewing compliance as an opportunity;
2. Making value chains sustainable;
3. Designing sustainable products and services;
4. Developing new business models; and

5. Creating Next-Practice platforms, including e.g. radical innovation.

In practice, a company may be working with different sustainability topics at different stages simultaneously, with marked differences in maturity. For example, companies may be far more advanced in their approach to energy sustainability than to chemical sustainability. This includes energy companies, which are actively exploring means of changing their offering. The traditional way for utility companies to access revenue are undergoing a fundamental change, towards an approach to revenue "where profit is driven by meeting goals to deliver an affordable, reliable, and clean power system is becoming more performance based "(Forbes, 2018). We have all heard of new business models for transport, such as car sharing and bike pools. In terms of chemicals, the change has been slower, which may indicate that there are relatively few companies where chemical sustainability as a concept has evolved to stage four. There are many potential reasons for this, but there are two factors especially with potentially large impact that have not perhaps been so widely discussed. These are:

1. Focus on compliance: Whilst sustainable chemical management is nothing new as a concept – it rose to prominence on the agenda of regulators and the chemical industry in the 1990's (Yale University, 2019) – much of the focus of both industry and policymakers has been on the vast overhauls of chemical regulations and international conventions that have taken and are still taking place across the globe. With both industry and policymakers focusing on creating and implementing regulatory requirements, much less resources, energy and drive has been dedicated to looking at changing business models as a means of enhancing operative sustainability.

2. Level of Market Demand: Optimisation of chemical functionality and sustainability are subjects that require specialist knowledge. This expertise resides in the chemical industry, whose core business it is. The company using the chemical may not be fully aware of the potential ways of optimisation that could be adopted through buying chemical performance and functionality rather than sacks and barrels. If there is a high demand for performance-based transport today, it is because the buyers are aware of the benefits to them.

The combination of an increasingly complex regulatory landscape and a requirement for specialist knowledge to even recognise the potential of performance-based business models may actively contribute to chemical sustainability being linked to the first level, "compliance as an opportunity", or even the level before that, pure compliance management. Compliance is based on operative management and procedures, whereas changing sourcing or sales models, at Level 4, requires strategic decisions. The further chemical know-how is from the core competencies of the company, the less likely the company is to recognise and work towards the potential benefits of allocating resources towards reaching Level 4 "chemical sustainability maturity". Recognition of the strategic potential which performance-based business models bring to companies where chemicals are not a core strength requires raising awareness in order for many more companies using chemicals to even identify the potential benefits of allocating resources towards adopting performance-based business models.

Failure to change

The authors of another Harvard Business Review Article note that a staggering 50-75 percent of any efforts to change fail, and of those that succeed, many are modified along the way (Blount & Carroll, 2017). Here, human "built-in reluctance to change" is highly relevant. Efforts to build capacity to drive uptake of performance-based business models would benefit from considerations of how to facilitate effective management of change, and thereby support strategic decision-making. This is further illustrated by two fundamental issues that 15 years of marketing Chemical Leasing to industry have highlighted:

1. Companies that have apparently successfully applied Chemical Leasing in a pilot, do not automatically replicate the business model to other processes or locations. This indicates that internal upscaling can be challenging. Changing to buying chemical functionality as a preferred option above buying chemicals by volume or weight is clearly a much more challenging change than making a single change in a single plant. This may stem from internal reluctance or barriers to change, or because there are not enough chemical suppliers offering performance-based business models.

2. The number of companies proceeding from initial interest to piloting represents but a fraction of those for whom purchasing chemical functionality through performance-based business models could bring benefits to . This could be due to one or a combination of the following reasons: a lack of clearly communicated and understood incentives to change; lack of sufficiently strong business case predictions to overcome the inertia stemming from a generic reluctance to change; or include very concrete challenges related to functionality or expertise, as performance-based business models are not suitable for every type of chemical use.

Change management as a tool

Change management approaches may indeed have been somewhat overlooked as a means to overcome such potential deal breakers. Whilst an operative focus during

the testing phase, i.e. transition from idea to pilot, is a prerequisite, when it comes to advancing from a successful pilot to upscaling, strategic decisions need to be made. The effective use of organisational management tools such as change management approaches could therefore contribute significantly to uptake. In order to stimulate uptake and a transformation from pilot-based trials to a mainstream business model, there is an urgent need to find ways and means to make it easier and more attractive for companies to strategically evaluate the potential benefits against required changes.

To enable performance-based business models to make the leap across the chasm between niche and mainstream within the chemical industry, harnessing management tools such as change management could provide significant contributions by allowing transparent identification and communication of the changes required before these become barriers. Where possible, use of variables that quantify foreseen benefits in terms that are attractive and meaningful, not only within the organisation but also to wider stakeholder groups, including shareholders, could increase the attractiveness of the proposition to change.

Decision making requirements

To make a strategic decision to change, the concept must be clear, the value proposition solid, and the required organisational changes mapped. Strategic decisions are not generally made by one person or department, but generally require multiple parties to agree. In discussions with several Nordic suppliers and users, a built-in reluctance to change, combined with lack of strategic focus, and the need to forecast sufficient added value to raise the focus to a strategic level, were recognised as potential deal breakers. For example, many publicised Chemical Leasing pilot cases and researches are written from a largely technical and operative point of view, and the audience receiving this information is from a technical or sustainability background. Thus, in order to change how chemicals are sourced, the sourcing department must sell the concept internally to other departments such as ICT, HR and marketing. It is therefore not enough that the business model change makes sense financially and from a sustainability point of view, it must also be easily grasped and attractively packaged, so that the proposition to change is approachable, understandable and enticing to management at both an operative and a strategic level.

Conclusions

In order to mainstream performance-based business models for chemicals, including, but not limited to, Chemical Leasing, there is a need to develop tools and approaches that help both parties identify, quantify, assess, and manage the practical business consequences of moving from a pilot to a companywide adoption of performance-based business models. By focusing on how to facilitate the transition, the strategic decision-making can be made easier. The required changes need to be broken down into easy, bite-size operative decisions. By paying more attention to the direct practical implications of a business model change, the potential to resonate more with strategic decision-makers increases. In order to do this, the practical link between change management practices and performance-based business models for sustainable chemical management needs to be strengthened.

To reach the full potential of performance-based business models as a vehicle for increasing chemical sustainability, the focus needs to be put on capacity building of how, on the one hand, to reach a decision to change, and on the other hand, make the implementation of change easier. To actively drive the overall market towards wider use of performance-based business models, capacity builders must therefore focus on supporting practical change management, an essential step in moving towards wider uptake of more sustainable, performance-based business models for chemicals.

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9.4 CHANGE MANAGEMENT - CHANGE OF A PARADIGM

Hildegard Nibel

Researcher, Switzerland

In a changing world, what does a business need to be ready for and capable of?

It needs a good balance between a belief in its own strengths, adaptation to the changing needs of its clients and markets as well as changing legislation, but also integration of best practices, research results, new production methods.

In general, staying with proven processes, products and business model(s) combined with curiosity and openness to new ideas. To mention a famous example: 3M allows its employees to spend 15 percent of their work time on new ideas and products.

What are the general trends and developments in industry, and in particular in the chemical industry?

General trends are digitalisation, agility and globalisation. Meanwhile, as climate change can't be denied anymore, it might soon also be resource efficiency, circular economy and sustainability. As an expert in occupational health and safety and as a naive consumer I would expect industry to use ever less and less toxic chemicals.

How often should a business change/ update itself?

I don't think that a rigid number of years can be recommended. There are push and pull factors for change: legislation, globalisation, market, competitors, research, innovation ... As is the case in the evolution of science, famously described by Thomas Kuhn, I would expect the different branches of the chemical industry to have times when they just improve current production procedures and revolutionary times, when the production systems are changed completely. It also depends very much on changes in legislation: if a substance is forbidden in a country, production companies and buyers change their procedures, or they buy or produce abroad to avoid these legal restrictions. Generally speaking, changes or updates ought to be considered before a new investment is made, to assess whether it should go ahead or whether there are other opportunities.

What are the main skills that are required nowadays?

As always, good basic education and training, conscientiousness, communication skills, curiosity and openness to new ideas, and an agreeable character to avoid negative team dynamics. Maybe nowadays an agreeable character is more important than ever before, because general rules of behaviour in companies and society have become less mandatory and therefore constant bargaining is going on. To support this development, team leaders ought to be selected with these special communication talents and further trained.

What are the main reasons why company management starts changing the business paradigm?

Decrease in sales and profits and openness to new ideas and opportunities.

In addition, there are definitely many economic and environmental influences which trigger change: the positioning of the company and competitors, the labour market, consumer behaviour and expectations, the general economic situation ... For instance, when a chemical is suspected to be dangerous any management concerned with long-term profits ought to change it as fast as possible. But there are definitely managers who continue to sell those substances as long as it is profitable, so as to get their bonus and then leave: "après nous le deluge".

Is the change of business models and paradigms a trend in the industry (or can it become one)?

This is probably very case-specific, depending on the people involved, the industry sector, local business, know-how within the producing and buying companies, labour market … but Chemical Leasing always should be considered as an opportunity for new or particularly hazardous substances or products.

Chemical Leasing and similar business models demand a change of a paradigm. Does this require a shift of thinking?

Yes, towards the client's business - production procedures, markets, competences, constraints etc. To use a psychological term, it requires greater empathy: a desire to understand the client's needs and limitations.

Therefore, it needs more communication. Not only between management of the supplier and the buyer, but also at all levels of the hierarchy. Innovation is not restricted to managers, business developers and marketing; all employees in a company can contribute to a fruitful exchange, to new business models. In addition, a procedure for fair sharing of the knowledge and savings of improved production processes has to be established not only between supplier and user, but also among the different hierarchy levels of the organisations involved. Basically, it needs mutual trust among business partners, and trust develops over time.

What other changes are required from a company that introduces a new business model?

There also needs to be a change in the organisational culture. Selection of personnel and personnel development both have to be modelled by any fundamental intention like changing the business model. The company which really intends to change has to offer learning possibilities to its employees to apply new business models in their current work situation.

In general, diversity is recommended to improve business. For instance, it has been shown that companies with female board members are more profitable.

How can change be facilitated?

Change happens naturally, if the psychological and economic costs are lower and rewards higher than in the current situation. To explore new ideas, employees need psychological and economic safety and reliability of conditions and rules within the company (Google, project Aristotle 2017). They need to know what their role is within the new business model. They have to be rewarded adequately for their contributions to improvements, e.g. by continuous education and training to increase their employability in the labour market:

"Train your employees well enough so that they could leave. Treat them well enough so that they don't want to."

How to communicate the value of the paradigm change to employees, business partners and customers?

A mission statement has to be discussed and communicated within the whole organisation. To make this mission statement live, it needs constant effort of what we Western work psychologists believe to be the Japanese innovation cycle:

- All people concerned with a product or service all meet together and discuss ideas to identify all the advantages and disadvantages, chances and risks.
- Later, smaller teams are built to further develop certain ideas and opportunities into products or services.

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9.5 TOWARDS THE IMPLEMENTATION OF SDGS

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The Sustainable Development Goals (SDGs) are a set of 17 goals and 169 targets for international cooperation and stand at the centre of the United Nations' Agenda 2030 for Sustainable Development. Building on the Millennium Development Goals (MDGs), Agenda 2030 and the SDGs form the framework for collective action on global challenges such as extreme poverty, climate change, environmental degradation, or diseases and health-related issues. Amongst other issues, the SDGs encompass the end of poverty in all its forms (SDG 1), the building of resilient infrastructure, promotion of inclusive and sustainable industrialisation and the fostering of innovation (SDG 9) or ensuring sustainable consumption and production patterns (SDG 12). Each of the 17 SDGs comprises a list of specific targets, which should be reached by the collective efforts of the global community by 2030. Each target is associated with one to three indicators to measure progress towards reaching the targets[11].

Considering this universal global framework for sustainable development, Chemical Leasing provides several highly interesting qualities that could support efforts to reach the SDGs. As a service-oriented business model, Chemical Leasing aims to shift the focus from increasing sales volumes of chemicals towards a value-added approach[12]. In a successful Chemical Leasing scenario, this can lead to a close collaboration between the supplier and the user of a chemical product. Such a collaboration may subsequently result in an optimisation of the use of this chemical product and the processes associated with its use. This should lead to an increase in resource efficiency of the chemical product; furthermore, significant environmental co-benefits may be realised. Examples of such environmental co-benefits may be the reduced consumption of water or energy for a production process, or the reduction of releases of hazardous chemicals into the environment. In addition, these optimisations can lead to improvements in worker safety and working conditions. For example, the optimised use of a chemical product might reduce the exposure of workers to hazardous chemicals, reduce the risks for work-related injuries, or lead to improved working conditions by lowering operational temperatures.

These effects we have outlined are not just theoretical. Through the Global Chemical Leasing Award, UNIDO has collected many successful examples of the application of Chemical Leasing. For the 4th Global Chemical Leasing Award in 2018, over 50 applications for cases of Chemical Leasing were submitted by either suppliers or users involved in Chemical Leasing models. Many of these cases demonstrated one or several of the outlined effects regarding an increase in resource efficiency and environmental co-benefits. For example, the application documents of one of the award-winners, a laundry company in Croatia, outlined the effects of obtaining its new laundry detergents in a Chemical Leasing model as follows. To optimise the amount of detergent used in the process, the new detergent supplier installed automated dosing machines for the washing processes. Combined with a newly installed water filtration system, 41 percent less detergent is now being used, compared to operations prior to the Chemical Leasing model. Furthermore, water use decreased by 71 percent and the washing temperature could be decreased, resulting in a 20 percent reduction of energy use. In addition, workplace safety increased since workers no longer come into direct contact with the detergent, and due to the temperature decrease of the washing process, working conditions in the plant have improved.

In many of these cases, Chemical Leasing has demonstrated its potential to increase resource efficiency in the use of chemicals, to create significant environmental co-benefits and to improve worker safety and working conditions. In order to ensure that Chemical Leasing activities follow the principles of sustainability, the German Federal Environment Agency and UNIDO jointly developed a set of sustainability criteria in 2010. These sustainability criteria encompass:

- Reduction of adverse impacts for environment, health, energy and resource consumption caused by chemicals and their application and production processes;
- Improved handling and storage of chemicals to prevent and minimise risks;
- No substitution of chemicals by substances with a higher risk;
- Generation of economic and social benefits; a contract should contain the objective of continuous improvements and should enable a fair and transparent sharing of the benefits between the partners;
- Monitoring of the improvements needs to be possible.

[11] *The Sustainable Development Agenda*
[12] *UNIDO Definition of Chemical Leasing*

If these criteria are fulfilled, the implementation of Chemical Leasing can increase the sustainability of industrial processes in the environmental, social, as well as economic dimensions and may therefore support efforts to reach the Sustainable Development Goals. Due to the breadth of potential impacts of Chemical Leasing, this applies to a variety of different goals and targets. Figure 12 outlines a comprehensive but not exhaustive collection of SDGs and their respective targets to which Chemical Leasing has the potential to contribute.

In addition to these goals and targets, the implementation of Chemical Leasing has the potential of providing indirect effects on sustainable development by generating economic benefits and increasing profitability while promoting the transfer of knowledge between the partners of the model.

Figure 12. SDGs and their Targets to which Chemical Leasing can Contribute

9.5.1 CHEMICALS LEASING BUSINESS MODELS – STRATEGIES TOWARDS MEASURING SUSTAINABILITY[13]

Frank Moser

Secretariat of Basel, Rotterdam and Stockholm Conventions

Background

At the United Nations Sustainable Development Summit in 2015, Heads of State as well as high-level leaders from business and civil society agreed on the 2030 Agenda for Sustainable Development[14]. This included the adoption of a set of 17 Sustainable Development Goals (SDGs) and 169 targets. All goals are interlinked and equally address the economic, social and environmental dimensions of sustainable development.

The resolution by which the General Assembly adopted the 2030 Agenda on 25 September 2015 underlined that a robust, voluntary, effective, participatory, transparent and integrated follow-up and review framework would make a vital contribution to implementation[15]. In this regard, it was stated that having a strong, transparent and flexible monitoring and evaluation mechanism would be paramount for the implementation of the 2030 Agenda[16].

Measuring progress in implementing the Sustainable Development Goals in line with a list of agreed indicators and milestones is therefore considered a critical success factor[17].

This section focuses on ways and means to measure the progress made in implementing the cross-cutting area of Sustainable Chemistry (Johnson 2012), which represents a specific area in the 2030 Agenda (Blum et al. 2017). We use work done on the Chemical Leasing business model presented in Moser et al. (2014). In that paper, a first attempt was made to develop an assessment methodology with which to analyse if Chemical Leasing is suitable to protect environmental health and safety by fostering the substitution of hazardous chemicals and hence to ensure compliance with sustainability criteria. Here, we seek to take stock of the work in that paper and we propose further strategies for refining the methodology, taking into account the targets of the SDGs that can be associated most closely with sustainable chemistry.

Chemical Leasing activities

The work of Moser et al. (2014) was a first attempt to determine if and to what extent Chemical Leasing is suitable for implementing Sustainable Chemistry. The authors proposed to evaluate the sustainability of Chemical Leasing projects using a conceptual framework made up of four basic goals, g1 to g4, which in turn were further broken down in a comprehensive list of sub-goals gij. The goals and sub-goals are shown in table 6.

Subject to certain conditions, this methodology allowed the authors to conclude 'with certainty' that introducing Chemical Leasing has increased sustainability. To arrive at this conclusion, every basic goal had to positively contribute to sustainability. It follows that an increase in overall sustainability was 'uncertain' if this condition was not fulfilled.

Relevance of the methodology to the Sustainable Development Goals

The work of Moser et al. (2014) was concluded before the formal adoption of the SDGs in 2015. It is therefore worthwhile assessing if and to what extent the methodology proposed in that paper is supportive of the five SDG targets and indicators which are most closely associated with Sustainable Chemistry. These are listed in table 7, along with the associated indicators.

Monitoring of the 2030 Agenda should follow, among other things, a bottom-up process that relies on the broad use of national accountability mechanisms and should be built upon a robust information system. The ability to produce basic data on economic and social indicators with high quality standards is seen as a critical feature for such a system. (Ocampo 2015)

The methodology proposed by Moser et al. (2014) can be used to collect data at the national level and, given its scope, can deliver in principle basic data on socio-economic indicators. It is therefore worthwhile to determine if and to what extent the SDG indicator system for Sustainable Chemistry overlap with the goals and sub-goals in the methodology proposed by the authors.

Table 8 below compares the SDG indicators set out in table 7 with the goals and sub-goals proposed by Moser et al. (2014).

