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Article

Towards a Circular Economy: The Role of Dutch Logistics Industries and Governments

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Abstract: While there is great potential in the chief values and prospects of a circular economy, this alone will not bring the circular economy to market or scale. In order for a circular economy to materialize, an integrated approach that focuses on a long-term system change or transition is required. To set the change process in motion, many (public and private) players (companies, authorities, citizens, and research institutions) need to be involved. Among the many stakeholders, a genuine enabler to implement a successful and sustainable circular strategy is the logistics industry. Given that The Netherlands is used as a case study, in this paper, we focus on the Dutch logistics industry and how this industry can contribute to the broader Dutch agenda to realize a more circular economy. It implies looking at the specific transition agenda for the logistics industry in relation to a circular economy, what barriers may exist that might hamper such a transition, and how public policy-makers are dealing with and can tackle these barriers.

Keywords: circular economy; logistics industry; transition; system change; barriers identification; The Netherlands

1. Introduction

The increasing demand and limited supply of resources, of which some critical substances are becoming scarce already, confronts society with the risks of dependency, shortage and increased cost. This causes a major challenge in several ways. Additional sourcing of resources will most likely cause more severe negative impact on the environment. New, less attractive and less accessible locations for sourcing/mining will be explored, causing land degradation, deterioration and local damage, while being more costly due to the location and the increase in social and environmental pressure on mining. Businesses and also nations will try to increase their sourcing and buying positions (e.g., China's strategy), while also looking for alternatives that offer a better business case and added value. Replacing the linear economy—source, use and waste—with a “circular” economy offers such an alternative [1].

The need for a transition towards a circular economy has in the past decade been advocated by an increasing number of academics, politicians, businesses and international organizations [2,3]. This is because studies show that the advantages of a circular economy are substantial. The reduction of cost and impact that can be achieved in the value chain by eliminating sourcing of raw materials and waste

processing allows business and society to redesign and invest in a circular system. In this circular system materials are applied in products in such a way that they can be recovered and reused almost endlessly. It prevents that “value” (i.e., resources) from just exiting the economy. The circular system can be organized to create sustainable value by minimizing the environmental impact and by inducing new economic activities (labor).

Building a circular economy will require coherent change in consumer behavior, governmental policies and business practices. Such a transition is complex and requires simultaneous changes in various subsystems, such as the energy, logistics and financial subsystems. It also needs clear guidance and monitoring, as circular systems are not necessarily “better” than linear systems under all circumstances. Inefficient circular systems can create a lot of social, economic and environmental damage as well (e.g., due to excessive use of transport and energy, or unattractive work conditions, such as in product recovery).

The shift to a value creating circular economy will lead to new business models, value chains, and product-service delivery models. It affects the design, production, use and disposal process, and the collection of products and materials for reuse. It also adds new processes to facilitate, maintain, share, repair, upgrade and remanufacture products.

The Dutch Council for the Environment and Infrastructure (in Dutch: Raad voor de leefomgeving en infrastructuur (Rli)) is the primary and independent strategic advisory board for the government and parliament in the fields of sustainable development of the living and working environment in The Netherlands. Very recently, the Rli has strategically explored the impact of a transition towards a circular economy, as well as the consequences for strategic changes in logistics and for the logistics industry [4,5]. The authors of this article were all involved in this exploration. Both studies explore major trends and developments and suggest strategic priorities for Dutch policies, based on an extended literature review, a large number of interviews (>110 to be more precise) with relevant stakeholders, position papers by and consultation of experts, round tables with front running businesses and policy makers. This article, based on both Rli studies, aims to describe the major challenges, opportunities and obstacles for the logistics sector as an enabler for a circular economic development, with a special focus on the logistics industry in The Netherlands. In both studies, this results in priorities for the logistics industry as well as policymakers. We acknowledge that The Netherlands is but one particular case study in a broader Europe, but a very interesting case study given that the concept of circular economy has already been strongly introduced.

