

CIRCULAR ECONOMY

Kemira Position Paper

Executive summary

This paper demonstrates **Kemira's current contribution to the circular economy** which can be evidenced in its customer offerings focused on driving resource efficiency, its operations, and its sourcing. As a chemicals company, Kemira provides expertise, application, know-how and chemicals that improve our customers' water, energy and raw material efficiency.

To accelerate the uptake of the reuse and recycling of raw materials in Europe, Kemira is calling for a **holistic approach, which should be a combination of regulatory, economic and societal drivers**. Regulation could drive reuse and recovery of raw materials and resources through the setting of realistic targets for reuse which take into account what is recoverable, how it can be recovered and how it can be marketed. In this respect Kemira supports the European Commission's goal to create a market for secondary raw materials. Furthermore, because the barrier to reuse is often the cost, both innovation and market instruments are needed to rebalance the market. Market intervention could include tax support for recycled/recovered materials (e.g. bio-nutrients such as Phosphorus), pricing models and taxes (virgin vs. waste streams). In addition, increasing end-consumer awareness of the need for resource efficiency across the economy as a whole would be one of the strongest drivers for Kemira and our customers to use and develop sustainable technologies and product offerings.

In this paper, Kemira provides examples of the need for policies to drive resource efficiency in three specific sectors which are of importance to the European economy, namely **water, pulp & paper and phosphorus**.

This paper also identifies **some existing challenges to the realization of the circular economy** in Europe, both in terms of removing obstacles to the uptake of reuse and recycling, and also by making use of industrial by-products as raw materials. These challenges include EU legislation on waste (including shipments of waste and end-of-waste criteria), environment and REACH. Kemira believes that more favorable conditions for the circular economy could be created, while maintaining the same level of environmental protection, though a simplified single EU system involving harmonized legislation and a centralized single market approach to these policies (including registrations and administrative requirements). This would end uncertainties or differences between Member States, and avoid unnecessary costs, delays or administrative burdens for the industry.

Finally, while acknowledging the need to maintain the highest levels of environmental protection, Kemira calls for a **more uniform implementation of all current and future European environmental legislation** across all Member States and **stringent enforcement** at national and EU levels.

Kemira's role in enabling the Circular Economy

Resource-efficiency at the heart of Kemira's strategy

As a chemicals company, Kemira understands that the role of chemistry in the circular economy is a fundamental one. Chemistry is an important building block in most materials and manufactured goods. Innovations in chemistry also enable waste material conversion for reuse and recycling. As the industry continues to innovate, the role of chemistry in driving and enabling the circular economy will continue to grow. In this regard, Kemira believes that for the circular economy to succeed, the role of chemistry as an enabler must be acknowledged and supported by decision makers.

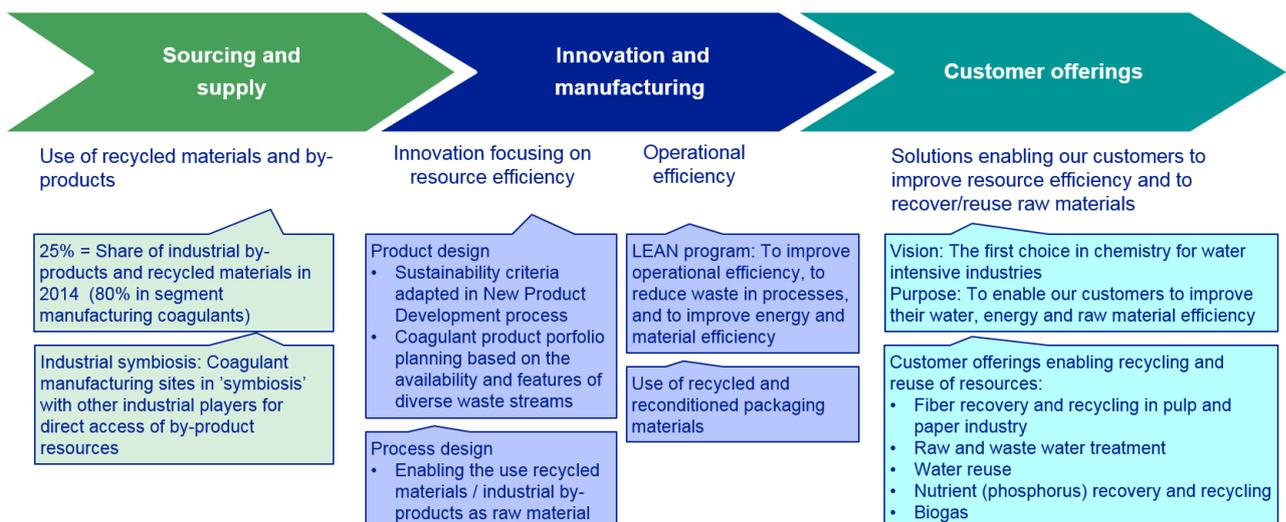
Kemira is a company which is at the heart of resource efficiency and the circular economy in Europe.