[13] *The views expressed in this article are those of the author and do not necessarily represent those of the United Nations Environment Programme and/or the Secretariat of the Basel, Rotterdam und Stockholm Conventions.*
[14] *Resolution A/69/L.85 adopted by the General Assembly. Draft outcome document of the UN summit for the adoption of the post-2015 development agenda.*
[15] *Resolution adopted by the General Assembly on 25 September 2015 [without reference to a Main Committee (A/70/L.1)] 70/1. Transforming our world: the 2030 Agenda for Sustainable Development, paragraph 72.*
[16] *70th Session of the General Assembly - United Nations Summit on Sustainable Development 2015 - Informal summary 25-27 September 2015 United Nations Headquarters, New York, page 3.*
[17] *Resolution adopted by the General Assembly on 25 September 2015 [without reference to a Main Committee (A/70/L.1)] 70/1. Transforming our world: the 2030 Agenda for Sustainable Development, paragraph 90.*

Table 6. Conceptual framework outlining basic goals & sub-goals for promoting sustainable chemistry through Chemical Leasing

Basic goals (gi)	Sub-goals (gij)
g1 Increase overall resource efficiency	g1,1 Use less energy
	g1,2 Use less raw and auxiliary materials
	g1,3 Use less water
	g1,4 Produce less waste / wastewater
g2 Reduce adverse effects on health and environment of the chemicals of concern	g2,1 Reduce impacts on labour health
	g2,2 Substitute carcinogenic, mutagenic and toxic for reproduction (CMR) chemicals
	g2,3 Substitute persistent, bioaccumulative and toxic (PBT) chemicals
	g2,4 Reduce impacts on water
	g2,5 Reduce impacts on air
	g2,6 Reduce impacts on soil
g3 Increase economic value and strengthen chemicals management	g3,1 Increase output with desired properties
	g3,2 Optimise handling / storage / logistics
	g3,3 Increase economic gain (revenue for supplier)
	g3,4 Increase economic gain: increase revenue for user
	g3,5 Increase competitiveness for supplier
	g3,6 Increase competitiveness for user
g4 Increase sustainability in surrounding systems	g4,1 Use less fossil resources
	g4,2 Reduce impacts on health of consumers
	g4,3 Promote recycling / use in cascades
	g4,4 Increase economic gains in the region / country: increase revenue for trade
	g4,5 Increase economic gains in the region / country: increase revenue for other stakeholders in the supply chain
	g4,6 Reduce poverty in the region
	g4,7 Increase employment in the region
	g4,8 Reduce impacts on water in the region
	g4,9 Reduce impacts on air, including reduction of greenhouse gases
	g4,10 Reduce impacts on ecosystems / biodiversity

Source: Moser et al. (2014)

Table 7. SDGs – targets and indicators relevant to sustainable chemistry

SDG target	SDG indicator
3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	3.9.1 Mortality rate attributed to household and ambient air pollution 3.9.2 Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services) 3.9.3 Mortality rate attributed to unintentional poisoning
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.2 Proportion of bodies of water with good ambient water quality
11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	11.6.1 Percentage of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities
12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimise their adverse impacts on human health and the environment	12.4.2 Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment
12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	12.5.1 National recycling rate, tons of material recycled

Conclusions

It can be seen from Table 8 that there is good overlap between the methodology's goals and sub-goals and the selected indicators of the SDGs. Thus, it can be concluded that overall the methodology introduced by Moser et al. (2014) shows a substantial potential to contribute to measurements of progress made in the implementation of the five SDG targets most closely associated with the area of Sustainable Chemistry. By using the methodology to assess whether or not a Chemical Leasing project contributes to Sustainable Chemistry, actors will at the same time be generating basic input to measure the implementation of the SDGs.

The methodology thus supports the call of governments and other stakeholders for having a strong, transparent and flexible monitoring and evaluation mechanism for the implementation of the 2030 Agenda[18].

The scope of the proposed methodology, however, is limited to the comparison of different Chemical Leasing projects in terms of their relative contribution to Sustainable Chemistry. In order for it to serve as a means of measuring the implementation of the SDGs, further work is needed. It would be particularly important for the methodology to better reflect the SDG framework by introducing into it qualitative and quantitative targets and indicators. With these refinements, the methodology would allow conclusions to be drawn about whether Chemical Leasing business models are sustainable per se, and to what extent Chemical Leasing promotes Sustainable Chemistry.

[18] *70th Session of the General Assembly - United Nations Summit on Sustainable Development 2015 - Informal summary 25-27 September 2015 United Nations Headquarters, New York, page 3.*

Table 8. Mapping of the SDG indicators and the goals and sub-goals of the proposed methodology

SDG indicator	Methodology goal	Methodology sub-goal
3.9.1 Mortality rate attributed to household and ambient air pollution 3.9.2 Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services) 3.9.3 Mortality rate attributed to unintentional poisoning	g2 Reduce adverse effects on health and environment of the chemicals of concern	g2,1 Reduce impacts on labour health g2,2 Substitute carcinogenic, mutagenic and toxic for reproduction (CMR) chemicals g2,3 Substitute persistent, bioaccumulative and toxic (PBT) chemicals g2,4 Reduce impacts on water g2,5 Reduce impacts on air g2,6 Reduce impacts on soil
	g3 Increase economic value and strengthen chemicals management	g3,2 Optimise handling / storage / logistics
	g4 Increase sustainability in surrounding systems	g4,8 Reduce impacts on water in the region g4,9 Reduce impacts on air, including reduction of greenhouse gases g4,10 Reduce impacts on ecosystems / biodiversity
6.3.2 Proportion of bodies of water with good ambient water quality	g1 Increase overall resource efficiency	g1,3 Use less water g1,4 Produce less waste / wastewater
	g2 Redue adverse effects on health and environment of the chemicals of concern	g2,2 Substitute carcinogenic, mutagenic and toxic for reproduction (CMR) chemicals g2,3 Substitute persistent, bioaccumulative and toxic (PBT) chemicals g2,4 Reduce impacts on water
11.6.1 Percentage of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities	g1 Increase overall resource efficiency	g1,2 Use less raw and auxiliary materials g1,3 Use less water g1,4 Produce less waste / wastewater
12.4.2 Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment	g1 Increase overall resource efficiency	g1,2 Use less raw and auxiliary materials g1,4 Produce less waste / wastewater
	g2 Reduce adverse effects on health and environment of the chemicals of concern	g2,1 Reduce impacts on labour health g2,2 Substitution of carcinogenic, mutagenic and toxic for reproduction (CMR) chemicals g2,3 Substitution of persistent, bioaccumulative and toxic (PBT) chemicals
	g3 Increase economic value and strengthen chemicals management	g3,2 Optimise handling / storage / logistics
12.5.1 National recycling rate, tons of material recycled	g1 Increase overall resource efficiency	g1,1 Use less energy g1,2 Use less raw and auxiliary materials g1,3 Use less water g1,4 Produce less waste / wastewater
	g3 Increase economic value and strengthen chemicals management	g3,1 Increase output with desired properties g3,2 Optimise handling / storage / logistics
	g4 Increase sustainability in surrounding systems	g4,1 Use less fossil resources g4,3 Promote recycling / use in cascades

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9.5.2 EXAMPLE: SDGS IN PERU

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What role do you think innovative business models in general play in regard to SDGs? In particular, how does Chemical Leasing contribute to the achievement of SDGs?

Innovative business models are established in order to generate value for organisations putting into practice new development paradigms (e.g. circular economy, green growth, etc.). In this context, innovative business models also offer new employment and entrepreneurship opportunities for people, either directly or through the value chains of companies such as suppliers. The achievement of SDGs requires new development approaches, which are frequently based on innovative business models.

Chemical Leasing is very well aligned to circular economy principles and other modern sustainability concepts. It is an innovative service-oriented business model that changes the focus of how chemicals are offered and used, and thus achieving an increase in environmental performance and profitability. Since chemicals are present in our everyday lives, the impact of Chemical Leasing solutions are highly relevant for our societies and for SDGs.

Is Peruvian society open enough to the application of innovative business models? What can help them to accept and apply changes in a business paradigm?

Peru has been one of the fastest growing economies in the region during the last decade, with an average growth rate of 5.9 percent and low inflation (with an average of 2.9 percent). In this context, there is a growing consensus in Peru that innovation is an imperative to achieve competitiveness and growth on a global scale. Despite the dissemination of innovative business models in Peru, there is still much to do to scale up new business paradigms.

Inertia and business-as-usual approaches are some of the main factors limiting wider dissemination of innovative business models. Inertia is not only an attribute of the private sector, it also is present in the public sector. Even though there are frequent changes in the political sphere, these changes are not accompanied by deep structural changes in public policies. So the introduction of new development paradigms in public policies is a current challenge.

The awareness of consumers and society in general on topics like environmental sustainability and social inclusion are powerful driving forces for profound changes in consumption and production patterns. Financial and technical support is certainly needed from the government, as is access to information for companies, if we are to see an acceleration in the implementation of innovative business models, especially by small and medium-sized enterprises.

What would be the strongest incentive to start the transformation towards sustainable business models, such as Chemical Leasing, in Peru?

There is a need for coherent product-policies based on incentives in order to scale up innovative sustainable business models such as Chemical Leasing. Additionally, pertinent information to consumers and civil society organisations is required to increase general awareness on chemicals. Corporations involved in sustainable business models have a large capacity to influence value chains at different levels. Therefore, sustainable business models should be promoted with a life cycle thinking.

What is the level of awareness in Peruvian society about innovative business models and sustainable business practices? And what is the perspective for the next five years?

According to a study prepared by KPMG, 40 percent of the world's leading companies recognise the sustainable development goals within their global reports. In Peru, companies are opting for different business models that will generate greater resources in the next five years, such as education and environmental information, awareness raising to companies, society and diverse communities about how sustainability impacts on projects, business and current organisations; mitigation and adaptation to climate change; renewable energies, sustainable construction; water treatment; sustainable leisure; industrial ecology, an area of engineering that considers the industrial system as an ecosystem, where the elements are recycled and each component is connected to everything else.

These new business models are looking to change the mind-set of Peruvian businessmen by letting them know about new businesses that help the environment and reduce the carbon footprint, and develop strategies to adapt to sustainable development objectives, investing in clean technologies. Therefore, CEOs and high-level executives from big companies are key actors in sustainable development processes.

In Peru, the trend is to improve the general environmental and social performance and reduce infrastructure gaps due to international commitments, social awareness and some markets requirements (e.g. food exporters to USA and EU). In this sense, innovative business models will have big opportunities in Peru.

PETRA SCHWAGER *is the Coordinator of UNIDO's Global Chemical Leasing Programme (2004-2020). She is also an active promoter of women empowerment and gender parity in UNIDO projects and beyond. She is a frequent speaker at different conferences sharing her experiences and promoting success stories of projects and innovative initiatives where women are at the forefront. She is a member of the Alumnae Community "Leadership, women and the UN" and author of articles on sustainable business models, gender and circular economy.*

Picture 14. ***Inclusiveness of the Global Award***

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9.6 INCLUSIVENESS AND WOMEN EMPOWERMENT IN CHEMICAL LEASING

Encouraging partnerships with different stakeholders and providing new opportunities for women economic engagement - towards sustainable industrial development

Petra Schwager

Chief, Energy Technologies and Industrial Applications Division, UNIDO

Inclusiveness and gender parity are in the focus of numerous research agendas and strategies initiated by international organizations, governments, UN agencies and the global experts' community. Sustainable Development Goal (SDG) 5 is entirely devoted to gender equality and women empowerment is an essential cross-cutting element of Inclusive and Sustainable Industrial Development (ISID) reflected in SDG 9. Furthermore, the importance of gender parity and the active participation of women in the economy are becoming even more evident in times of the global crisis.

Here is an interview with Petra Schwager.

I see that you regularly speak about inclusiveness, which does not imply gender equality only. Why do you give so much importance to the inclusive development and implementation of your projects?

As a UN manager, I work on daily basis with different stakeholders around the globe. I see the advantage of multicultural collaboration and of teams that include members of diverse backgrounds, competences, different ages and gender.

When I speak about inclusiveness, I refer to providing equal access to opportunities and resources for many different types of people, treating them all fairly and equally. We aim for sustainability and sustainable development needs to be inclusive. All my projects, be it on energy, resource efficiency, Chemical Leasing, eco-industrial parks, all support multi-dimensional inclusiveness, they create value and benefits on different levels and for divers stakeholders. This is important.

Another key aspect: If we want to create something innovative and act as forerunners, we need to move out of our comfort zone and leave "business as usual" behind. In Chemical Leasing, we often work with young people and students from different backgrounds and join hands with dynamic and divers enterprises. At the same time, we are aware of the importance of cooperating with

experienced and older specialists who have in-depth knowledge and who can share their knowhow and mentor young experts.

Moreover, inclusive and sustainable industrial development needs the dynamic engagement and participation of women in order to harness the full potential of both gender. More than ever, the encouragement and active support of women on their "way-up" need to be considered, better to say, reconsidered stronger. To sum it up, all generations, women and men from different backgrounds and cultures need to work together to find new ways to make society and industry more inclusive. This will contribute to bring forward the so much needed transformation and trigger innovation at all levels.

Could you please give a few examples on how "Inclusiveness" is being applied to UNIDO's Global Chemical Leasing Programme?

When I started the Chemical Leasing Programme, right from the beginning, it was clear to me that we need to create a diverse and inclusive network to be successful. I also placed specific importance on gender issues and on encouraging the active participation of women in our projects. Already in the development of the UNIDO definition of Chemical Leasing, we cooperated with divers partners from industry, government, academia and experts of developing and industrialized countries. In the practical application of the model in companies of different sizes, sectors and countries. we have a long-standing cooperation with the National Cleaner Production Centres and their local experts. Recently, we also have signed a cooperation agreement with the members of the international student network ENACTUS who collaborate with a wide range of different companies and communities to jointly develop sustainable solutions and projects. We count that this cooperation will generate many new cases and innovative ideas for Chemical Leasing mainstreaming. In addition, several universities have already developed curriculum where Chemical Leasing is a core feature (e.g. in Ukraine and Brazil).

You have launched the Chemical Leasing Award 2021. Is it also inclusive and gender-friendly?

Yes, it is. Our Award jury recognized the important role of women in the promotion of Chemical Leasing and launched a special award category for women-led initiatives. This category is co-sponsored by the European Association of Chemical Distributors (FECC). Furthermore, we created a specific award for start-ups with the aim to support young entrepreneurs around the globe in their endeavour to initiate a Chemical Leasing business. As already mentioned, we have an excellent partnership with ENACTUS and aim to encourage many students, especially from developing countries, to present their ideas and initiatives in the different categories of the Award 2021.

Chemical Leasing is often referred to as a circular economy business model, do you see any particular chances that the circular economy transition creates for women?

Let me just mention a few opportunities that circular economy offers.

Transition to circular economy demands cross-cutting competences, such as problem solving and good communication. In addition, there is an increasing demand for soft skills to enable adequate customer relations and convene partnerships with all relevant stakeholder. Particularly, these skills are of great importance in successful application and promotion of innovative and performance-based business models. Women and, of course, also men who have such skills, have a better chance to discover new job opportunities. From my experience, the female experts that are involved in Chemical Leasing consultancies often demonstrate these competences.

Then I would like to mention digitalization. It is driving the circular economic growth and the increasing application of Chemical Leasing in industry. In addition, digital platforms enable women to study and work from home and have free access to a great amount of studies. High-quality online trainings lead to a higher number of people educated in sustainable chemicals management and circular economy business models, such as Chemical Leasing. Social skills complemented with higher education and advanced digital literacy are essential for future managers and consultants, also in the chemical business. And, I believe that women could and should take this opportunity!

Can you please tell more about your experience with women empowerment in a framework of the Chemical Leasing Programme? And what are the benefits for women from being involved in Chemical Leasing activities?

In developing and mainstreaming Chemical Leasing around the globe, UNIDO together with its partners, is constantly striving to provide equal opportunities for women and men to participate in consulting and training activities and specifically encourages women to take part

in pilot industrial projects. Our experience shows that women, in research, academia and consultancy are very interested in this new model. In some countries, like Brazil, Colombia, El Salvador, Peru, Serbia, Sri Lanka and Ukraine, women engineers have even taken the lead in disseminating the business concept and introducing it at the business and policy levels. Usually, women are very active participants in UNIDO's webinars and training, representing between **40 to 60 percent** of all attendees and depending on the region.

Both, Chemical Leasing training and on-site work, create a very good platform for professional networking and career development. These can help female and male consultants/engineers to gain additional skills and experiences, allowing them to specialise in a new area. The work on the business model triggers interesting synergies with other environmental approaches and concepts. At the same time, it can be an excellent asset for women who try to differentiate themselves from other experts working on environmental management topics.

What is the impact of Chemical Leasing to communities and women, that are not directly involved in your programme?

Since the Chemical Leasing model is based on the principle of creating not only economic but also environmental and social benefits, it has a significant impact on women. Many sectors of industry involve a female labour force; for example, in a number of countries and companies, women traditionally work in cleaning or laundry operations. Chemical Leasing projects can considerably improve health and safety conditions in the cleaning area and contribute to the well-being of women and consequently their children. Last but not least: fewer risks and less negative impacts on the environment make the life of local communities, including women, more sustainable.

WOMEN AT THE FOREFRONT

Women around the globe have significantly contributed to the dissemination and application of Chemical Leasing to industry. Below are a few statements of female experts that work at the forefront of the UNIDO Chemical Leasing Programme:

"I learned more about processes and also how to convince people to open their minds to a new approach."

Vojislavka Satric
International expert on Chemical Leasing and sustainable chemical management from Serbia, who in 2012 and 2014 received Gold in the Global Chemical Leasing Award for "Consulting services" and in 2012 Silver for "Public Relations"

"Chemical Leasing is one of my key consulting services today. It is still a very innovative and not well known concept in Brazil and its industry consulting market. It became my advantage and an important element of my business portfolio. Training and technical assistance on Chemical Leasing are areas where I work today and earn money."

Ana Oestereich
Consultant on eco-efficiency, circular economy and Chemical Leasing, who received Silver award for "Public Relations" activities in 2014

"An engagement with Chemical Leasing has helped me to position myself on the market as an international expert on the innovative and sustainable business model."

Lakmini Edirisinghe
Chemical Leasing expert from the National Cleaner Production Centre of Sri Lanka. She and her colleagues were recognized with Bronze in 2014 for the work in consulting and PR activities

"The model and its paradigm shift can inspire women-entrepreneurs in my country to start something new and innovative and to do their businesses in a different way."

Doaa Tawfik
Cleaner production and resource efficiency specialist from the National Cleaner Production Centre of Egypt

"Women who have been trained and work on Chemical Leasing can demonstrate advanced skills in research and development, in managerial and technical areas so that they have good chances to be promoted."

Paula Hoyos Cadavid
Expert in sustainable chemical management and Chemical Leasing from Colombia

Dorothee Arns

Director General, the European Association of Chemical Distributors (FECC)

In this changing world we are living in, do you feel that there are new trends and driving forces in the industry, in particular in the chemicals sector, which open up new opportunities for women? Do you see the potential for women to be more engaged in chemical operations? What are supporting and what are hindering factors?

> **We can only embrace the diversity in the markets and anticipate the trends properly if our industry reflects in-house the diversity out there in the world.**
>
> **Dorothee Arns**

Indeed, business conditions are changing more quickly than ever before. Our societies including our industry and its customers are becoming more and more diverse. We can only embrace the diversity in the markets and anticipate the trends properly if our industry reflects in-house the diversity out there in the world. Additionally, all independent studies have proved the business case for diversity: diverse teams simply perform better. So, in this sense there is a big opportunity for women in the chemical industry.

Nevertheless, our industry still comes across far too often as male-dominated. It has improved over the past decade, but there is still much to do, especially when we think of the low numbers of women in top management positions. This can only be achieved by having female role models and flexible, family-friendly working arrangements for women and men alike so that they can share private and professional obligations in a fair way. Digitalisation will certainly help in this respect.

What proves to be a frequent obstacle for promoting women to leadership roles is that women are more focused on getting the job done at the expense of building up and retaining networks. Additionally, there is a traditional tendency in our industry (and others too, by the way) of promoting men on the basis of their potential, while women are promoted on the basis of their achievements and their performance in previous positions.

This has nothing to do with bad intentions, but with unconscious bias.

Experts say that, as a result of technological progress the industry in the near future will require more and more specific skills — "a combination of technological know-how, problem-solving, and critical thinking as well as soft skills such as perseverance, collaboration, creativity and empathy". Do you agree with this? Will it be also the case in the chemicals sector? In this regard, do you think that there could be a greater demand for female employees, and women could get more chances for professional development?

Yes, I agree with this assessment. Our societal challenges have become so complex – just think of the circular economy, marine litter, or recycling – that one sector alone cannot solve them anymore. Indeed, what we need is innovation in all aspects, from new technologies, new designs to new business processes, new concepts on how to deal with products at their end of the life cycle and with waste. This can only be achieved by open-mindedness, drive for achievement, problem-solving skills, the willingness to learn from others and to collaborate across traditional communities and across all sectors.

These skills are also key for Chemical Leasing and other performance-based concepts: the supplier must be open to such business models, understand how the customers "tick" and which technology they are applying. In this respect, out-of-the-box thinking is also needed, because all this means a paradigm shift.

Is this gender-specific? Personally, I think it is more a question of personality and mentality, less of gender and of age.

How can performance (service)-oriented business models in general, and Chemical Leasing in particular, benefit from the higher engagement of women in the industry? And vice-versa, how could women potentially benefit from the wider implementation of performance (service)-oriented business models?

What we are seeing already now is a much stronger trend towards diversification in the chemical industry than ever before, starting with a whole series of highly diverse chemical raw materials up to final applications. This trend will for sure continue.

Consequently, the jobs and their profiles in this industry will also change and further diversify, accelerated by digitalisation, which implies emerging new job profiles for people who have these specific skills, regardless of whether they are men or women.

In your current position, do you have an opportunity to discuss the gender issue and encourage the self-realisation of women in the chemical industry? Do you see the importance in such activities and why?

Yes, this topic has always been close to my heart, and the fact that I have the opportunity to actively contribute to it at the interface between the economy and politics is definitely one aspect of my role in Brussels which I enjoy the most. For example, in 2018 I had the pleasure and the honour of representing the chemical industry in a workshop of the European Parliament with senior leaders of the EU Commission, the Parliament, the Council, the Austrian EU-Presidency and the International Labour Organization. It was great to exchange views, combine the expertise from different angles and see that the room was absolutely packed with interested women AND men. In my private time, I am mentoring young women from every corner of the globe in their first professional years, and if I can help them it really makes my day.

9.7 CHEMICAL LEASING AND INTERNATIONAL CHEMICAL POLICIES AND INITIATIVES

Chemical Leasing can be used as a modern policy instrument for the sustainable management of chemicals. The business model fits into a wide menu of international and national initiatives and obligations and can help policy- and decision-makers bring fresh momentum to chemical management and sustainable production.

Chemical Leasing has a wide range of applications. It can help companies meet the targets of public sector programmes, as well as respond to mechanisms and initiatives for the responsible management of chemicals. It can be applied to local projects as well as to regional initiatives such as those related to the EU Regulation REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals).

With its potential for reducing costs, waste and worker exposure, Chemical Leasing is fully in line with the Strategic Approach to International Chemicals Management (SAICM) and is aligned with initiatives such as Resource-Efficiency and Cleaner Production, Green Industry, Sustainable Chemistry and Responsible Care. Chemical Leasing also shares the goals of the global chemical conventions such as the Stockholm, Basel and Rotterdam conventions.

It is also evident that there is a close connection of Chemical Leasing to the Circular Economy approach. Implementing Chemical Leasing strengthens the cooperation of different actors along the supply chain, thus fostering exchange of know-how, life cycle data, and zero-waste thinking. Chemical Leasing encourages the reuse and recycling of chemicals and the installation of closed loop systems.

From a business perspective, Chemical Leasing fully fits in with voluntary sustainability reporting tools and management systems. Chemical Leasing can help companies meet legal requirements relating to, for example, substance control, environmental permits, and occupational health and safety requirements. Applying Chemical Leasing can be a way of limiting the use of harmful chemicals to specific trained and knowledgeable operators who can be monitored closely.

Below, is an overview of binding and non-binding agreements and conventions and their linkages with Chemical Leasing.

9.7.1 BINDING INTERNATIONAL AGREEMENTS AND CONVENTIONS

To ensure a control of chemicals, many initiatives by governments as well as from industry have been launched over the last decades. National governments and the EU have put in place strict regulations for consumer and environmental protection, as well as occupational health. Regulations govern chemical processes as well as the transport and management of chemical substances. At an international level, the industry is also subject to a number of programmes and conventions.

Chemical Leasing builds a business case for ensuring that chemicals are managed throughout their life cycle with a minimum of waste or "zero waste". The approach mirrors the chemical conventions' objectives of protecting human health and the environment from toxic chemicals. Chemical Leasing is wider in scope than the conventions, in that it can be applied to hazardous and non-hazardous chemicals and not only to those which are most harmful.

Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal is the most comprehensive global environmental agreement on hazardous and other wastes. It aims at protecting human health and the environment against any adverse effects resulting from the generation, management, transboundary movements and disposal of waste which are hazardous (based on their origin and/or composition) as well as other wastes (e.g., household waste and incinerator ash). (UNEP, 2010). Environmentally Sound Management (ESM) is a central focus of the Convention and is addressed primarily through an integrated life cycle approach.

Waste prevention and environmentally sound management of wastes are an inherent part of the Chemical Leasing concept. In Chemical Leasing business cases, the chemical supplier not only advises on efficient use of chemicals but can also take care of the chemical waste, recycling and/or final treatment.

Rotterdam Convention

The Rotterdam Convention on the Prior Informed Consent for Certain Hazardous Chemicals and Pesticides in International Trade is a multilateral agreement that promotes shared responsibilities in the international trade of certain hazardous chemicals and contributes to the environmentally sound use of those chemicals, by facilitating exchange of information about their characteristics (UNEP and FAO, 2008). It covers pesticides and

industrial chemicals that have been banned or severely restricted for health or environmental reasons in the country of origin.

Chemical Leasing can be used as a business model to find new means of making the use of certain chemicals safer. The pilot projects with agricultural chemicals (pesticides and fertilizers) in Sri Lanka and Serbia indicate that the business model can significantly contribute to a reduction of chemicals used.

Stockholm Convention

The Stockholm Convention on Persistent Organic Pollutants is the most significant global legally binding instrument for targeting Persistent Organic Pollutants (POPs), to protect human health and the environment. POPs are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or on the environment. In implementing the Convention, governments have to take measures to eliminate or at least reduce the release of POPs – especially the "Dirty Dozen", the twelve worst ones - into the environment.

Although Chemical Leasing does not focus solely on POPs, many of its objectives are in line with the Stockholm Convention. Chemical Leasing aims to help companies reduce the use and/or release of harmful chemicals by linking the reduction in chemical footprint to financial incentives. There is also a potential to apply Chemical Leasing as a vehicle for the substitution of POPs and for bringing alternatives to the market.

Chemical Leasing can provide a business model to support the use of best available techniques and best environmental practices (BAT/BEP), so that the use of POPs is managed in an environmentally sound manner. This gives greater control over how POPs are managed throughout their life cycle, and the service company can be monitored closely and required to ensure that closed systems are used. As Chemical Leasing is a service-oriented business model, it can also:

- stimulate the innovation of alternative technical solutions
- ensure that any stockpiles of waste material containing or contaminated with POPs are managed safely

REACH

The European Union (EU) adopted the Regulation REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) in 2006 to improve the protection of human health and the environment from the risks that can be posed by chemicals, while enhancing the competitiveness of the EU chemical industry. REACH also promotes alternative methods for hazard assessment of substances in order to reduce animal testing. In principle, REACH applies to all chemical substances, not only those used in industrial processes but also those that are present in our everyday lives, for example in cleaning products, paints, clothing, furniture and electrical appliances. The regulation therefore impacts most companies across the EU.

REACH places the burden of proof on companies. To comply with the regulation, companies must identify and manage the risks linked to the substances they manufacture and market in the EU. They have to demonstrate how the substances can be used safely, and they must communicate risk management measures to the users.

Chemical Leasing and REACH share the same philosophy of sharing the costs, benefits, responsibility and know-how between chemical suppliers and users. Like REACH, Chemical Leasing is relevant to a wide range of companies across many sectors, including manufacturers, importers, exporters and downstream users.

Chemical Leasing further secures compliance with the obligation or duty to handle chemicals with care. This implies that chemicals and their applications are not only monitored but also managed with maximum accuracy. Chemical Leasing is also an effective tool for demonstrating adequate control, as specific parameters must be satisfied in order to obtain REACH authorization. Adequate control is an inherent principle of service-oriented business models.

Chemical Leasing offers an ideal environment for identifying and applying the chemical safety concepts and assessments of use, exposure and risk, in particular within the chemical safety report REACH requires companies to provide. The specification of relevant use and exposure categories under REACH and the required risk management can build upon the assessments already performed during the implementation of Chemical Leasing.

Application of Chemical Leasing business models implies measures for monitoring the quality and condition of chemicals, their applications, and the impact on health and the environment. Identical measures are required by REACH.

Moreover, Chemical Leasing has the potential for substituting the most hazardous substances with less dangerous ones.

Similar links can be made to analogous national regulations, laws and programmes that are in force or under development, such as the U.S. Toxics Release Inventory and Toxic Chemical Substance Inventory, the Chinese and Turkish "REACH", the Japanese Chemical Substances Control Law, the Korean Toxic Chemicals Control Act, and comparable chemical laws and regulations in other countries.

9.7.2 NON-BINDING INTERNATIONAL INITIATIVES

There are also a number of international initiatives which are supported by governments and stakeholders but are not legally binding and cannot therefore be enforced. Their implementation relies on the commitment of concerned stakeholders, such as industry, political representatives, national and international organizations, and scientific organizations.

A variety of non-binding international initiatives exist that affect the chemical sector and that aim at a more sustainable production and use of chemicals. These include SAICM, Resource Efficient and Cleaner Production (RECP), Green Industry, Responsible Care, Green and Sustainable Chemistry and Circular Economy.

Chemical Leasing is a means of supporting such international initiatives, as outlined below.

SAICM

The Strategic Approach to International Chemical Management (SAICM) was adopted in 2006 by the International Conference on Chemicals Management (ICCM) to foster the sound management of chemicals around the world. SAICM provides a framework for efforts to achieve the 2020 goal set out in the Johannesburg Plan of Implementation. By then, SAICM aims to ensure that chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment. SAICM is supported by the Inter-Organization Programme for the Sound Management of Chemicals (IOMC), established in 1995 and now consisting of nine international organizations involved in chemical safety. A major focus of the IOMC today is to support countries in their efforts to implement SAICM.

Under SAICM, the following "emerging policy issues" that require cooperative action have been identified: lead in paint, chemicals in products, hazardous substance within the life cycle of electrical and electronic products, nanotechnology and manufactured nanomaterials, endocrine-disrupting chemicals, and perfluorinated chemicals and the transition to safer alternatives.

SAICM's Overarching Policy Strategy sets out five key objectives:

1. Risk reduction: to assess and manage risks, addressing product lifecycles, implementing risk reduction measures including scientific methods, safer alternatives, affordable sustainable techniques to prevent the adverse effects of chemicals on human health and the environment.

2. Knowledge and Information: to facilitate informed decision-making through improved access to, and understanding of, technical information relating to hazards, risks and impacts.

3. Governance: to pursue the sound management of chemicals through multi-sector and multi-stakeholder approaches, creating enabling conditions and strengthening enforcement and implementation of national, regional and international agreements, and promoting codes of conduct based on environmental and social responsibility.

4. Capacity-building and technical cooperation: to increase the capacity for sound management of chemicals in all countries as needed, especially in developing countries and countries with economies in transition, including through partnerships and mechanisms that promote technical cooperation and the take up of appropriate and clean techniques.

5. Illegal international traffic: to promote cooperation and information sharing, to strengthen capacity at national, regional and international levels for the prevention and control of illegal international traffic of banned or restricted chemicals mixtures and compounds and wastes.

SAICM is a well-established mechanism that holds the potential to kick-start Chemical Leasing projects. SAICM presents the opportunity to promote innovative projects that encourage the development of business cases for sustainable and green chemistry. Chemical Leasing can be applied in all areas identified by SAICM, as it is applicable across all industrial sectors. The only requirement is that the chemicals targeted in SAICM projects can be defined or "quantified" by means of a unit of payment rather than by their quantity. If this is the case, Chemical Leasing can support SAICM implementation.

Sustainable Consumption and Production (SCP)

The key objective of Sustainable Consumption and Production is to generate economic growth and welfare without depleting resources or degrading the environment. SCP must involve life cycle thinking about improving overall environmental performance. In addition, consumers need to make informed choices and create the demand for sustainable products.

Chemical Leasing supports SCP in several ways: production processes are optimized with the support of the supplier, and fewer chemicals are consumed.

Resource Efficient and Cleaner Production (RECP)

Environmental protection in enterprises has been undergoing structural changes in recent years. The emphasis is shifting to preventive techniques that focus on the production processes themselves. RECP covers the application of preventive management strategies that increase the efficiency of the use of natural resources, minimize generation of waste and emissions, and foster safe

and responsible production. Not only does this reduce the pollution load on the environment but it also makes good business sense.

The RECP Network established by UNIDO and UNEP supports all three pillars of sustainability by aiming at increased resource efficiency and risk reduction for humans and the environment. It also contributes to solving some of today's global challenges, such as climate change, resource scarcity, decent jobs, and environmental degradation.

Chemical Leasing is based on the preventive idea of RECP. It contributes significantly to resource efficiency by:

- optimizing the use of chemicals in production processes, which reduces the overall amount of chemicals needed, and
- reducing the energy required to produce chemical substances

Green Industry

Green Industry combines the ideas of industrial development and growth with sustainability and environmental protection. UNIDO's Green Industry Initiative and Green Industry Platform support developing countries in their efforts towards Green Industry by capacity building and awareness raising.

By contributing to both economic viability and environmental protection, Chemical Leasing contributes importantly to the development of a green chemical industry. In addition, the service aspect of Chemical Leasing underpins its potential to generate jobs, because services are people-driven and enhanced by the exchange of know-how.

Responsible Production (RP)

Responsible Production, an approach developed by UNEP, focuses on the prevention of accidents associated with chemicals in small and medium-sized enterprises (SMEs). In a systematic five-step approach, accident risks are identified and assessed, and risk reduction measures are suggested and implemented. Stakeholders such as chemical suppliers, equipment manufacturers, insurance companies, and local authorities are involved in the entire process. Experience has shown that chemicals handling is a major problem in SMEs, and that risk reduction measures often help to reduce chemical consumption. This approach corresponds to the objectives of Chemical Leasing.

The documentation of results obtained in RP and Chemical Leasing projects should be mutually supportive, as Chemical Leasing documentation may address improvements related to safety while RP documentation may address improvements that reduce the consumption of chemicals. The Chemical Leasing sustainability criteria might also be used for RP in an adapted version.

Responsible Care and Global Product Strategy

Responsible Care and the Global Product Strategy (GPS), two initiatives launched by the chemical industry, aim at enhancing the safe use of chemicals at company level. Both initiatives include elements such as worker training and equipment maintenance that are crucial for successful Chemical Leasing projects.

Although Chemical Leasing, as a preventive, service-based business model, goes beyond these industry initiatives, it is evident that a successful Chemical Leasing project also fulfils Responsible Care and GPS requirements, and that synergies in both directions are possible. Moreover, it is clearly in the industry's interest to support Chemical Leasing along with Responsible Care and GPS, as the implementation of Chemical Leasing projects and sustainability criteria can raise the visibility of the industry initiatives, highlight companies' commitment to the safe management of chemicals, and pave the way for future Chemical Leasing projects.

Green Chemistry

Green Chemistry has been an emerging area of sustainable design since its introduction in the 1990s. It is a concept that seeks to reduce and eliminate hazardous chemical substances through the improved design of chemical products and processes. The 12 Principles of Green Chemistry provide a framework for developing green chemicals, processes, and products. These principles are accompanied by the 12 Principles of Green Engineering. Implementing these two sets of principles will enable the chemical industry to become more sustainable from an economic, environmental, and social perspective (source).

Chemical Leasing addresses several of these principles, such as waste prevention and the use of less hazardous chemicals due to process optimisation and the coupled reduction in chemical quantities. The integration of innovative business models such as Chemical Leasing into green chemistry projects can help overcome barriers to the promotion of the green chemistry concept.

Sustainable Chemistry

Sustainable Chemistry contributes to improving resource efficiency and minimising risk in the chemical industry, and it aims at an environmentally friendly production and use of chemicals. This includes, for example, preventing pollution and waste, considering the entire life

> Chemical Leasing and Green Chemistry work hand in hand. Chemical Leasing tries to get maximum performance and maximum function from the chemical process. Applying this business model increases efficiency, increases effectiveness and reduces waste. For its part, Green Chemistry is looking at the fundamental molecular science of the inherent nature of chemicals and the way chemicals are transformed into useful products. These two things are working together, are harmonious, are synergistic and make a continuum from the fundamental molecular science all the way through to the business models, the business frameworks.
>
> *Paul Anastas, Director, Center for Green Chemistry and Green Engineering, Yale University*

cycle of a product, or enhancing a product's recyclability and durability. It "encompasses the design, manufacture and use of efficient, effective, safe and more environmentally sound chemical products and processes" (source).

Thus, sustainable chemistry is essential for long-term sustainable development: it respects the need to improve the quality of human life within the carrying capacity of the world.

Chemical Leasing enables companies to engage in sustainable chemistry and to improve resource and energy efficiency, reduce waste, decrease risks caused by hazardous chemicals and lessen the negative environmental impacts of their processes. In addition, Chemical Leasing increases the competitiveness and profitability of the business partners.

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Chemical Leasing can serve as an instrument for moving towards Sustainable Chemistry. The long record of successful Chemical Leasing case studies worldwide provides an excellent basis for including Chemical Leasing more prominently in the concept of Sustainable Chemistry.