The circular economy is central to Kemira's value chain at all stages. These include:

- **our customer offerings and solutions**, which are focused at driving resource efficiency in our customer industries;
- **our own operations**: LEAN program which focuses on topics such as operational efficiency and reducing waste in materials and processes, improving energy efficiency, process efficiency and resource efficiency internally, and using less materials, looking for opportunities for reusing and recycling in all aspects of our work;
- **our supply side**: the use of recycled materials / industrial by-products as raw materials, industrial symbiosis.

Circular economy relevance in Kemira context

Value chain approach



Kemira's case studies to promote the circular economy

Kemira provides chemical solutions which enable the circular economy to its customers, in particular to the water intensive industries and municipal water treatment, by offering solutions to reuse and recycle water and to recover energy and nutrients from waste water. In addition, Kemira offers solutions to the paper industry, to facilitate the implementation of their bioeconomy strategies and to enable the use of high quality recycled fiber.

1. Water recycling and reuse

Water reuse is a central component of integrated water management and promoting water reuse will be a clear step towards achieving a circular economy, as identified by the AQUAREC project and the European Commission's Green Paper on water reuse.

Indeed, designed correctly, water reuse can help achieve considerable savings because often water does not need to meet drinking water quality standards, it only needs to be clean enough. Water reuse can also help decrease the amount of waste water discharged into the environment, ensure the safeguarding of water supplies and manage the imbalance between water demand and supply in water-stressed regions.

Kemira is the market leader in providing chemicals and solutions for integrated water management including drinking water, wastewater and sludge treatment, and improved water treatment efficiency. Kemira supports waste water operators with a broad range of solutions which support the separation of dissolved and particulate impurities from water and consequently promote water recycling.

Poor implementation of the Water Framework Directive (2000/60/EC) and Urban Waste Water Treatment Directive (91/271/EEC) has often led to water reuse being ignored. In addition, the current price of reused water is too high to encourage its uptake, while the price of freshwater is too low in some instances. Instead of the existing national standards, EU wide standards should be created to lower the compliance and monitoring costs and create economies of scale.

Furthermore, when no economic drivers exist, and high investment costs of reuse plants and related infrastructure serve as an additional barrier to uptake, regulation is needed to ensure water reuse. Any future regulation should however take into account the differences in terms of water availability in EU Member States, and water reuse should only be encouraged where it makes economic and environmental sense. There is also a need for proper pricing mechanisms for reused water. There are currently no EU-wide or globally accepted quality standards for water reuse. These should be created in order to define what quality of water can be used in which applications, and to ensure public acceptance for reused water.

2. Bioeconomy and fiber recovery and reuse in the pulp and paper sector

Kemira is the largest pulp and paper chemical supplier in the world and supports pulp & paper producers in innovating and constantly improving their operational efficiency and end product quality. Kemira's products and solutions also support the reuse of materials like cellulose fiber and water in this industrial segment. Much of Kemira's R&D work involves seeking solutions that contribute to the growth of the bioeconomy in the paper industry, by facilitating and improving the efficiency of biorefining processes that may use massive quantities of water and by finding solutions for the processing of other kinds of biomass.