Circular Economy

Circular Economy aims to reduce the overall use of virgin materials by economies through the adoption of five strategies: improving the efficiency with which materials are used, extending the amount of time products are in use, using products more intensively during use, substituting service and software solutions for physical products, and recycling the materials contained in products at the end of their useful lives.

Chemical Leasing supports the implementation of circular economies by ensuring that chemical products are used more efficiently by industry (and other sectors such as the hospitality and agricultural sectors where the business model has been successfully used) and by allowing for a more efficient and effective recycling of chemical products once they are spent.

Chemical Leasing also supports circular economy implementation in a more indirect way. The experience which has been gained through Chemical Leasing in successfully creating contracts regulating the delivery of chemical services can be usefully applied in the design of similar contracts for other materials. It is believed that such contracts will play an important role in the adoption of circular economies.

Sustainable Chemistry and Circular Economy will both be important initiatives to help in the spread of Chemical Leasing in the future. Individual articles are dedicated to these topics in this book (see Circular economy; Sustainable Chemistry).

9.8 ENTROPY, EPIGENETICS, EFFICIENCY - PILLARS FOR A "QUALITY-BASED" CHEMICALS POLICY VISION BEYOND 2020

Thomas Jakl

Deputy Director-General, the Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK), Austria

Fascinating achievements will be delivered by researchers and companies in the near future as part of "green/sustainable chemistry" initiatives. As we will are confronted with the undeniable benefits being delivered by new substances and new pathways in chemical synthesis, as well as by new technologies in general, questions might arise as to whether current indicators are capable of adequately describing this kind of progress. The future challenge in evaluating substances and processes will be to also address qualitative aspects. Aspects such as "conservation of molecular structures throughout a synthetic process" or the sheer "renewability of raw materials" are as hard to address as the fact that "dissipation of materials" is to be minimised as a precondition for resource efficiency. These are not core elements of a future "sustainable" chemistry alone; these essential preconditions for a true "circular economy".

However, they are difficult to describe with the current toolbox of indicators. Here, entropy opens up a window on the essence of sustainability. Looking at the development of entropy when evaluating processes and products sharpens the eye in a way that cannot be achieved by conventional evaluation approaches. Although these conventional approaches enable us to elucidate effects in the form of material flows or energy balances and to make the results consistent with economic values through a monetarisation of the effects, there is a limit to what they can do when it comes to the evaluation of qualitative aspects or of the basic principle or direction of a process.

Entropy – essential for judging qualitative aspects within cost/benefit analysis

Loss of species diversity, of consolidation and controllability of material flows, of degrees of freedom when energy is used, of "grown" structures …all these aspects, which include crucial, critical problems for the development of civil society, can be described and outlined more clearly by using the concept of entropy, thus also informing and improving the current cost/benefit analysis methodology.

To arrive at a clear and specific description, entropy must be used in a way that is both expedient and consistent with its original meaning. We should not make the common mistake of reducing the meaning of entropy to some sort of disorder, which would be far too limited in scope. It becomes clear, then, that the concept of entropy provides an important additional benefit, in that it leads us to the essence of the evaluation of processes and products, if such an evaluation is to be primarily concerned with the suitability of these processes and products for an economic system which is to be viable in the long term. In trying to identify what all the approaches into which entropy has found its way have in common, we find that the increase in entropy always describes a loss – a loss of useful energy, a loss of structure, a loss of information – and, ultimately, a loss of quality. With respect to the main feature of a circular economy, Alexandre Lemile (2019) states that: "following this approach, we must move away from activities that devalue the material, such as recycling, or even destroy it by incineration, and instead invest in those activities that preserve it: reuse and remanufacture. These are especially important since they create many more secure jobs." R. Le Moigne and J. Iles (2019) spell out another approach for describing circularity in chemicals management as a means of keeping the quality level high and thus minimising entropy: "Companies could adopt new chemical usage strategies by circulating the molecules tied up in chemicals that have reached the end of their life span, and reuse chemicals more than once. This would result in capturing the value of those chemicals, while reducing their environmental impact."

While being useful and meaningful, the concept of entropy is difficult to grasp and not easy to communicate. A two-step approach is recommended: First, experience gained from different approaches should be used to provide the basis for further procedures – an approach based on scientific findings should be developed. Secondly, this approach should be used as a basis for applying entropy as an indicator that can be grasped intuitively. The ISC3 (International Sustainable Collaborative Centre) in Bonn, Germany, is currently dedicating its efforts to achieve progress in that regard.

Epigenetics – understanding communication between chemicals and the biota

When it comes to quality aspects, the classical paradigm of toxicology cannot be upheld either. "How" and "when" external factors interact with biological systems will determine the way we will judge them in the future. The field of epigenetics is redefining the biological understanding of feedbacks between living organisms and their environment. External factors – such as chemicals – are altering the way genetic information enshrined in DNA is (de-)activated and transformed without changing the genetic code itself. These activity patterns

might be readily reversible, or they might, on the other hand, be passed on to subsequent generations.

Epigenetic changes are implicated in serious adverse health effects, including cancer, endocrine disruption, and other diseases. A number of effects related to epigenetic regulation are considered specifically relevant for risk assessment – in particular:

1. Effects elicited by substances that directly impact on components of systems regulating epigenesis, e.g. the cellular methylation, and thus may induce changes in regulatory pathways.

2. Epigenetic modes of action of known hazardous agents (e.g. endocrine disruptors, carcinogens), specifically those leading to irreversible alterations of epigenetic regulation.

3. Transgenerational effects associated with modifications of epigenetic regulation.

Epigenetic effects may differ in relevant characteristics from other effects or adverse outcome pathways currently considered in risk assessments. The time lapse between exposure and adverse outcomes, for example, may differ significantly from "classical" toxic effects when epigenetic mechanisms are implicated. This will require sufficient knowledge about the pathways involved in epigenetic regulation, the study of the association between disruption of endocrine/epigenetic systems, and adverse outcome pathways relevant for (regulatory) risk assessment, as well as determination whether the effects of environmental stressors on epigenetic pathways are larger than physiological variability. It is just a matter of time until risk assessment methodologies will have to take into account this new language between the living world and its surroundings.

Selling services instead of barrels – Resource Efficiency has to become part of chemicals policy

Finally, quality-aspects will also increasingly shape the way we are looking at the application of chemicals. The focus for chemicals management will be widened from assessing hazards and risks towards the monitoring and continuous optimisation of application and use, thus also addressing resource efficiency as a goal for future chemicals policy. In short, we are developing from "using the right chemicals" to "using chemicals right." This is where performance-based concepts such as "Chemical Leasing" come in, as the only business model that makes it an economically driven goal for the manufacturer or producer to use less. When the manufacturer of a chemical is paid for the chemical's performance rather than for its quantity, it will be in their interest to achieve this goal (i.e. performance) with as little as possible. R. Le Moigne and J. Iles are getting to this point when they say, "perhaps the best way to manage chemicals would be to pay per function provided, rather than per quantity consumed."

If the manufacturer is paid per unit (meters of cleaned pipes; square meters of covered surface, working hours of plant maintained), it will be in the manufacturer's prime economic interest that the product is used as efficiently as possible. Thus, there are many aspects that point in the same direction. The "circular economy" discussion, too, is a "secret code" for improved resource efficiency. The future for chemical products within a circular economy belongs to applications embedded in new service-oriented business models such as "Chemical Leasing". Once again, Alex Lemille expresses it with great clarity: "The vision is about addressing the needs of your customers, shifting from a product to a service-based model, lowering your production costs thanks to the re-use of or ease of remanufacture of a product sold or leased with the guarantee that it will be returned at some point to your plant to be prepared for its next economic life.". Along the same lines, the world's leading consulting companies, law firms and applied researchers share the same conclusion: In a circular economy the traditional paradigm "Producers are selling, and users are applying" will not prevail. Among all these voices I pick out a recent report by Deloitte (Dickson et al): "The key long-term development concerns sustainability and the circular economy. Chemical companies can be part of the solution here by not only helping to solve sustainability challenges faced by end-use industries but also by capturing new opportunities. Apart from investing in new technologies and developing new materials, chemicals companies should work with suppliers, regulators, and customers to enable solutions for solving "ecosystem-wide" issues related to energy and material efficiencies and develop newer ways of doing business — for instance, exploring new service-heavy business models such as Chemical Leasing, owning the entire circular economy loop, redesigning products and processes with customers, and establishing dedicated supply chains for advanced materials. Barriers to solving sustainability challenges can be overcome by choosing a starting point that is not beset with inertia.".

The United Nations Environment Program (UNEP) published its second "Global Chemical Outlook" in 2019, which outlines the key developments and challenges in the area of Chemicals Policy. The Outlook dedicates a comprehensive chapter to business models and provides a concise analysis about the effects arising when Chemical Leasing is actually implemented: "The economic advantages of Chemical Leasing have been analysed. A recent study (OECD 2017) reported that the benefits of increasing the user's competitiveness include direct cost savings (reduction of chemical quantities if processes are further optimised); indirect cost savings (through energy and waste management); access to better knowledge, with improvement of processes and reduction of risks; and reliable, long-term business relationships. In addition, the benefits of increasing the supplier's competitiveness include higher profits (monetary reward for

supply of expertise and services); reduced raw materials costs; reliable, long-term business relationships; access to knowledge about the application of chemicals; and first-hand experience concerning areas for improvement/innovation of substances."

How can all these elements, pointing not only at the quality of chemicals as such but mainly at the quality of applications of chemicals, be integrated into our traditional framework of chemicals legislation, so to say the "REACH-philosophy", in such a way that legislation supports and enables these new solutions? Goals for resource efficiency should be required by the legal framework and could subsequently be fine-tuned and agreed upon case-by-case between authorities and companies. Monitoring of applications within an "authorisation", or within a possible new requirement for continuous optimisation to be documented in the chemical safety report, could become part of ECHA's (the EU's Chemical Agency's) portfolio. This shift will also determine the way ECHA co-operates with the Member States and industry. ECHA should (together with Member States) compile and evaluate data gathered at companies to demonstrate the appropriate use of chemicals in order to check whether envisaged effects do in fact materialise. The discussion has reached the political level such as the European Union's Council of Environment Ministers. The Council steers the future development of policy areas via issuing positions and perspectives in the "Council Conclusions". In its meeting in June 2019, the Council unanimously adopted conclusions on a future EU's chemical policy. One element mirrors the topics treated above in particular: "The Council encourages promoting approaches, such as green and sustainable chemistry and non-chemical alternatives and embedding key elements of these concepts in the EU chemicals policy through regulatory measures, which reinforce especially the effort to find alternatives for substances of concern, and non-regulatory measures in order to facilitate the development of safe and sustainable chemical and non-chemical solutions, including, among others, promoting the non-toxic circular economy; in this context, the council invites Member States and the Commission to stimulate technical research and the development of appropriate methodologies, service-based business models and other safe by design approaches throughout the entire value chain in the innovation process."

The future role of entropy, epigenetics and efficiency are framing the mind-set for a circular economy and thus also for a chemicals policy beyond 2020, as this new paradigm will largely deal with quality: quality of design, quality of effects and quality of applications.

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9.9 CIRCULAR ECONOMY AND CHEMICAL LEASING

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Over the last decade, the concept of circular economy has received growing attention in the policy arena, an attention that will continue to grow. It is therefore pertinent to explore the relationship between circular economy and Chemical Leasing, to assess how Chemical Leasing could further support the implementation of circular economies.

Circular Economy

In our current economies, materials flow through them primarily in a linear fashion: industry extracts virgin materials and processes them into products; consumers then use those products, often only once, before discarding most of them as waste. The result is that economic growth is closely tracked by growth in the amounts of virgin materials our economies extract and use as well as in the volumes of wastes (solid, liquid and gaseous) our economies release into the environment. This in turn leads to ever-more intensive impacts on the natural environment. These impacts have now reached a level of intensity where ecosystems are beginning to collapse. There is general agreement that there is a pressing need to decouple future economic growth – which human development continues to require, especially in the developing countries – from the negative impacts of this growth on the world's ecosystems. The transition to circular economies (CE) is seen as vital to these efforts.

Circular economies will come about through the implementation of five strategies whose overall goal is to reduce overall material flows into and out of our economies:

- "narrowing" material flows – this can be brought about through improvements in the efficiency with which we process materials and use the products made of them;
- "slowing down" material flows, so that they remain in use in our economies for longer – this can be accomplished by maintaining and repairing products more, by remanufacturing and refurbishing products more, or by increasing the reuse of products;
- "intensifying" our use of material flows – this can be done by ensuring that products are more intensively used during their lifetimes;
- "dematerialising" our economies, primarily by substituting service and software solutions for physical products;
- "closing loops", where products at the end of their useful lives are recycled to extract the materials they contain for further use in new products[19].

A key principle embedded in the CE concept is that the value of materials and products should be maintained for as long as possible. This means that as much, if not more, importance should be given to activities which extend the useful life of product as to activities which recycle them at the end of their lives.

Note that the current CE conceptions do not capture well the need to also detoxify material flows, by substituting the use of toxic materials with less or non-toxic materials. This is important in order to reduce impacts on human health and the environment from leakage of toxic materials during both production and use – important topics covered in much occupational safety and health, environmental, and consumer protection legislation and regulation.

Chemical Leasing in a Circular Economy

Reviewing the information contained in Chemical Leasing case studies described in various sources[20], this section draws conclusions about the relationship between Chemical Leasing and CE concepts and makes some suggestions about how Chemical Leasing could contribute to the transition to CE.

A first observation is that Chemical Leasing is "subordinate" to CE. The CE concept covers economy-wide flows of materials, while Chemical Leasing has traditionally focused on the industrial sector. Thus, the support which Chemical Leasing can bring to the CE agenda is limited to that sector. That being said, wherever chemicals are used in significant quantities in the economy to offer a service, the Chemical Leasing business model has the potential to be applied. There are already some examples: it has been used in the agricultural sector (a Chemical Leasing contract on the application of pesticides and fertilisers) as well as in the service sector (contracts on the use of chemicals in water purification and in the hospitality sector). These examples suggest that a greater use of Chemical Leasing in the non-industrial sectors of the economy should be explored as a way of using Chemical Leasing more broadly to promote the CE agenda.

[19] *Adapted from Martin Geissdoerfer et al, "Business models and supply chains for the circular economy", Journal of Cleaner Production, Volume 190, 20 July 2018, Pages 712-721.*

[20] *www.chemicalleasing.org; personal communication Emina Alic, UNIDO; OECD, "Economic Features of Chemical Leasing", 2017.*

The Chemical Leasing concept is subordinate to the CE concept in another way. It only deals with one class of materials – chemicals – while CE covers all materials being used in an economy. However, in principle there is no reason why the Chemical Leasing business model could not be used for any material in the economy offering a service. The Chemical Leasing case studies reviewed contain a few examples of where – perhaps more as a secondary benefit of the implementation of the main, chemical-related options – non-chemical material flows were reduced (packaging in several cases, spare parts in one case). In this context, the analysis undertaken for the European Chemical Industry Council (Cefic) is of great interest (Accenture, 2017). The report suggests that chemical companies should explore collaborations of the type used in Chemical Leasing to ensure that products containing or made with chemicals, like plastics or rubber, are redesigned to remain in use longer. The report also points out that chemicals themselves could enhance the circularity of other material flows. This suggests that there could be areas where chemical companies could enter into Chemical Leasing -type contracts to support the CE agenda by circularising material flows through the use of enabling chemicals.

Secondly, since CE is primarily about the management of material flows, it is pertinent to see how Chemical Leasing affects these flows. A review of the case studies suggests that of the five broad CE strategies described above Chemical Leasing primarily works on the first, narrowing. The principal material-flow outcome of most of the case studies is a reduction in chemical flows, through the adoption of resource efficiency options. A good number of the case studies also lead to reductions in energy. These in turn lead to reductions in material flows, either directly (the enterprise uses less fuel) or more indirectly through reductions in electricity use and thus the fuels used to generate that electricity.

In case studies where the chemicals in question are auxiliary chemicals[21] in the production process, the material-flow outcomes often also include recovery/recycling activities. These would fit into the CE strategy of slowing down (the chemical's useful life is extended by ensuring its reuse)[22] . Some case studies also have cascading as a material-flow outcome, which also fits into the CE strategy of slowing down. Chemicals are not necessarily involved. Case studies have examples of extending the useful life of water streams because Chemical Leasing activities have meant that they are no longer being contaminated with chemicals and so can be safely reused.

The case studies showed up no examples of where Chemical Leasing contracts led to options which fit into the CE strategies of use intensification, dematerialisation or closing the loops (the latter meaning that the basic materials from which products are made are reused; in the case of chemicals, this would mean the reuse of the atomic building blocks of the chemicals). It could be of interest to explore if and how Chemical Leasing could contribute to these other three CE strategies.

One area where Chemical Leasing goes beyond the current scope of CE is in its focus on toxicity reduction. This is an important consideration for Chemical Leasing but not for CE, as explained earlier. In a good number of the case studies, toxic materials have been substituted by non or less toxic materials.

A quite different area of interaction between the Chemical Leasing and CE concepts is in the use of new business models. Proponents of the CE concept have realised that successful implementation of the five circular economy strategies will very often require changes in the contractual relations between suppliers and consumers of the products. In many cases, rather than focusing on the delivery of physical amounts of products the contracts will need to focus on delivery of services. As one of the more active actors in the Chemical Leasing space, UNIDO has gathered a rich experience not only on the winning strategies to complete a successful Chemical Leasing contract, but also on the challenges and barriers to success. UNIDO should make this experience available to actors in the circular economy field, to whom it could be of great value. The EU, for instance, has recognised the role which the business models used in Chemical Leasing can play in developing CE business models (EC 2016, EC 2019). Furthermore, UNIDO itself could apply the lessons it has learned in Chemical Leasing to other CE opportunities in the industrial and allied sectors.

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[21] *Chemicals which play an important role in production processes but are not part of the final product. Examples are cutting oils, cleaning solvents, catalysts.*
[22] *Note, however, that if the outcome is the burning of a waste stream, even if for energy recovery (which is the case in at least one case study), or its destruction in some other way, or its disposal in a landfill, this puts Chemical Leasing outside the scope of CE, where the objective is to reuse materials.*

9.9.1 THE EU CIRCULAR ECONOMY PACKAGE HIGHLIGHTS THE VALUE OF NEW BUSINESS MODELS

With the ambitious Circular Economy Package adopted in December 2015, the EU aims to make its economic model more sustainable. The package includes new legislative proposals on waste and an Action Plan with measures for all stages of the production cycle, from design to production and consumption, waste management and recycling. In a circular economy, the value of products and materials is maintained for as long as possible. Waste and resource use are minimised, and when a product reaches the end of its useful life, the resources it contains are used again to create further value.

In Europe, the chemical industry is one of the largest industrial sectors, generating ca. 1.1 percent of EU GDP and employing around 1.14 million workers.[23] 95 percent of goods are directly linked to chemicals or chemical processes[24], including products mentioned in other sections of this document.