Recycled fiber has a limited lifetime, does not have the same quality as virgin fiber and some paper grades always require input of virgin materials to meet the required end product quality. It is possible through chemistry to extend the lifetime of recycled fiber to reach five to six, or even seven recycling rounds. As for the chemistry itself, the share of reused raw materials is expected to grow in replacing virgin raw materials in chemical manufacturing, thus further contributing to the circular economy.

Promoting the uptake of reused raw materials and resource efficiency in the paper sector (as in other sectors) should also involve environmental education at consumer level, and the extension of existing schemes such as EU Ecolabel to cover raw materials and the entire manufacturing process.

Kemira also believes that environmental permits of paper plants should be based on BAT (Best Available Technology) to ensure that efficiency requirements in manufacturing processes are met, including elements such as resource and operational efficiency, emissions and waste water treatment, and water reuse.

3. Phosphorus recovery and reuse

Kemira is market leader in the EMEA region and North America in chemical solutions for integrated water management, and has extensive expertise on phosphorus removal and recovery from waste water.

Phosphorus is one of the vital building blocks for life, and is essential for food production, animal feed, and biofuels. However, 95% of the phosphorus used in Europe is imported from outside the EU, in particular from Morocco and Russia, where escalation of existing geopolitical conflicts could lead to a catastrophic supply problem. Furthermore, most of the phosphorus in Europe is wasted due to insufficient wastewater treatment and poor nutrient recycling. The wasted phosphorus in turn causes environmental damage through eutrophication in rivers, lakes and oceans resulting in algal blooms and depletion of oxygen in the water.

Currently, within Europe, only 32% of the phosphorus present in wastewater is recycled. About 50% is disposed or incinerated and the remaining part is found in wastewater after treatment. With the use of coagulants, 90% of the phosphorus lost with the treated water could be captured at the treatment plant. This share could also be recycled to agriculture.

Chemical treatment, using coagulants which are mainly iron or aluminum salts, is an essential element of phosphorus recovery from wastewater. Coagulants have been used for more than one hundred years to clean and purify water and for phosphorus removal for the last fifty years. This is the most effective and cost-efficient solution to capture and remove phosphorus from wastewater in order to make it available for recycling. Kemira is the world's leading supplier of inorganic coagulants and has developed a broad range of both aluminum and iron coagulants with which we are able to provide the best product performance over a large range of process conditions.

While the EU has recently given greater attention to the problem of phosphorus supply since the publication of the EU's Consultative Communication on the Sustainable Use of Phosphorus in 2013, more action is needed to stop the current wastage. Kemira sees a number of drivers for phosphorus removal and recovery in Europe, which are not all yet in place. These include:

- **compliance with existing and emerging legislation on water quality** (increasingly stringent regulations and greater enforcement of existing EU Directives on phosphorus concentrations in both wastewater and sludge);

- **economic drivers and the recovery of value from waste** (like the harmonization of end-of-waste criteria or giving fiscal advantages for use of recovered phosphorus);
- **sustainability and environmental concerns** (such as increasing awareness among farmers, consumers and industry and setting stricter values for the presence of pollutants in water).

Kemira therefore strongly supports the Commission's focus on secondary markets for raw materials and bio-nutrients in particular.

Circular economy in Kemira's sourcing and operations

In 2014, 25% of raw materials across all Kemira business segments originate from recycled sources or industrial by-products from external partners, which in many cases would be disposed. This figure reaches as high as 80% in our coagulants portfolio (coagulants are iron and aluminum salts used in the drinking water and waste water treatment process). These include recycled materials and industrial by-products from smelters, steel and metal manufacturing, and other industries.

Kemira also promotes resource-efficiency in its own operations, through the LEAN program. The LEAN program in Kemira's manufacturing process involves a series of activities to create more value for customers, which entails optimizing value chains and flows of information, improving production efficiency and increasing production responsibility, while providing a standardized toolset for identifying and minimizing different kinds of waste through the whole manufacturing process.