EU policies are in place addressing safe use of chemicals and reducing environmental impacts (e.g. the REACH regulation that aims at the safe use of chemicals, through reducing exposure of consumers and workers to hazardous chemicals). Few policies address material efficiency (in the sense of using less material for the same result). Here, **new business models like Chemical Leasing could contribute to material efficiency**:

- The Circular Economy concept[25] needs close linkage to real-world problems of industries. **Chemical Leasing is a performance-based innovative business model applied across sectors that is in line with the Circular Economy concept.**
- The Circular Economy needs to be promoted at the global level. **Chemical Leasing as a globally applied - business model could be an enabler for this.**
- Sustainable industrialisation can only be achieved by enhanced stakeholder cooperation. **Chemical Leasing aligns incentives of chemical users and suppliers and creates win-win situations for economy, environment and communities.**

9.9.2 ACCENTURE ABOUT EXTENDING A BUSINESS PORTFOLIO WITH NEW BUSINESS MODELS [26]

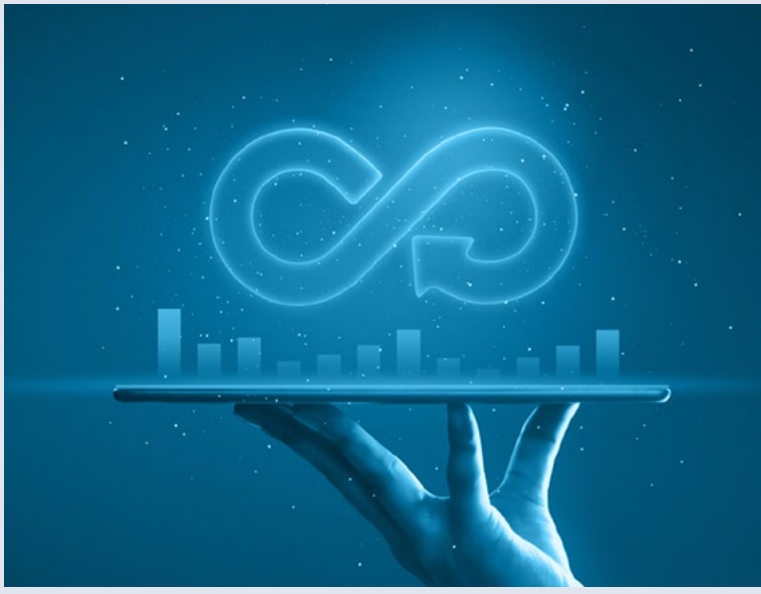
As European chemical companies move to the circular economy, they should consider a portfolio of integrated initiatives and plan for a transformation encompassing the entire value chain:

- Understand how the circular economy creates growth potential for their portfolios and shift capital and operating expenses accordingly.
- Prepare to shift focus from volume to value.
- Explore opportunities to benefit from new business models in areas **such as Chemical Leasing** and the management of molecule-circulating loops (e.g., infrastructure for reverse logistics).
- Increase resilience through partnering with OEMs and deeper integration with customer value chains—comparable to what can be observed in the steel industry where some players have been migrating from steel milling to downstream applications.
- Decrease dependence on oil and gas.

9.9.3 THE CIRCULAR ECONOMY CLUB ABOUT CHEMICAL LEASING

"The Circular Economy Club is a strong supporter of the UNIDO Chemical Leasing initiative, which recognises organisations that break from the traditional model of driving sales through increased material usage and encourages the application of business solutions that focus on the impact and added value for partners and the environment. The Chemical Leasing model provides a strong example of the product (chemical) as a service model that will be a key part of Circular Economy solutions in the future."

Anna Tari, *Founder*



@lemonsoup14

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9.10 SUSTAINABLE CHEMISTRY AND CHEMICAL LEASING

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Ever since humans mastered the art of transforming the Earth's resources, their well-being has been constantly improving. This well-being is currently very much based on a wealth of different chemicals: petrochemicals, polymers, agrochemicals and fertilizers, coatings, dyes and pigments, adhesives, detergents, cleaning agents and personal care products, chemical fibres (e.g. textiles), construction materials (e.g. insulation materials), pharmaceuticals, and other products of the chemical and allied industries. As a result of favourable conditions and skills acquired over the centuries, the last 50 years has witnessed a doubling of the human population and a fourfold growth in global Gross Domestic Product (GDP). This has resulted in a threefold increase in resource use. Further increases in population and resource use is expected (UNEP, 2019). Despite all the benefits we gain from the products of the chemical and allied industries, their adverse impacts must be addressed. The manufacture of complex products which are difficult to repair or recycle is resulting in a shortage and wasteful dissipation of resources, in environmental pollution, in health issues, and in climate change. A transition of the chemical and allied industries towards sustainability is therefore urgently needed.

Sustainable chemistry is a guiding principle for the chemical and allied industries' contributions to sustainable development. Sustainable chemistry focuses on the function and services needed in a specific context rather than on chemicals themselves (Kümmerer, 2017). According to the principles of sustainable chemistry, the function and services must be delivered in a sustainable manner, which means among other things in a manner which preserves resources, reduces losses e.g. by dissipation, minimises product complexity, adapts product lifetime, facilitates recycling, avoids toxic and environmentally harmful products and by-products, but also takes into account ethical and social aspects. Thus, sustainable chemistry offers numerous opportunities for new business models such as Chemical Leasing.

> **Chemical Leasing is an important pillar of sustainable chemistry.**
>
> *Klaus Kümmerer*

Sustainable chemistry promotes nonchemical alternatives first, allows for chemical solutions only if necessary, and then requires sound management of chemicals and the application of green chemistry thinking. Like sustainable chemistry, Chemical Leasing focuses on the function and services needed in a specific context rather than on the chemicals themselves. Chemical Leasing is in line with sustainable chemistry's systems thinking and contributes to it by offering the customers the services - albeit based on chemicals - in a commercially viable way, thereby reducing resource depletion and environmental pollution.

Like sustainable chemistry, this core philosophy of Chemical Leasing poses a challenge to the conventional business models of the chemical and allied industries. In conventional business models, suppliers focus on increasing sales volumes (tonnage), and their responsibility for the product usually ends at the moment of sale or eventually upon expiration of the warranty period. This often leads to customers using the product inefficiently or even incorrectly, and to disposing of it incorrectly or when there is no need to dispose of it, in the process generating waste or losing resources. Finally, there is the environmental harm caused by the product itself and by the increased extraction of the virgin raw materials and their processing. According to the principles of sustainable chemistry, such situations should be avoided. Another core philosophy of sustainable chemistry is the adoption of circular economy principles. These can be summarised as follows: design for repair, reuse, recycling (optimal material recovery), reducing and simplifying diverseness, reducing dynamics of products and processes, preserving raw materials, minimizing entropy increase and transfers, avoiding rebound effects, developing circular metrics, shifting traditional chemical practices towards efficient and safe processes adapted for a specific purpose, and adopting rent, share, and lease business models (Kümmerer, Clark, Zuin, 2020).

Business models like Chemical Leasing, based on the value-added and the functions performed by chemicals rather than the amount of chemicals, require a change of mind-set on the part of the suppliers. In cases where customers pay for the service or function of chemicals (knowledge) instead of the amount (tonnage), suppliers also benefit from more efficient solutions, saving raw materials (reuse, repair, recycle) and avoiding toxic and problematic substances, as their responsibility for products might even cover their entire life cycle. Providing such highly effective, individual solutions requires close cooperation, knowledge and expertise exchange between the buyer and the supplier.

Chemical Leasing looks to preserving resources and taking on extended downstream user responsibility, creating a dialogue among different stakeholders in the chemical and allied industries, i.e. between the stakeholders ("customers") in need for a certain service or function delivered by a chemical product and the stakeholders delivering

the chemical products ("manufacturers"). This is well aligned with sustainable chemistry. Chemical Leasing is an important building bloc of it. Chemical Leasing can therefore play an important role in promoting sustainable chemistry and vice versa. It can be a powerful tool in bringing sustainable solutions and products to the market in a commercially viable way. This would significantly contribute to the transition of the chemical and allied industries towards sustainability and bring humanity closer to reaching the sustainable development goals.

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UNEP, Global Resources Outlook

9.11 PARTNERSHIPS TO ADVANCE THE IMPLEMENTATION OF CHEMICAL LEASING

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Chemical Leasing can benefit from many types of partnership for its promotion and its successful implementation. These partnerships tend to be multi-stakeholder partnerships and include industry, international organisations, government, research institutions, civil society and others.

Within the contractual relationship at the core of Chemical Leasing, there is one essential partnership, that between the user and supplier of chemicals. It is this partnership which ensures that the business model is successfully implemented. It is also the basis of the cooperation to improve the processes where the model is implemented. However, sometimes the partners can face barriers to implementing the model which the involvement of other partners can help to overcome.

In its Chemical Leasing projects, a third partner that UNIDO has often used are the National Cleaner Production Centres (NCPCs) which make up the Global Network of Resource Efficiency and Cleaner Production (RECPnet). UNIDO has trained and provided knowhow to the NCPCs on Chemical Leasing. The NCPCs have later provided technical assistance to both companies and chemical suppliers to support them in the implementation of the model. The NCPCs also promote the model in their countries and provide trainings and policy advice to the national and local authorities.

Public Private Partnerships (PPPs) could also be used in Chemical Leasing agreements. In this case, a PPP would involve a governmental entity and the two partners in the Chemical Leasing effort. Especially in the case of SMEs, a PPP could help companies overcome barriers to the implementation of a Chemical Leasing model because the public partner could provide them additional resources (knowledge, financial resources, capacity, access to technologies,). This in turn would be beneficial for society as a whole, when, for example, the government of Austria through the Ministry Federal Minister for Climate Action, Environment, Energy, Mobility, Innovation and Technology of reimbursed 50 percent of the consultancy and development costs incurred in a Chemical Leasing project in a company. This support has helped with the successful implementation of the model in several companies. Currently, the government of Switzerland through the Federal Office for the Environment of Switzerland supports companies that want to implement Chemical Leasing by covering three days of the consultancy and connecting them with national experts in the country.

Other types of partnerships have been very useful in the promotion of Chemical Leasing. UNIDO promotes Chemical Leasing with the direct support of the Austrian, German and Swiss Governments. These countries have been funding the Global Chemical Leasing Programme. This long partnership has contributed to the upscaling of Chemical Leasing through various projects and the Global Chemical Leasing Award.

In the framework of UNIDO's Global Chemical Leasing Programme, UNIDO has also established partnerships with universities, research institutions and other student organisations. For example, UNIDO and Enactus are collaborating on the promotion Chemical Leasing and performance-based business models and projects among students and young entrepreneurs. Enactus is an international non-profit organisation dedicated to inspiring students to improve the world through entrepreneurial action. It also is partnering with Apex industry organisations which have a strategic interest in Chemical Leasing. For instance, it recently signed an agreement with the European Association of Chemical Distributors.

In the case of research institutions, among other activities they can help analyse the wider applicability of Chemical Leasing and extend its use (e.g. to other industries), make critical/analytical observations, develop and apply innovative ideas to Chemical Leasing business areas, promote and mainstream the model through publications or papers, etc.

In summary, partnerships are the key element for the success and upscaling of the Chemical Leasing. UNIDO, together with its partners, plans to continue promoting Chemical Leasing and bringing more support for the implementation of the model at the global level. To facilitate this, UNIDO and seven countries, Austria, El Salvador, Germany, Peru, Serbia, Sri Lanka and Switzerland, have signed a Joint Declaration on Chemical Leasing. Efforts to include more countries continue.

9.11.1 JOINT DECLARATION OF INTENT

In November 2016, representatives of UNIDO, the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management, the German Federal Ministry for the Environment, Nature Conversation, Building and Nuclear Safety and the Swiss Federal Office for the Environment signed the Joint Declaration of Intent on Chemical Leasing. These four institutions are actively promoting Chemical Leasing through UNIDO's Global Chemical Leasing Programme and the Global Chemical Leasing Award. The Declaration aims to increase awareness of Chemical Leasing at the political level and strengthen the cooperation of the partners in the global promotion of Chemical Leasing.

At the signing ceremony, Andrä Rupprechter, Austria's Federal Minister for Agriculture, Forestry, Environment and Water Management, declared: "Chemical Leasing represents the single most important trend for both the producers as well as users of chemicals. This service-based business model is making obvious how the "circular economy" can be turned into an economic success. It is only within that concept that all partners along the supply chain are sharing one common economic goal: the resource-efficient use of chemical products. This common declaration signed today by UNIDO, Germany, Switzerland and Austria is a clear commitment to add more chapters to that worldwide success story."

Axel Vorwerk, Deputy Director General of Germany's Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, added: "Industry is called on to invest in and advance the development of innovative, sustainable processes and products. Governments help design suitable framework conditions. Germany is strongly committed to achieving the targets set out in the 2030 Agenda for Sustainable Development and supports the Chemical Leasing initiative as a building block on the road towards sustainable chemistry."

Martin Schiess, Head of the Air Pollution Control and Chemicals Division of the Swiss Federal Office for the Environment, said: "Chemical Leasing can contribute to the sustainable use of chemicals in many ways, such as improving the performance of chemicals in industrial processes while reducing consumption of resources and environmental pollution at the same time. Switzerland is willing to cooperate with UNIDO, Austria and Germany, together with industry partners, to promote Chemical Leasing, recognising its potential contribution to sustainable chemistry."

In the Joint Declaration, the partners declared their intention of setting up a framework for close cooperation between them on Chemical Leasing, with the objective of contributing to

- Achieving the SDGs
- Supporting SAICM
- Promoting Inclusive and Sustainable Industrial Development (ISID) and
- Achieving other goals set by relevant Multilateral Environmental Agreements such as the Stockholm Convention, the Rotterdam Convention, the Basel Convention, just to name a few.

They intend to take action in the following areas:

- Raising awareness and including Chemical Leasing in related local, regional, national and intergovernmental policies, programmes and activities such as Sustainable Chemical Management, Sustainable and Green Chemistry, Resource Efficiency and Cleaner Production and Circular Economy
- Advocating and enabling Chemical Leasing to become a mainstream business model across industries and countries
- Up-scaling Chemical Leasing within companies and organisations
- Promoting Chemical Leasing as a circular economy business model by fostering the safe use of chemicals in an inclusive and cooperative manner and for the sake of human health and ecosystems, and by promoting resource efficiency and the reuse and recycling of goods with a goal of "zero waste".
- Supporting academia to undertake research into Chemical Leasing and publishing scientific papers on the topic
- Implementing activities set out in the SAICM Global Plan of Action in order to achieve the sound management of chemical throughout their life cycle by means of Chemical Leasing
- Promoting Chemical Leasing as a way of advancing synergies across the international Chemical Conventions and other Multilateral Environmental Agreements

Picture 15. UNIDO and Chemical Leasing partners

@UNIDO

During the signing ceremony, the partners stressed that additional partners are welcome to join the initiative. In 2018, 3 more countries joined this initiative: El Salvador, Serbia, Sri Lanka and Peru joined in 2020. Extracts of their official speeches are included below.

SERBIA

Sonja Roglić

Head, Chemicals Department, Ministry of Environmental Protection

The Government of Serbia strongly supports new business models and their implementation. We see Chemical Leasing as an innovative business model which contributes to circular economy and to the adoption of sound chemicals management by industries, and which advances sustainable development.

Since 2008, the Cleaner Production Centre in Serbia has been promoting and implementing Chemical Leasing in industry, and we are impressed by the results achieved. They demonstrate environmental benefits such as significant reductions in chemicals consumption as well as economic and social benefits.

The Government of Serbia plans to set up a framework for close cooperation between Partners regarding Chemical Leasing and to take action as stipulated in the Joint Declaration of Intent on Chemical Leasing.

SRI LANKA

Duraisamy Jeevanadan

Additional Secretary, Ministry of Mahaweli Development and Environment

Sound management of chemicals is a vital topic for our country, specifically for our sustainability agenda. This year, the Ministry of Environment developed the overarching policy for chemicals management in Sri Lanka in consultations with various key stakeholders. Next month, this policy will be presented to the cabinet for official endorsement.

Since 2008, the NCPC has implemented its Chemical Leasing activities with the support of UNIDO. The Chemical Leasing activities in Sri Lanka include pilot projects with the industries, research forums with university academia, and public sector engagement, among other things. As a result, a number of Sri Lankan companies appear as finalists in the Global Chemical Leasing Award.

Among the highlights of the Chemical Leasing activities in the country, the successful application of Chemical Leasing in the Agriculture sector is one of the groundbreaking initiatives which has become an eye opener for policy makers.

EL SALVADOR

Jessica Laguardia

Legal Representative, Ministry of Environment and Natural Resources

El Salvador recognises the need for concerted action to effectively address the health and environmental risks arising from unsound management of chemicals and wastes; requiring the collaboration of all relevant stakeholders, including the private sector, international organisations, academia, NGO's, among others; to achieve an adequate implementation of sound management of chemicals and wastes.

We are also aware of Sustainable Development Goal number 12, on sustainable consumption and production, with one of its targets being the achievement of environmentally sound management of chemicals and all wastes throughout their life cycle. Therefore, the Ministry, in its efforts to reduce environmental risks and improve the quality of life of people, has developed the National Environmental Policy and Strategy. Among the goals set out in the Strategy, is the attention to serious sanitation problems that have affected the health of people and ecosystems, caused by mismanagement of solid and toxic waste; as well as the protection, recovery and management of water resources.

The National Environmental Policy of El Salvador has many principles in common with the Chemical Leasing model. Chemical Leasing contributes to the implementation of our national environmental policies, in the water and sanitation components, as well as in the rational management of hazardous substances and wastes. The model provides an opportunity to help reduce the contamination of water resources associated with chemical substances, make a better use of water and raw materials, and reduce the consumption of toxic substances and pollutant emissions to the air, water and soil.

Within the framework of multilateral environmental agreements, El Salvador has made efforts to comply with the commitments and goals of reducing emissions, achieving the gradual elimination of ozone-depleting substances and eliminating inventories of Persistent Organic Pollutants (POPs). Chemical Leasing supports the country comply with these multilateral environmental agreements.

We understand that Chemical Leasing is not the key or the only solution for solving chemical mismanagement and pollution, but it is part of a whole system of national actions and public policies to promote and encourage the achievement of global goals (SDGs, environmental agreements, national policies and projects); and at the same time, encourage a sustainable economic development.

9.11.2 COLLABORATION WITH ACADEMIA AND THE SCIENTIFIC COMMUNITY

UNIDO and its National Cleaner Production Centres (NCPCs) have always strived for collaboration with universities and scientists to anchor the Chemical Leasing business model in higher education. Training courses, lectures and even a curriculum for Chemical Leasing have been elaborated in different countries around the globe, to further develop and spread the idea of Chemical Leasing in various sectors/fields, including agriculture, process engineering, chemistry and economic and social sciences. In this way, students get to learn about this innovative business model and its areas of application, researchers can contribute to developing appropriate solutions that adapt the Chemical Leasing model to the particular needs of the partners, and academic institutions can provide awareness raising, competent information and training in Chemical Leasing to individuals and stakeholders, also outside of academia.

Below, representatives from academia and the scientific community share their experiences with the Chemical Leasing business model, they talk about their motivation to introduce Chemical Leasing in their field of work and the potential of Chemical Leasing from an academic point of view.

BILA TSERKVA NATIONAL AGRARIAN UNIVERSITY, UKRAINE

Tetiana Grabovska

Associate Professor of the Department of General Ecology and Ecotrophology

Did winning the Global Chemical Leasing Award change anything for the university? And why was winning important for you and the university?

The development of organic farming is the most promising sector of agriculture in Ukraine but also around the world. It combines traditions, science and innovation to green natural cycles, improve the state of the environment, preserve biodiversity etc. We are proud that our university was one of the first in Ukraine to insert the use of the Chemical Leasing business model in the agricultural sector into the curriculum and so improve the quality of our educational services. Our graduates have become more competitive in the labour market due to the knowledge and skills they have acquired on how to apply the innovative approaches of sustainable chemicals management, as well as how to promote alternative methods of agriculture (e.g., organic agriculture). This prestigious international award has contributed to raising the rating of our university and made us more attractive to applicants.

What was your motivation to introduce the curriculum on Chemical Leasing in the University?

Our main goal was to acquaint students with innovations in the field of greening industry that are based on integrated management and sustainable development. Since Chemical Leasing ensures environmental protection and environmental safety, it was a promising and appropriate way to study the handling of chemicals. Moreover, it is currently very relevant for Ukraine, which has a large agricultural potential but polluted and degraded lands. That is why our graduates have to be well educated about modern, environmentally acceptable, socially oriented and efficient productions that is based on the Chemical Leasing concept.

What is the feedback from your students? How did they find the idea of studying about the Chemical Leasing business model?

Students were curious about new progressive ideas, which contributed to the intensification of their research activities. This is reflected in the topics of their speeches at conferences and diploma projects. They studied this topic with enthusiasm and shared information on social networks. Students are proud to study at the university that is awarded for an idea that is in their training course. Of course, this is a victory not only for the team of the department, but also for the students who are open to get new knowledge and ideas.

Do you see a potential of introducing a course on innovative business models to other faculties and Universities in Ukraine?

We consider the promotion of such knowledge as effective, especially for the specialties that work with bio-resources, as well as for production sectors, whose activities pose threats to the environment.

A curriculum for the discipline "Techno-ecology" which took into consideration the Chemical Leasing model, has been approved by the Scientific and Methodological Council of the University. All curricula are presented on the university's website and are available to all. So anyone

who creates their own curriculum for the same or similar discipline are able to use the topics and modules in that curriculum.

In addition, we are going to publish a tutorial on the proposed module for Chemical Leasing, as well as submit it for approval to the Ministry of Education and Science (once approved, it will be available in the libraries of all Ukrainian universities). This will promote the dissemination of knowledge about Chemical Leasing to other universities.

How do you see the future of the Chemical Leasing business model in Ukraine in general and especially for academia?

We are certain that the insertion of Chemical Leasing into the educational process will provide the opportunity to train specialists who will carry the idea of environmental protection and the reasonable management of chemicals, and practice it in the agro-industrial complex, taking into account regional peculiarities.

EAFIT UNIVERSITY, COLOMBIA

Paula Marcela Hernández Diaz

Professor in the Department of Process Engineering, at the School of Engineering

How does academia see a new business model like Chemical Leasing?

For the processes engineering undergraduate program at EAFIT University, Chemical Leasing is an opportunity to apply the skills that the program offers – chemistry, process design, and process optimisation, among others – as part of its commitment to sustainable industrial development. The Chemical Leasing model is a win-win model. The industry that adopts it saves in chemicals while the environment and workers increase their wellbeing.

What is the role of academia in bringing new business models like Chemical Leasing to the market?

Undergraduate programs such as processes engineering have the challenge of innovating in both their pedagogical models and in their models of industrial application so that they really contribute to the achievement of sustainable development. Therefore, with respect to academics, research, and outreach, which are a university's missions, higher education institutions should strive to make their graduates and professors bring this knowledge to their work and research sites, respectively.

How do you see the mainstreaming of Chemical Leasing and the potential of Chemical Leasing from an academic point of view?

Chemical Leasing has all the potential to be applied in all higher education institutions, especially in programs such as process engineering which work directly on the improvement, design and optimisation of physicochemical and biotechnological processes, where the use of chemical reagents is mandatory. This type of industry is called on to transform its processes to stop polluting the environment and the people who operate them. Therefore, there is great potential to include it in both curricula and research projects as well as offer it through consultancies to industries.

UNIVERSITY OF BELGRADE, SERBIA

Ivanka Popovic

Rector

How do you see the role of academia in promoting new innovative business models such as Chemical Leasing and how do you see the value of these for academia?

Most higher education institutions have embraced the Sustainable Development Goals and have included them in their vision and mission. Chemical Leasing is a methodology that promotes some of these goals and contributes to their realisation. As a business model, Chemical Leasing can be easily explained to students in many areas of study, with the possibility of focusing on certain aspects relevant to a specific field. The Chemical Leasing model is a versatile and flexible teaching tool. Researchers can also contribute to developing appropriate solutions that adapt the Chemical Leasing model to the particular needs of the partners. Finally, academic institutions can provide competent training in Chemical Leasing to individuals and stakeholders outside of academia.

How do you see the future potential of business models such as Chemical Leasing from academia's perspective, at international level and in Serbia?

The use of the Chemical Leasing model may enable academia to reach out both nationally and internationally. Besides the "greening" of curricula, the business opportunities of the model can be quite attractive. Academia has the competencies to meet the challenge of matching the right partners. The model can motivate some members of academia to leave their "ivory tower" and contribute to the so-called Third Mission of higher education and respond to various societal needs.

Does the University of Belgrade have experience on innovative business models like Chemical Leasing?

Yes, the University of Belgrade has been a champion of Chemical Leasing through the successful operation of the Cleaner Production Centre (CPC) of Serbia at the university's Faculty of Technology and Metallurgy. The team of the CPC is very competent and are recipients of numerous Chemical Leasing Awards. In the category "Case Studies", there were two silver awards in 2010, four gold awards in 2012 and two bronze awards in 2018. In the category "Public Relations", Ms. V. Satric won the gold award in 2010 and the silver in 2012, as well as the gold award in both 2012 and 2014 in the category "Consulting Services". She also received a gold award in the category "Scientific Papers" with two other colleagues in 2014. Because of the commitment to Chemical Leasing, Serbia signed the Declaration of Intent on Chemical Leasing in 2018. Consequently, the Chemical Leasing method is well known at the University and is firmly embedded there as a successful business model. The University has assisted many companies in implementing the method, it has inserted the Chemical Leasing methodology into several curricula thus building up the competence of students, it has trained numerous experts both in Serbia and abroad, and it has become one of the key players in sustainable development in Serbia.

How can research help to further contribute to the broader application and mainstreaming of models such as Chemical Leasing in Serbia and at the global level?

Although an ingeniously simple concept, the Chemical Leasing method is not easy to implement. It would be beneficial to use various data sets to screen for possible partners. As the matching of potential partners is the initial challenge in Chemical Leasing, I believe that the design of web portals integrating various relevant databases could considerably improve the number of potential partnerships. These web portals could function at the national level but could eventually be networked into regional ones. Once having recognised a possible match, the research potential available in academia has the capacity to overcome other challenges that would enable the successful implementation of the business model. Research is essential for the further development of the Chemical Leasing methodology.

UNIVERSITY OF GÄVLE, SWEDEN

Rodrigo Lozano

Professor of Organisational Sustainability at the Faculty of Engineering and Sustainable Development

How does academia see new business model like Chemical Leasing? What are the main points on Chemical Leasing?

When we started working on it, we were positive. We were quite engaged with it and wanted to do quite a lot of things. We found that the definition was perhaps a little bit too vague, that was the reason why we re-defined it. But since then I don't see a lot of people in academia being very interested in the concept. You can also see that in the number of citations we have had and also in the number of other articles on Chemical Leasing, they were not so high. So the academic uptake of Chemical Leasing has been rather poor.

The reason for that could be that the concept has not really been linked up with the main chemical engineering schools. Chemical engineering and chemistry are rather separated from business: business does not care about chemical engineering and vice versa. And this is a concept that has real potential to link both of them, but this link has not been provided so far.

I personally teach Chemical Leasing every single year in "green chemistry and sustainable chemistry" course, and the students are usually quite interested in the concept because it is a new business model. And most of the examples I have for teaching are the ones I co-worked with Serbia and which I know myself, so we have a lot to present to the students. But I don't teach in a chemical engineering school.

For practitioners and for academia as well, many of the case studies that are available are too brief, there is not enough information in the case studies that we could teach our students, more fleshing out of the concept would be needed.

What is the role of academia in bringing new business models to the market, especially Chemical Leasing?

We have also to make sure that we are teaching Chemical Leasing in a different context. I teach it as part of tools and initiatives for sustainability, and Chemical Leasing falls in the green chemistry imitative. It is one of the many tools that we teach.

But Chemical Leasing is just one of the many different ways of tackling business models for the chemical industry. It might be the best one but in education you need to provide different ones.

We also have to make sure that chemistry and chemical engineering schools and business schools know about it and that they see the different contexts. For the former, it would be a way to learn that things can be done in different ways, that it is linked to Circular Economy and closing the loops, while for business schools, it would be a way to show that this could be a different way of earning money. And finally, we need to make sure that these two schools start talking to each other.

How do you see the potential of Chemical Leasing and the future if this business model?

UNIDO was already quite interested in the academic part some 5 years ago. It should continue to be interested in how we can teach these things to the new students, so that we can promote it.

I see great potential, but we as academia need support from UNIDO. We need new examples and we need to expand it beyond the few people who have already worked on it and want to teach it.

RISK AND POLICY ANALYSTS (RPA) EUROPE, ITALY

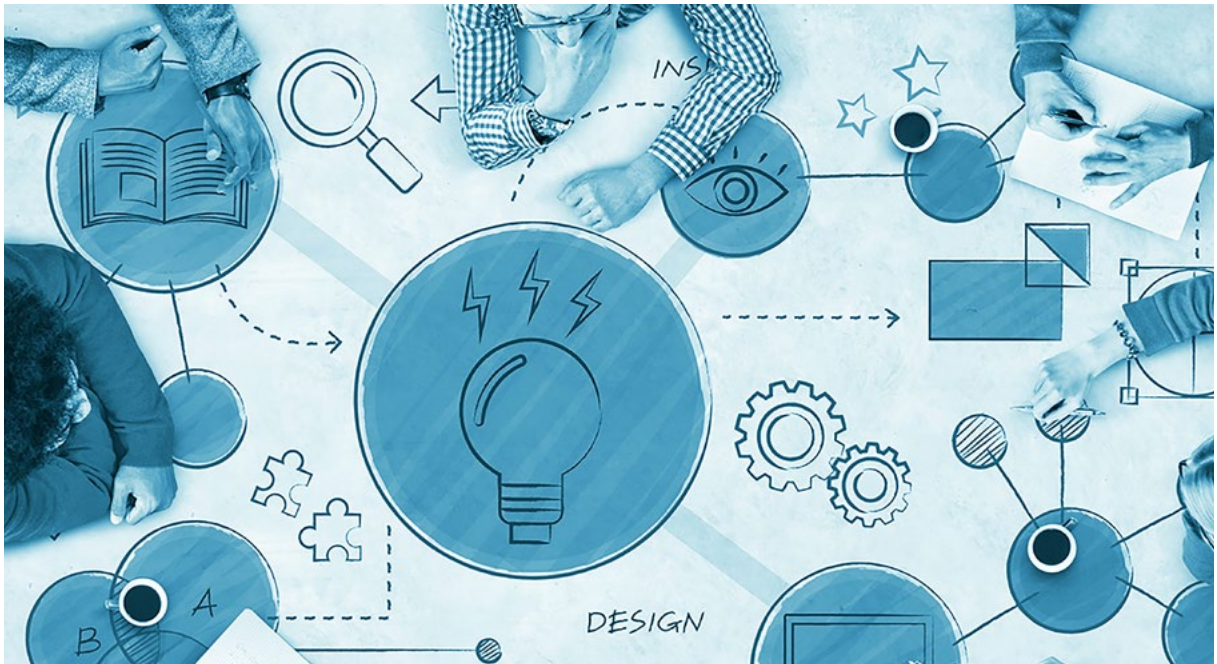
Marco Camboni

Managing Director, co-author of the OECD study on Chemical Leasing

As a researcher, how do you see the future of such business models?

Servitisation[27] is a global trend in most, if not all, sectors of the economy and Chemical Leasing is one of the service-oriented business models at its centre. There are several factors driving the uptake of Product Service System business models, but two of the most important drivers are the capacity to achieve higher environmental benefits for society while creating distinctive and sustainable value for all contractual parties. In a context characterised by growing international competition and the increasingly urgent need of decoupling economic development and consumption of resources, those are very desirable features. We have Sustainable Development Goals at global level and ambitious targets within the Circular Economy Action Plan in the EU, and Chemical Leasing can play a role in achieving these objectives. With the exception of the automotive coatings market niche, there is still a widely untapped potential for the uptake of circular economy business models in many sectors.

[27] *Origin of the term:*
- *Servitization of business: Adding value by adding services, European Management Journal, 1988, Sandra Vandermerwe and Juan Rada,*
- *The servitization of manufacturing: A systematic literature review of interdependent trends, International Journal of Operations & Production Management, 2013, Howard Lightfoot, Tim Baines, Palie Smart*



What kind of research could be relevant, helping in the wider acceptance and application of Chemical Leasing in the world?

A database, organised by sector and chemical group, compiling all experiences and providing information on the results, on the most problematic aspects and some details on the contractual arrangements to overcome them, could be very useful. Research on the applicability of Chemical Leasing in industrial clusters could also be quite relevant. There are some barriers in terms of the transferability of chemical management costs from small and medium-sized enterprises to chemical service suppliers, and in industrial districts there may be the opportunity for the collaboration and participation in Chemical Leasing of SMEs that are part of the same supply chains or that compete on the products or services offered. Finally, research on how public policies can facilitate, or at least not hinder, servitising contracts.

Do you see any interest in the research community on the topic of innovative business models, and in particular on the transformation of a business paradigm from the classical model "more you sell - more you earn" to a new paradigm, "less is more"?

Oh yes! Research within industrial economics is well alive and there can only be an increasing interest in business models which help greening the manufacturing and downstream sectors. But I would not qualify the new paradigm as "less is more", since this only applies to the quantity of products. Effectively, the paradigm of suppliers moving to Product Service Systems could be qualified as "more is more", as they are offering additional "features" to their offer and they have to deal with additional layers of complexity.

In the research you undertook for the OECD on Chemical Leasing, what was the most interesting thing for you, as a researcher, in the Chemical Leasing model? What was the most challenging question and how did you deal with it?

It was interesting to discover the real human drivers beyond the analysis of the homo oeconomicus. For all stakeholders involved, Chemical Leasing is more than just a business model to achieve higher profits. It requires a strong environmental commitment from all contractual parties, which may help in overcoming some of the transactional hazards arising in Product Service System contracts.

YALE UNIVERSITY, USA

Paul Anastas

Director of the Center for Green Chemistry and Green Engineering

How do you see the role of academia in bringing new business models to industry/ to the market?

When we look at our society and our economy, there is a certain status quo at any particular time, among market forces, social forces, legal forces, that we all are familiar with.

What academia often does is, study this status quo, in order to see what is working well and what is working poorly. What is giving us the outcomes in terms of human well-being, environmental well-being, economic well-being, and look at which parts of the existing status quo should remain, and which should be modified with new frameworks, new laws, new policies.

So academia takes an analytical look at the status quo and says: "this way of doing business, this business model is causing too much waste; it's inefficient, it's causing income disparities or health disparities". So over time, what academia has done is shine a spotlight on these inefficiencies, on undesirable aspects of the status quo, and has proposed new frameworks, new ways of thinking. That is what has always happened over time or even centuries. Academia proposes new models, experiments within societal and economic systems to see if they work, to see if they give better results, if they provide better terms for the well-being of society and better terms for the economy.

If we look at the history of products, of manufacturing processes, and more specifically that part which involves chemicals, we see that much has worked well over the past two centuries. We have so many products that have improved our modes of transportation, computation, communication, medicine, wellness, how we grow our food. At the same time, though, we see that together with all these achievements there have come issues associated with waste, pollution, emissions, toxic chemicals, resource depletion. So what academia has done is say: "how can you get the benefits of these new chemistries without these unintended consequences?" The key point is that no one ever wants to buy a chemical! They want to buy the function, the performance, the service,

which those chemicals provide. So there emerges this wonderful concept, Chemical Leasing, that says: "how can you get all this service, all of the functions, all of the performance of chemicals without having to own that chemical?" That realisation, that new conceptual perspective has become a model and a way of thinking about new ways of doing business, new ways of getting all of the positives of the chemical industry, without all of those negatives.

There have been so many manifestations of this wonderful concept. Academia plays a role in partnership with business and industry and making this realisation come true.

Then academia needs to train the next generation of engineers, of scientists, business managers with an idea questioning the way things are and imagining things that could be. When we look at the old ways of doing business, the traditional status quo, we need to think about business models like Chemical Leasing, we need to think about what types of science and technology enables and empowers Chemical Leasing. What are the new inventions, whether they be technological or policy inventions, whether they be legal or regulatory discoveries, new metrics. We need to do this over the entire enterprise, from the basic science all the way through to the implementation models. Academia needs to train the new generation in order to think of continuous improvement, in order to help try Chemical Leasing.

UNIVERSITY OF NOTTINGHAM, UNITED KINGDOM

Michael George

Professor of Chemistry, Faculty of Science, and Participant of the Global Chemical Leasing Award 2018

From a scientific perspective, what do you think about the Chemical Leasing business model?

As we see the use of chemicals worldwide, spread through the media with the topic of plastics for example, there is a huge need to reduce the amount of chemicals. But we also have to realise that business has to make money, so there has to be a new way of thinking. Chemical Leasing is one of the ways to achieve that.

What do you think that science can do for the business model?

Science can do many things for business, but it is important to remember that science at a University is not always the short term, it needs to think how to make big changes, big shifts. A lot of times you try to please people very quickly, but radical changes are needed, so innovation is also needed in research to make big shifts.

What do you think about the Award?

We were very humbled and honoured to win the Bronze in the category "Research". We proposed an idea which would, we hoped, actually make a difference. Chemical Leasing is a very important part of that.

9.11.3 PARTNERSHIP BETWEEN UNIDO AND ENACTUS

Oliver Faber

Managing Director, County Leader, Enactus Germany

Academic Dean at Fresenius University of Applied Sciences, Cologne

In December 2019, the international network Enactus signed a cooperation agreement with UNIDO. With this partnership, both sides hope to achieve greater effectiveness in achieving the UN's Sustainability Development Goals (SDGs). Both partners want to support countries in meeting the SDGs by using market economic principles. These form the institutional framework of their agreement.