Innovation to support the Circular Economy

Resource efficiency and chemistry enabling the circular economy through our offerings are at the heart of Kemira's innovation strategy and customer focus. Kemira provides expertise, application know-how and chemical solutions that improve our customers' water, energy and raw material efficiency. Through innovation, Kemira has also acquired extensive knowledge in using recycled materials / industrial by-products as raw materials.

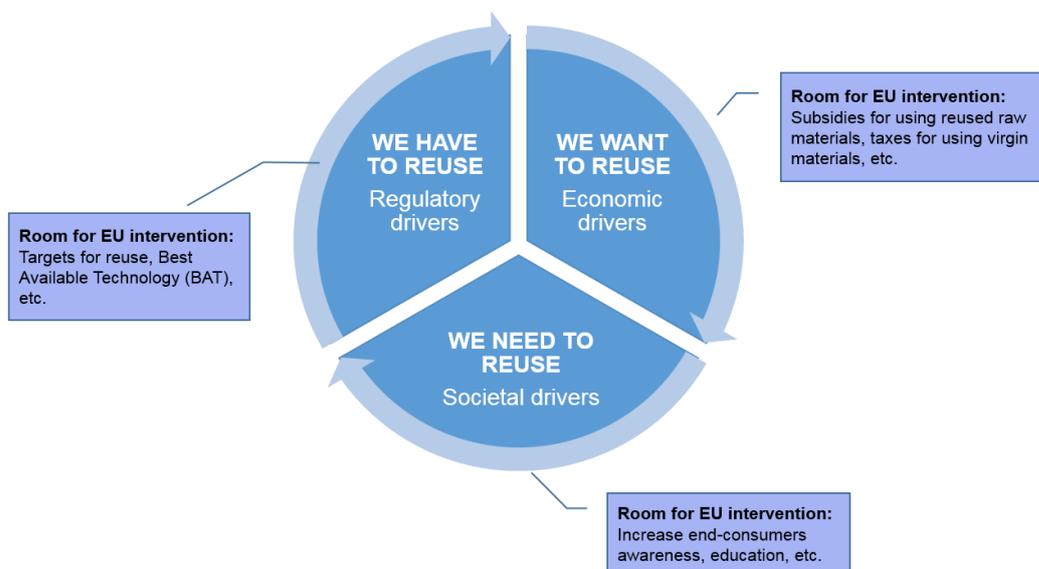
Innovation is therefore central to Kemira's business. Kemira currently employs 250 R&D experts and innovation sales represented a share of 8% of Kemira's total revenue in 2014, with the objective of reaching 10% by the end of 2016.

However, in many cases the technologies involved remain costly, and the overall processing of recycled materials / industrial by-products to a usable form makes the secondary raw material more expensive than the primary / virgin material. A large part of our innovation focuses on the identification and testing of alternative raw materials, and most importantly the reduction in cost through the use of new processes or materials.

Kemira believes that support and funding to research institutes and universities through the EU Research and Innovation program, Horizon 2020, and programs run by national governments is of great importance. In combination with this, the private sector also has a role to play. This includes the funding of innovation, closer collaboration with universities, and the establishment of SMEs to bring innovation to the market. A permanent mechanism could be established for the private sector to give directions to research institutes and industry.

Three drivers for resource efficiency and reuse

Overall, Kemira believes that there are three drivers to achieving greater levels of reuse and resource efficiency in our value chains, and that the preferred approach would be a holistic one taking into account three lines of thought as follows:



Regulatory drivers

Regulation could drive reuse and recovery of raw materials and resources through the setting of targets for reuse. Waste targets could be set to take into account what is recoverable, how it can be recovered and how it can be marketed. In this respect Kemira supports the creation of a market for secondary raw materials.