Enactus is a community of student, academic and business leaders committed to using the power of entrepreneurial action to transform lives and shape a better, more sustainable world. The SDGs serve as a framework to help track and define the sustainable changes brought about by entrepreneurial action.

UNIDO's strategic priorities are very much in line with the objectives of Enactus: to create shared prosperity, advance economic competitiveness, safeguard the environment, strengthen knowledge and institutions.

At the core of the Enactus programme is the philosophy that competition encourages creativity and rewards results. UNIDO's strategic priority "advancing economic competitiveness" recognises that industry is the seedbed

for entrepreneurship, business investment, technological progress, the upgrading of skills, and the creation of decent jobs.

While monetary incentives play a central role in the market economy, only a responsible approach to resource use, the environment, and social issues can ensure long-term entrepreneurial success. Environmental and climate protection are high on the political agenda and it is becoming increasingly important for companies to present a credible sustainability strategy to their stakeholders, especially investors, customers and employees.

Enactus teams create, through smart but sustainable business solutions, a positive impact, especially in the areas of job creation, provision of food and water, women's economic empowerment, and youth development. Through their entrepreneurial endeavours, teams from Enactus work towards long-term goals that will create a better world for us all. The teams' projects are evaluated according to the following criterion: *which Enactus team has most effectively demonstrated over the last year entrepreneurial leadership in driving business and innovation for a sustainable positive impact to benefit people, the planet and prosperity?*

The UNIDO-supported "Chemical Leasing" programme aims to implement a new incentive structure via a performance-based business model, with the aim of reducing adverse impacts on the environment, health, energy and resource consumption caused by chemicals and their application in production processes. A performance-based business model responds to this demand: customers are not interested in buying the product itself, they want to buy the service which it offers. The model aligns the interests and motivations of the partners, and helps achieve a win-win situation for them and the environment. The life cycle of the chemicals is prolonged, waste is minimized and resources are used more efficiently, which all contribute to achieving circular-economic goals. At the same time, both partners are better off.

The "Chemical Leasing" programme can thus become a link between UNIDO and Enactus: it offers companies the opportunity to enter into a dialogue with over 70,000 motivated next-generation managers in 35 countries to discuss new approaches and ideas, share experiences and opinions, and develop and implement innovative business models. The combination of a performance-based business model with the Enactus criteria can become a critical success factor.

Since Enactus and UNIDO are both active in many countries, this offers country- and sector-specific opportunities for cooperation. Examples include agriculture, water, energy and recycling/circular economy, packaging or clothing.

The annual competitions organised by Enactus and the "Chemical Leasing" programme both provide a platform for informal exchanges and networking, and for the further development of innovative, entrepreneurial approaches to achieve the 17 SDGs and to ensure sustainable economic and social success.

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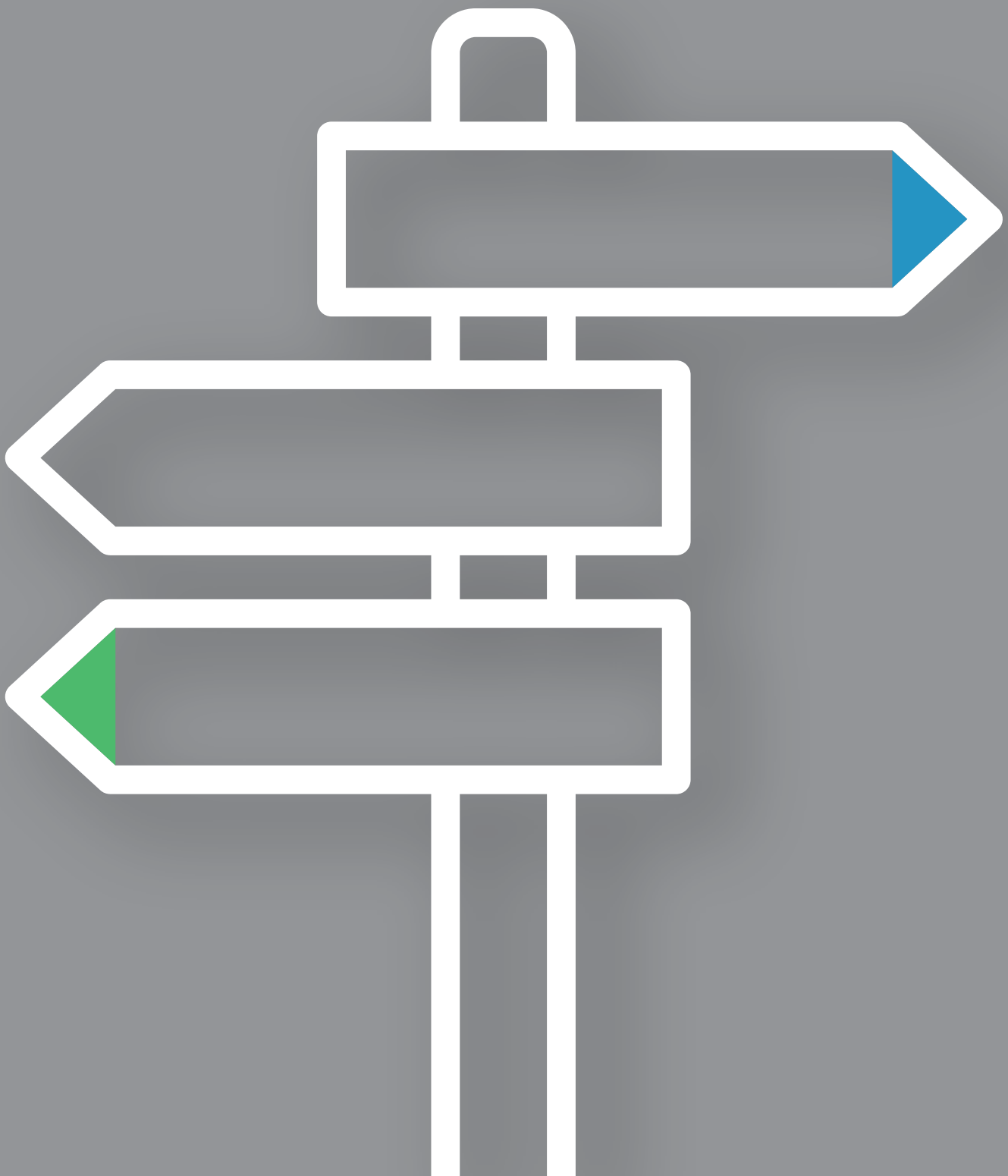
PART E
The way forward



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Part E is a collection of quotes about where Chemical Leasing stands today and the potential and future of the Chemical Leasing business model, in regard to the needs of industry, trends, international and national objectives.

The statements were provided by representatives of business, academia, governments, NGOs and research institutions from different countries.

It shows the potential of the Chemical Leasing business model, its further development and its possible role at policy and industry level. It gives some ideas on the future of performance-based business models such as Chemical Leasing, on how to foster innovation and, last but not least, it provides some food for thought for the discussion on what is needed for further replication and wider mainstreaming of Chemical Leasing.

INTERNATIONAL ORGANIZATIONS

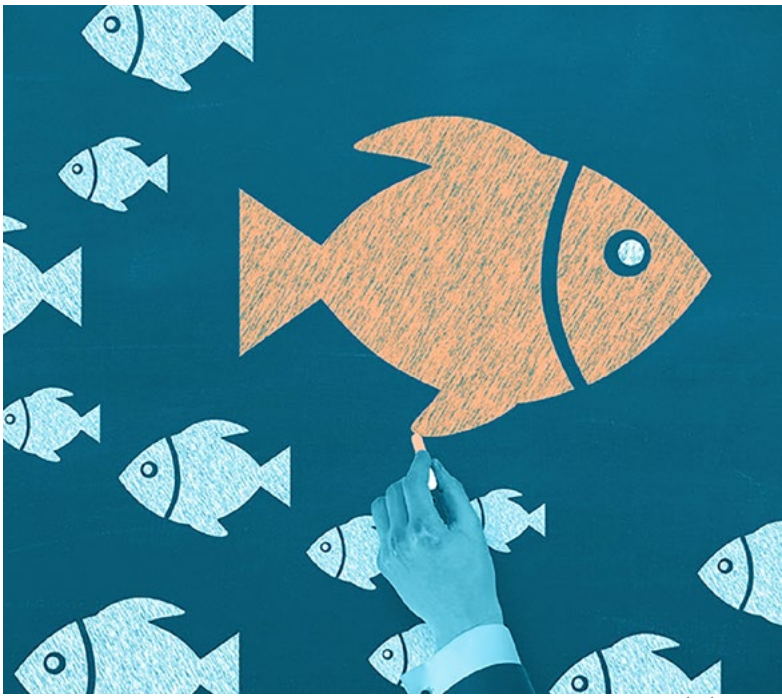
ECHA - EUROPEAN CHEMICALS AGENCY

Bjorn Hansen

Executive Director

Circularity and better integration of existing chemicals regulation are the key topics and challenges in the area of sustainable chemicals management. ECHA has the competencies to progress in these areas together with its partners in Member States and industry, and in that way contribute to make the European Green Deal of the new European Commission a reality. The concept of Chemical Leasing is fascinating. I truly hope that innovation and technology will allow us to put this concept into practice – towards a new service model of how chemicals that fit the concept are used.

When I recently read in several news outlets about the possible creation of an EU investment fund for Chemicals Leasing start-ups to foster circularity, I thought that this concept is at the forefront of innovation, deserving recognition and support in the common interest of a safe and sustainable use of chemicals.



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CEFIC - EUROPEAN CHEMICAL INDUSTRY COUNCIL

Sylvie Lemoine

Executive Director
Product Stewardship

Chemistry is central to the idea of the circular economy. Circular economy provides the European chemical industry with a massive opportunity to preserve value through multiple life cycles by recovering or recycling valuable waste.

There are many ways available to manage valuable raw materials in products throughout their lifecycles.

Chemical Leasing is one of the options available for sustainable management of chemicals and improving circularity along the value chain. The buyer purchases the service of a chemical or product and, consequently, pays for its performance. For example, instead of selling solvents, some companies sell a "solvent solution". They provide fresh solvent, get payed for the number of parts which are cleaned with the solvent and recover the used solvent for reconditioning and reuse. In this case, the seller has the incentive to recover and recycle the material. This facilitates circularity in the supply chain.

While Chemical Leasing works for some applications, it is not applicable to all chemicals and their uses due to feasibility and performance issues. Whether Chemical Leasing is a viable option depends on many parameters, including its economic benefits and environmental impact.

FECC - EUROPEAN ASSOCIATION OF CHEMICAL DISTRIBUTORS

Dorothee Arns

Director General

You have an extensive experience in the field of chemicals management. Do you remember when you had your first "encounter" with performance-based business models applied in the chemical's management, and what were your first thoughts about them?

Indeed, I have been working for the chemical industry since more than 20 years, and I think the first time I saw performance-based business models was in the automotive industry about 20 years ago. At the time, I was business manager for commodities, used to selling chemicals in high volumes and usually in bulk. The automotive industry – our customers – changed their business model to a performance-based approach at a relatively early stage. For cars, this meant, for example, that the supplier's performance was measured by cars coated, not any longer by how many tons of coatings would be needed to coat a car.

My initial thought, frankly speaking, was concern about potentially losing sales volume with this approach, but after the first "culture shock" I was rather fascinated. New, innovative business models have always intrigued me. Meanwhile, performance-based contracting and the optimisation of chemical input has become much more widely spread, not only in the automotive sector, but also in other areas. With regulators putting more emphasis than ever before on resource-efficiency – especially via implementation of the circular economy –concepts fostering end-products with optimal resource input may become ever more important.

In your experience, are chemical suppliers in Europe today more open to innovations, new business models and new approaches in chemicals management than 10 years ago? What brings them to change their attitude?

Well, I think chemical suppliers in Europe have always been open to innovations and structural changes, because in terms of energy and feedstock prices, regulation and labour

costs, we certainly cannot compete with other regions. Hence, this was always a must and is part of our DNA. Just now, the focus of innovation is rapidly shifting towards circular economy solutions, due to global sustainability deliberations. We are moving from mere shareholder value, which was the order of the day still some years ago, to stakeholder value. The question is less how companies perform economically, but more how they contribute to a sustainable society in Europe.

Do you think that the "shift" in a technological progress will encourage the further development and mainstreaming of performance-based business models such as Chemical Leasing?

Very likely. However, it is not only the technology itself, but also the development of a deeper mutual understanding of what are the value-creating factors for all stakeholders involved to achieve a win-win situation for everyone. In many cases, there are more than two parties involved in this business model, so the analysis of needs, targets, and drivers is even more important, because we are talking of triple or quadruple win-win solutions.

What do you think about the future of the service-oriented business models and in particular of Chemical Leasing? How does Chemical Leasing meet the strategic goals of your organisation and how does it respond to the needs of the industry in general and in particular of your members?

Personally, I think Chemical Leasing has a bright future ahead, although of course it is a strategic decision of all individual member companies which path to follow. I see a good match with implementing the principles of Responsible Care as well as with sustainability. Responsible Care, because our members as suppliers will educate their clients about the characteristics of their products and how to use them safely and in an environmentally friendly manner, which means applied product stewardship. Sustainability, because the target is achieved under the conditions of utmost resource-efficiency; nothing is wasted. Chemical leasing models may make more sense for small- and medium-sized enterprises, which might not have cohorts of chemists in-house, but this kind of know-how is critical for the production process. In many of these cases, chemicals are only used as a tool or indispensable auxiliary. This is a classical segment for chemical distributors.

ISC3 - INTERNATIONAL SUSTAINABLE CHEMISTRY COLLABORATIVE CENTRE

Alexis Bazzanella

Co-Director ISC3 Innovation Hub

How do you think Chemical Leasing can foster innovation?

Chemical Leasing is a proven tool for efficient chemicals management that appeals to industry. It undoubtedly has gained momentum within the past decade and has been applied successfully in many industries and across sectors. Based on principles such as sustainability, mutual trust or open innovation, Chemical Leasing can break up silos, stimulate the exchange of know-how, and open doors for new, innovative solutions. It fosters innovation, because it offers a systematic approach to introducing different dimensions of innovation, including social, economic and environmental aspects, all at once. It brings business partners along value chains closer together and inspires them to explore new opportunities, which is the most important aspect of seeding and nourishing innovation.

How can ISC3 and innovation hubs help further the development /wider application of new business models such as Chemical Leasing?

ISC3 wants to shape the transformation of chemicals-related sectors towards sustainable chemistry. Therefore, establishing a new system thinking and a common understanding of sustainable chemistry among different stakeholder groups is crucial. "Collaboration" is at the very heart of our centre's activities, in fact it is one of our five strategic activity fields besides research, education, innovation and information. This has a lot in common with the objectives of Chemical Leasing, as the application in practice has shown that collaboration lies at the very heart of this service-based business model. To further unleash the huge potential of Chemical Leasing as an important contribution to the objectives of sustainable chemistry, it seems promising to fuse the experiences of more than 15 years of work on Chemical Leasing Going Global into the different strategic fields of ISC3. This can be done by educating the next generation of managers, chemists and engineers in Sustainable Chemistry Courses and Master Programs on Chemical Leasing and other new business models. Moreover, innovation hubs (including the ISC3 Innovation Hub) can support start-ups by teaching them about new business models in incubation programs or acceleration classes covering topics as discussed for Chemical Leasing. National and international networks such as our ISC3 Global Start-Up Service partner network can take up such innovative ideas and spread the message across industries and countries. As such, innovative business models like Chemical Leasing will continue to be a crucial building block for transforming whole industries towards Sustainable Chemistry.

How do you see the future of business models such as Chemical Leasing?

Service-based business models such as Chemical Leasing will have a great future ahead if they manage to include the latest developments of digitisation (Industry 4.0) and consider a smooth integration of IT into the service offering package. The smart analysis of data and at the same time the trustworthy sharing of data between provider and supplier is crucial for the success of every Chemical Leasing cooperation. As such, partners will have to move away from semi-structured data management solutions towards fully integrated cloud solutions empowered by well-designed IT programs and implemented by qualified and well-equipped plant managers, chemical engineers and business managers. In the wider context, it is absolutely necessary to advocate for a more complex consideration of dimensions of success that go beyond the short-term economic dimension provided by traditional sales models. In this regard, policymakers have to strive towards developing policy frameworks at the global level which foster sustainable chemistry innovation, and which make it attractive to invest into new ideas and business models such as Chemical Leasing.

OECD - ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Eeva Leinala

Principal Administrator, Environment Health and Safety Division, Environment Directorate

How do you/your organisation see Chemical Leasing as a business model contributing to safe and sound management of chemicals and risk reduction?

Innovation in different domains is required to continue to improve the sound management of chemicals. Chemical Leasing is one such innovation, which is focused on how to structure the business model for chemicals in a way that naturally incentivises a reduction in the use of chemicals along with improved chemical handling and waste management.

What do you think is needed to further replicate innovative business models such as Chemical Leasing at the global level?

The OECD report on Economic Features of Chemical Leasing, highlighted some impediments to the Chemical Leasing model, along with potential activities that could be undertaken to facilitate its uptake. Certainly, awareness raising is important, but also addressing challenges such as Chemical Leasing contract development, supporting companies with information on moving from a product-based to a service-based model and incentivising these types of business models through policy or financial approaches.

What role do you see Chemical Leasing playing in the future in the chemical industry?

There is an opportunity to continue expanding the Chemical Leasing model within the chemical industry, particularly as a service for companies that have limited capacity in chemicals management. However, to reach a larger number of companies, service suppliers must also expand their portfolio of chemical applications. There may be an opportunity to further sector/cluster-based approaches to overcome size constraints and realise economies of scale.

What are the economic features of Chemical Leasing and how does it contribute to socio-economic development?

There are complexities within a Chemical Leasing model that must be addressed including potential issues such as contractual dependency, risk of bilateral monopoly, and information asymmetries. However, these can be mitigated during contract development. In order to offer a Chemical Leasing contract, the life-cycle cost of chemicals management within a company must also be understood; often there is a lack of awareness of these total costs. However, if these challenges can be overcome, the model's design should lead to aligned incentives for both the service provider and buyer to decreased life cycle costs.

MINISTRIES

PERU, MINISTRY OF ENVIRONMENT

Marcos Alegre

Former Vice Minister

“Chemical Leasing will have a good environment for scaling up in Peru, since the Peruvian economy is growing and we are giving growing attention to sustainability issues in our society. We are optimistic that young consumers/future decision-makers will have a critical participation in the transition to a circular economy in Peru.

SERBIA, NATIONAL SAICM FOCAL POINT, MINISTRY OF ENVIRONMENTAL PROTECTION

Sonja Roglic

Head of Chemicals Department

“In Serbia, the importance of the Chemical Leasing was recognised and initiatives to promote and implement Chemical Leasing have been undertaken since 2008.

The Ministry of Environmental Protection, which is responsible for sound chemicals management, supported the process of inclusion of this concept at the national level. We

recognised the close relation between Chemical Leasing and the principles set out in the Strategic Approach to International Chemicals Management (SAICM), as well as in the goals of the 2030 Agenda for Sustainable Development.

We strongly support this business model and its implementation. We see that Chemical Leasing, as an innovative business model, contributes to circular economy and to the adoption of sound chemicals management by industries and promotes sustainable development.

In addition, it is of the high importance that Chemical Leasing provides practical solutions to achieving SAICM's objectives, promotes sustainable chemicals management, and helps to achieve broader environmental goals such as the reduction of energy consumption, of waste generated and of emissions.

The Ministry of Environmental Protection wants to set up a framework for close cooperation between partners regarding Chemical Leasing and to take action as stipulated in the Joint Declaration of Intent on Chemical Leasing.

UNIVERSITIES

COLOMBIA, EAFIT UNIVERSITY

Paula Marcela Hernández Diaz

Professor

Adriana Aristizábal Castrillón

Assistant Professor, Department of Process Engineering at the School of Engineering

How do you see the future of Chemical Leasing playing a role at the policy and industry level?

I see that Chemical Leasing can have an active role at the policy and industry level. To apply Chemical Leasing, it is necessary to know very well both the process (chemically) and the sector in order to be competitive and decrease or eliminate the environmental impact of the process. Thus, the person or industry who applies Chemical Leasing has "authority" to participate in policy for the industrial sector.

What do you think is needed to further replicate innovative business models such as Chemical Leasing at the global level?

Sell it! What I mean by that is show the advantages and potential of Chemical Leasing, in Higher Education Institutions, to the UN and governments, show that this model contributes strongly to the achievement of the SDGs, especially SDGs 12, 9, 8, 6, 11, and more indirectly to the others SDGs. Is there any other business model that can achieve this?

From my point of view, Chemical Leasing is a business model that makes the application of cleaner production and life cycle approaches in industry economically feasible. This is the way engineers should communicate with the CEOs of chemical companies to implement their process optimisation initiatives in line with green chemistry principles. In academia, we should make that clear for our students, not only introducing technical skills but also managements skills.

UKRAINE, INSTITUTE OF ENERGY SAVINGS AND ENERGY MANAGEMENT, NATIONAL TECHNICAL UNIVERSITY

Andrii Vorfolomeiev

Assistant Professor and Director at the Resource Efficient and Cleaner Production Centre

How do you see the potential for Chemical Leasing in industries in Ukraine?

Ukraine is a big producer of chemicals (mainly fertilisers) and an even bigger consumer. Taking into consideration the structure of the Ukrainian economy, Chemical Leasing has the biggest potential in the agricultural sector. However, national examples from the food production and the machine building sectors demonstrate that this business model generates economic and environmental benefits in different sectors. In addition, because the EU and Ukraine have signed the Association Agreement, Ukrainian industry is changing over to new conditions, including new regulations (based on EU Directives), markets and opportunities. For companies, it means facing new obligations in terms of chemicals, wastes, emissions etc. To deal with these, they need to modernise their facilities, train their personnel, and build up their expertise. Chemical Leasing proposes to Ukrainian companies that they can do it without significant extra expenditures in human and capital resources because it is a model where user and a supplier share the necessary capacities.

There are Ukrainian companies which already use this business model (some of them even obtained prestigious Chemical Leasing Award in 2018). With the awareness raising on Chemical Leasing and its benefits, their numbers will grow. Moreover, several Ukrainian universities have already inserted the Chemical Leasing study courses into their curricula. This will create a critical mass of people who will be familiar with Chemical Leasing principles and be able to apply the model at company level.

What benefits do business models such as Chemical Leasing bring to industries and societies?

Speaking about Chemical Leasing, it of course has benefits for both the environment as well as human health. But we should not just focus on decreasing the impacts to society at large. In our region, the employees in industrial companies often neglect the basic rules of safe chemical use. Chemical Leasing includes knowledge transfer from service supplier to user, and this education component enables not only a decrease in human exposure to chemicals and the replacement of hazardous chemicals, but it also develops the culture of proper chemical handling, and minimising the potential of chemical accidents, including releases, explosions and fires.

So, even taking into consideration the solid economic benefits to both the user and supplier, I think the most valuable part of the Chemical Leasing business model is knowledge and technology transfer. It will boost the industry by creating the national nodes of expertise, new 'green' markets and jobs, while simultaneously decreasing environmental impacts and improving worker safety.

YALE UNIVERSITY

Paul Anastas

Director of the Center for Green Chemistry and Green Engineering

How do you see the future of Chemical Leasing?

The potential of Chemical Leasing is immense, and it is just at the very beginning of its ability to bring about a positive change. There are many wonderful examples of where Chemical Leasing has demonstrated its power to bring about positive results, not only for business but also for human health and the environment. It is going to touch many more sectors that use chemical products and formulations but are not really aware that they are using chemicals. Chemicals touch 95 percent of manufacturing and products, but much of that is in companies downstream in supply chains, so they do not think of themselves as being part of the chemical enterprise. They just think of what they are using, the formulations or articles, but of course these are all part of the same chemical continuum. I think that as people become more and more aware of the power and the potential of Chemical Leasing, it is going to grow and become more widespread in many more sectors.

I believe that when you align economic and profitability goals with environmental and human health goals – that it is good for business and good for the planet and human health – then I think that there will be immense growth: it becomes self-driving! We should show that clearly, demonstrate it over and over again, then people will be very eager to be part of the Chemical Leasing framework.

What can help the replication of business models such as Chemical Leasing?

There is nothing more important than awareness. While the Chemical Leasing is a proven business model that has demonstrated itself in many different sectors, situations and country contexts- I don't think that there is the kind of universal awareness that there needs to be. There should be a greater level of awareness of what Chemical Leasing is and the great potential it has for business and for the planet. Everyone has a role in raising awareness, from teachers, to the business leaders, to the media, to the marketers. to the government and policy makers. There should be a shared responsibility around communication. Everyone has a role to play in raising awareness.

NATIONAL CLEANER PRODUCTION CENTRES

SERBIA, NCPC

Branko Dunjic

Director

How do you see the potential for Chemical Leasing in industries in Serbia?

As in every country, chemicals are widely used in Serbia: in industry, in households, in hotels, at airports, in agriculture. They are used everywhere. Chemicals are introduced into new areas, and new products are entering the market at a very high pace. the consumption of chemicals is growing. Even though there is an abundance of information about their characteristics on products' labels and on the Internet, the consumers are not really well informed about their composition and the hazards. The image of the chemical industry and chemicals is negative. At the same time, chemicals improve our quality of life and it would be very difficult to imagine modern life without them. Serbia is a candidate for EU membership and the concept of circular economy will become more and more important. Therefore, such service-oriented business models will attract, in my opinion, a lot of

attention from chemical suppliers and users operating in Serbia and in the Balkans. We are lucky that the concept of Chemical Leasing is not new for industry in Serbia and the region, as through UNIDO projects more than 15 companies have tested this new approach and some of them (FKL, for example) have been paying for performance instead of for quantity for 10 years already.

Which benefits do performance-based business models such as Chemical Leasing bring to industries and societies?

When partners regulate their relationship by performance-based business models, as a rule consumption of chemicals is decreased significantly. This means that there are economic savings. At the same time, partners share information, so the user knows better how to store, use and re-use chemicals which leads to a safer working environment. In a lot of cases, new recycling/recovery processes are included in the contract, thus creating new jobs. In conclusion, when Chemical Leasing is applied the right way, benefits are economic, social and environmental.

How do you see the future of performance-based business models such as Chemical Leasing in Serbia?

As I already said, the experience of several Serbian companies with Chemical Leasing has been very positive and promising. The Ministry of Environment signed the Declaration of Intent, which shows high-level political commitment. This, combined with outstanding results from several companies that are using Chemical Leasing in their routine operations, should pave the way for wider application of this performance-based business model in our country. At the end of the day, all companies that can apply Chemical Leasing will do it as it makes business sense.

SRI LANKA, NCPC

Samantha Kumarasena

Director

How do you see the potential for Chemical Leasing in industries in Sri Lanka?

Sri Lanka is a growing economy and this island nation is well known for its scenic beauty. The tourism industry is growing rapidly, and the country is recognised as a biodiversity hotspot in the world. We face the challenge of taking the country's development agenda forward while preserving our natural environment.

The use of chemicals in industry sectors rather than the manufacturing of chemicals is very significant in the economy. Per capita chemical consumption in the country keeps on increasing and excessive chemical consumption and wastages are reported not only in those industries using chemicals but also in the service sectors such as the hospitality industry as well as in agriculture.

The country has already developed success stories in the application of Chemical Leasing in agriculture as well as in vital industrial sectors so that both the broader agricultural sector as well as industry can confidently pick up Chemical Leasing as a business model to minimise their environmental impacts. Now that the Government of Sri Lanka has joined the Joint Declaration of Intent on Chemical Leasing, it will be motivated to more strongly promote Chemical Leasing as a promising tool for sound chemicals management. In a nutshell, Sri Lanka has an urgent need to manage the environmental consequences of using chemicals and by now the enabling environment has evolved with an elementary

understanding on the part of the government and with success stories developed by the NCPC over last decade to convince the industry. Hence, we are optimistic about the future potential of Chemical Leasing in Sri Lanka.

Which benefits do performance-based business models such as Chemical Leasing bring to industries and societies?

Industries in Sri Lanka using chemicals lagging behind in knowledge and expertise in the optimisation of chemical consumption. In addition, the country has a poor R&D infrastructure and budget. The chemical suppliers will help the user industries here to better understand the chemicals they use and to optimise the chemical usage, providing their expertise and R&D support. Disposal of chemical waste is also a burning issue in Sri Lanka, where there are no engineered landfill sites for hazardous wastes. This situation will improve when the suppliers are engaged in optimisation and managing reverse logistics. In addition, there are broader benefits with reduced chemical consumption that society as a whole will enjoy.

How do you see the future of performance-based business models such as Chemical Leasing in Sri Lanka?

There is a trend in the country. Enterprises are looking for innovative business models engaging supply chain partners. Chemical Leasing is such a business model for the partners in the chemical supply chain. As the country is a developing economy with an increasing consumption of chemicals, Chemical Leasing has a shining future.

11

GLOSSARY

11

The terminology in this Glossary is based on or cites common business and technical literature, but in some cases has been slightly adapted according to specific practices within Chemical Leasing. Please note that the glossary does not provide official UNIDO definitions for the given terms.

Baseline

An initial set of data and observations that are used as a basis for comparison and for defining change.

Business Model

A description and classification of the core aspects of a business, including purpose, business process, target customers, offerings, strategies, infrastructure, organisational structures, trading practices, and operational processes and policies.

Benefit oriented payment

The payment for a chemical is shifted so that the user pays for the benefit or function the chemical provides, e.g.: kg of laundry cleaned, m3 of water treated, m2 of area coated, etc.

Carbon footprint

The amount of greenhouse gases and specifically carbon dioxide emitted by something (e.g. a person's activities or a product's manufacture and transport) during a given period.

Circular Economy

A circular economy is one that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles. Source and more insights: EU DG Environment and Ellen Mac Arthur Foundation.

Core Business

The primary area or activity that a company was founded on or focuses on in its business operations, and the main source of a company's profits and success.

Corporate Social Responsibility

A company's sense of responsibility towards the community and environment (both environmental and social) in which it operates. Companies express this citizenship (1) through their waste and pollution reduction processes, (2) by contributing educational and social programs, and (3) by earning adequate returns on the employed resources. Source: Business Dictionary.

Environmental impact

The effect that the activities of people and businesses have on the environment.

Evaluation

The systematic and objective analysis of completed or ongoing activities to determine their relevance, effectiveness, efficiency and impact at a given point in time.

Green Chemistry

Green chemistry is the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances. There are different approaches to the implementation green chemistry. One well-known example are the twelve principles of "green chemistry" according to Anastas and Warner, dated 1998. Source: Yale University.

Global Product Strategy

Initiative launched by the International Council of Chemical Associations (ICCA) in 2006, to advance the product stewardship performance of individual companies and the global chemical industry as a whole. Together with the Responsible Care Global Charter, it is the chemical industry's contribution to SAICM. Source: ICCA.

Hazardous substances

Substances which, by reason of being explosive, flammable, poisonous, corrosive, oxidising, or otherwise harmful, can cause death or injury.

Monitoring

Monitoring is a periodic gathering and assessment of data that aims at providing detailed and regular information on the progress or delay of an ongoing activity. Monitoring gives an oversight of the implementation stage of the activity. Its purpose is to determine if the planned outputs, deliveries and schedules are on course and on time and if targets can be reached so that action can be taken to correct the deficiencies as quickly as possible.

National Cleaner Production Centres

National Cleaner Production Centres (NCPCs) deliver environment-related services to enterprises, government agencies and other organisations, mainly in their respective country. Their key services include information dissemination and awareness creation; professional training; in-plant assessments and demonstrations; policy advice; and support for the transfer of Environmentally Sound Technologies. See also here.

Pollution

The introduction of contaminants (unwanted constituents) into the natural environment that causes adverse change. Pollution can be chemical substances as well as noise, heat or light. Pollutants can occur in air, soil and water and can affect human health and the environment.

Pollution control

A term used in environmental management, meaning the control of emissions and effluents into air, water and soil.

Pollution prevention

Measures that help to reduce the amount of pollution into the air, water and soil. In contrast to pollution control, pollution prevention seeks to reduce the amount of pollution at its source by increasing the efficiency of a process.

Process optimisation

The discipline of adjusting a process to optimise some specified set of parameters. The most common goals are minimising cost, maximising output and/or efficiency.

Public Private Partnership (PPP)

PPP is a contractual arrangement between a public agency and a private sector entity. Through this agreement, the skills and assets of each sector (public and private) are shared in delivering a service or facility for the use of the general public.

Responsible Care

The chemical industry's initiative to improve health, environmental performance, enhance security, and to communicate with stakeholders about products and processes. See also here.

Resource Efficient and Cleaner Production (RECP)

RECP is the continuous application of an integrated preventive environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment. It specifically works to advance the three dimensions of sustainable development in an integrated manner, by catalysing:

- Production Efficiency through optimisation of the productive use of natural resources (materials, energy and water) by enterprises and other organisations;
- Environmental Protection through minimisation of the impact on environment and nature, by preventing the generation of waste and emissions and improving the use of chemicals in enterprises and other organisations; and
- Social Enhancement through minimisation of risks to people and communities from enterprises and other organisations and supporting their own development.

Sustainability

Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations. Source: US EPA.

Sustainability Criteria for Chemical Leasing

See page 31

Sustainable Chemistry

Sustainable chemistry links preventive protection of the environment and health with an innovative economic strategy that will also result in more jobs. It is a broad-ranging area that concerns stakeholders in the scientific community, the economy, public authorities, and environmental and consumer advocate associations. Source: Umweltbundesamt.

Sustainable development

Sustainable development, according to the Report of the World Commission on Environment and Development (WCED, 1987) "Our Common Future" (also known as the "Brundtland Report") is development that meets the needs of present generations without compromising the ability of future generations to meet their own needs WCED. Our Common Future - Brundtland Report. Oxford University Press, Oxford, 1987

Stakeholders

A person, group, or organisation that has direct or indirect involvement in the actions, objectives and policies of an entity. Key stakeholders in a business organisation include creditors, customers, directors, employees, government (and its agencies), owners (shareholders), suppliers, unions, and the community from which the business draws its resources.

Technical specification

A detailed description of technical requirements, usually with specific acceptance criteria, stated in terms suitable to form the basis for the actual design development and production processes of an item having the qualities specified in the operational characteristics.

Unit of payment

Charge per unit. In the Chemical Leasing business model, functional units (volume of treated water, area coated, etc.) are used to quantify the payment.

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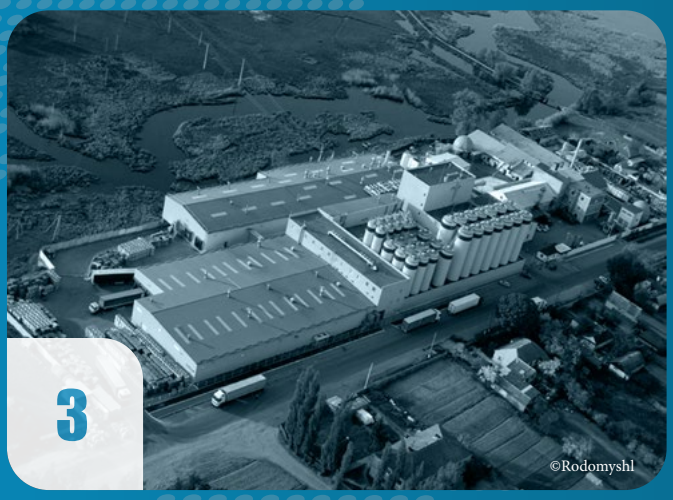
Chemical Leasing
A PERFORMANCE-BASED BUSINESS MODEL

1. International experts visiting a water treatment plant in Colombia

2. Global Chemical Leasing Award 2018 in Austria

3. Rodomyshl beverage plant in Ukraine

4. Business partners in Sri Lanka



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©Vodokanal Spb

5

©Safechem

7

5. Chemical Leasing project in Russia

6. International expert meeting in Germany

7. Employees of Safechem (chemical supplier from Germany) holding an award certificate

6

©UNIDO

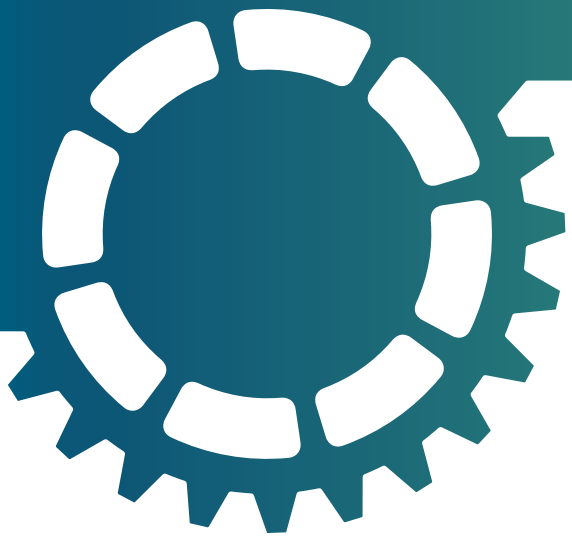
©NCPC Sri Lanka

...WHEN CHEMICALS PERFORM THE BEST

CHEMICAL LEASING 2020

FUNCTION TO IMPACT

A performance-based business model for sustainable chemicals management



This publication invites you to look at Chemical Leasing which began as a vision and is now a highly recognised circular economy business model for sound chemicals management.

The chemical industry is one of the world's largest manufacturing sectors and is growing significantly. It is a major employer worldwide, and chemicals and many useful applications, enriching our daily lives. At the same time, if not managed well, chemicals may harm the environment and people's health.

Chemical Leasing offers concrete solutions for the sound management of chemicals, the reduction of emissions and for a more efficient use of resources. It thus creates a perfect business environment to tackle challenges in a changing global context.

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

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