However, such targets must be carefully considered to take into account the competitiveness of the global economy, as setting unrealistic targets for EU economic actors will drive manufacturing and industry outside of Europe to regimes where less strict environmental laws apply. The environmental benefits must therefore be carefully balanced with the economic elements. These could perhaps include fiscal measures to ensure that resources are taxed based on their environmental impact, with stakeholders seeing an economic advantage in making use of reused resources or raw materials. Environmental permissions should be based on BAT (Best Available Technology) to ensure that efficiency requirements in manufacturing processes are met.

When considering regulation as a driver of reuse, clear long-term policies from legislators are needed. EU and Member State policies must be aligned and coherent. They must also align with international rules impacting companies operating in the EU and globally, such as those set at WTO and OECD level. This would give companies the certainty to make the necessary economic investments and develop systems to encourage reuse, production and raw-material sourcing. The EU's trade policy should also seek to ensure that the circular economy extends beyond the EU's borders, for example by advocating that imported products are subject to similar circular economy requirements as any EU product.

Where environmental laws do exist, or when new targets are set through environmental laws, they must be strongly enforced and implemented in all Member States' legal systems to give certainty to market players developing technologies based on the legislation. Current examples of EU legislation which is perhaps not fully implemented and monitored by the Commission and Member States includes the EU Biocidal Products Regulation (528/2012) and large elements of the EU body of water legislation.

One such example of how regulation could drive the circular economy without creating unnecessary costs could be in the concept of fully utilizing the biomaterial in wastewater to generate energy (such as biogas and electricity) and bio-nutrients (such as Phosphorus). Aside from initial capital expenditures, the resources gained would in theory pay for any additional operating costs incurred.

Economic drivers

In addition to the legislative obstacles detailed above, in Kemira's experience, the barrier to reuse and recycling is often one of cost. In many cases virgin raw materials are the cheaper option, and the cost of the recovery process is often a hindrance. For that reason, both innovation and market instruments are needed to rebalance markets. Market intervention could include tax support for recycled/recovered materials (e.g. bio-nutrients such as Phosphorus), pricing models and taxes (virgin vs. waste streams). Such measures should look at the true costs of virgin raw materials, taking environmental and sustainability concerns into account. In addition to this, innovation, in particular looking at how to reduce the cost of reusing and recovering value from waste, is essential to Kemira's strategy.

Societal drivers

Societal drivers would likely be addressed through the increased awareness of all stakeholders, from raw material providers to decision makers to end-consumers. Depending on the market and product concerned, consumers sometimes welcome reuse but are not willing to pay more. They are also often not aware of reuse or recovery or see reuse as a negative aspect (as could be the case with reused water).

A number of elements are needed to address conceptions and consumer preferences through environmental education. One straight-forward option could be the extension of the existing EU schemes such as the EU Ecolabel to cover additional categories of products (such as water or products containing recycled fiber). Such actions could also address information and awareness campaigns. The inclusion of sustainability criteria in public procurement would also increase awareness, and have a knock-on impact on private sector markets.

Increasing end-consumer awareness of the need for resource efficiency across the economy as a whole would be one of the strongest drivers for Kemira and our customers to develop and use sustainable technologies and product offerings.

The table below provides examples of these three types of drivers to promote the circular economy in the specific sectors mentioned above.

Water recycling and reuse	Fiber recovery and reuse in the paper sector	Bioeconomy	Phosphorus recovery and reuse
<ul style="list-style-type: none"> • Pricing model for reused water • Quality standards for reused water • EU funding for research on water reuse (Horizon 2020) • Increasing awareness of end-consumers on water reuse and related safety and quality standards 	<ul style="list-style-type: none"> • Extension of EU existing schemes such as EU Eco-Label to promote products containing recycled fiber • Environmental permits of paper industries based on Best Available Technology (BAT) • Increasing awareness of end-consumers on sustainable consumption and recycling 	<ul style="list-style-type: none"> • Business model for biorefineries • Incentives to use biomass as raw materials • EU funding for research to promote bioeconomy in industrial innovations (Horizon 2020) • Increasing awareness of industry and end-consumers on sustainable consumption and the benefits for environment 	<ul style="list-style-type: none"> • Creation of a market for recovered phosphorus from waste water and other waste streams • Incentives to use recovered phosphorus as fertiliser or as raw material in industrial applications • Harmonisation of end-of-waste criteria • Increasing awareness of farmers, industry and consumers

Barriers to the use of recycled materials

Kemira has identified some challenges to the uptake of reuse and recycling of raw materials. These lead to increased fixed costs and delays in bringing new product offerings to the market.

In particular, stringent rules on **cross-border transfers of waste** under the EU Regulation on shipments of waste (1013/2006) create an obstacle. Kemira fully supports the EU's aim to ensure supervision and control of waste shipments, however we believe that the approach should be a risk-based one, with an internal market approach taken to registrations of transfers of waste. The shipment of hazardous wastes and of wastes destined for disposal is generally subject to notification procedures with the prior written consent of all relevant authorities of dispatch, transit and destination. When industrial by-products are categorized as waste or hazardous waste under the EU Regulation, Kemira believes that the same level of environmental protection could be obtained by means of a single EU registration with the countries of departure or arrival, which could then be accessed by any authority via a central database. Existing legislation is creating a scenario where shipments of waste are only worthwhile for very large shipments (several hundred tons). Smaller scale shipments, or even samples to test innovations with new raw materials, are prohibitively expensive.

The issue of **end-of-waste criteria** is also relevant here. An internal market approach is necessary to stop uncertainties or differences between Member States with product classification (waste or by-product). This will enable a well-functioning internal market for secondary raw materials, giving increased attention to the future use, rather than the source, of the materials.

Likewise, the **REACH regulation** has a positive role to play in environmental legislation, but in some cases has proven to be a further obstacle to the uptake of reuse and innovation in terms of raw materials. When innovating with new types of reused raw materials, the interface created between the Waste Framework Directive (2008/98/EC) and the REACH Regulation (1907/2006) constitutes a barrier to the

reuse of certain materials, due to the fact that when raw materials cease to be waste, REACH registration requirements apply as for any other materials. Registration requirements of waste materials under the REACH regulation are therefore very difficult to comply with and induce unreasonably higher costs compared to better identifiable virgin raw materials. The chemical industry already provides downstream users with information regarding the presence of substances of very high concern (SVHCs) so as to enable people to use them safely. As a general rule, if the regulations permit the use of a substance in the downstream economy because it has been shown to be safe, there is no reason why it should not be recycled and used again safely. Such an approach may be a preferable option in order to maintain the highest levels of environmental protection while allowing companies to innovate with the re-use of waste.

Creating a Single Market for the Circular Economy

Kemira understands and supports the high level of environmental protection afforded by existing EU environmental legislation. We therefore believe that any amendments to existing legislation must ensure that these highest levels of environmental protection are maintained. Our approach therefore focuses on **mutual recognition and co-operation between Member States**, and **streamlining of legislation and compliance without any reduction in standards**. Where legislation does exist, it must be implemented in a uniform manner across all Member States, and stringent enforcement must exist at national and EU level.

About Kemira

Kemira is a global chemicals company serving customers in water-intensive industries. We provide expertise, application know-how and chemicals that improve our customers' water, energy and raw material efficiency. Our focus is on pulp & paper, oil & gas, mining and water treatment. In 2014, Kemira's annual revenue was EUR 2.1 billion. Kemira employs around 4,250 people, including 2,400 across the EMEA region. Kemira shares are listed on the NASDAQ OMX Helsinki Ltd.

Kemira drives to achieve above-the-market growth through our customer focus, competent people, high-performing organization, product and service innovations, and a strengthened presence in selected emerging markets.

Paper

We have unique expertise in applying chemicals and supporting pulp & paper producers to innovate and constantly improve their operational efficiency.

Oil & Mining

We provide a unique combination of innovative chemicals and application knowledge that improves process efficiency and yield in oil, gas and metals recovery.

Municipal & Industrial

We enable our municipal and industrial customers to improve their water treatment efficiency by providing expertise and chemicals for raw and waste water management.

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