The structure of this article is as follows. In Section 2, the general concept of circular economy and the basic motives to stimulate a circular development are memorized. Next, Section 3 zooms in to the situation in The Netherlands. In Section 4, we explore the potential role of the logistics sector in support of circular economy, and summarize the recommendations made by the Rli to the Dutch policymakers and the logistics industry. Section 5 describes some main barriers for the logistics sector for implementing the recommendations. In Section 6, main conclusions are drawn.

2. The Concept of Circular Economy

The notion of circularity in economic production–consumption processes has been launched in the past decade as the latest stage in the evolutionary debate on sustainability. Since the end of the previous century notions such as “people-planet-profit”, “cradle-to-cradle”, “multi-value creation” and “responsible entrepreneurship”, dominated the discourse on sustainability. These notions were driven by the findings that social and environmental interests were undervalued and harmed in the current economic model dominated by short-term profit [6]. Alternative technologies, such as the concept of cradle-to-cradle and closing the loop, took hold when economic analysis showed the enormous benefits of circular resource management. As this economic benefit can very well coincide with social and environmental value creation, the concept of a circular economy was embraced as a very attractive and new sustainable economic principal.

Unlike the current economy, which is largely based on the principle “take-make-waste” (linear economy), the focus point in a circular economy is to not unnecessarily destroy resources. This implies far more than the reduction of waste through recycling [2], stresses the following focal points: reducing the consumption of raw materials, designing products in such a manner that they can easily be taken apart and reused after use (eco-design), prolonging the lifespan of products through maintenance and repair, and the use of recyclables in products and recovering raw materials from waste flows. A circular economy aims for the creation of economic value (the economic value of materials or products increases), the creation of social value (minimization of social value destruction throughout the entire system, such as the prevention of unhealthy working conditions in the extraction of raw materials and reuse) as well as value creation in terms of the environment (resilience of natural resources).

In the literature on circular economy, a distinction is made between various gradations or options for circularity. This starts with “refuse” and ends with “recover energy” [7]. These different gradations or options (often referred to as the 9 Rs) are listed as follows:

- (1) Refuse: preventing the use of raw materials;
- (2) Reduce: reducing the use of raw materials;
- (3) Reuse: product reuse (second-hand, sharing of products);
- (4) Repair: maintenance and repair;
- (5) Refurbish: refurbishing a product;
- (6) Remanufacture: creating new products from (parts of) old products;
- (7) Repurpose: product reuse for a different purpose;
- (8) Recycle: processing and reuse of materials; and
- (9) Recover energy: incineration of residual flows.

The gradations of circularity also make clear that “recover energy” (from materials through the incineration of residual flows) is the final option for extracting value from resources. Recovery of energy actually “ends” the resource-cycle by degrading and decomposing materials into heat, emissions and ashes. In the current economy, “recycling” (the processing and reusing of materials) is a process that degrades materials as well, as the applied recycling system is not able to create high quality secondary resources out of all waste streams.

While recycling and energy-recovery are at the heart of a recycling-based economy, a circular economy clearly entails more and comprises more levels. Figure 1 expresses the basic models of respectively a linear economy, a recycling economy (called “economy with feedback loops” in the figure), and a circular economy. The recycling economy and a fully circular economy differ from each other in that the recycling economy does still involve the input of raw materials and the generation of waste (residuals), while the loops are closed in a circular economy. Moreover, where in the first two models energy consumption is dominantly related to the external production and large scale use of scarce raw materials (oil and gas), accepts the circular economy model the production and use of renewable energy as one of the constituent principles [5].

In the economy with feedback loops, the reuse of materials is mostly regarded as a separate optimization step, which is a (undeliberate) consequence of the choices made in the phase of design, production and use of a product. In the circular economy, the (re)use of materials is an integrated factor in the optimization of the delivery of functionality.

There are at least three major advantages of or motives for pursuing a circular economy [5,8].

Firstly, a country or global region (e.g., Europe) that is able to implement a circular economy becomes less dependent upon the import of raw materials for production of goods. With the growing world population and average consumption level, raw materials become increasingly scarce, resulting in, e.g., higher prices on the global market. Moreover, the production and distribution of certain raw materials increasingly tend to become part of strategic policies of supply countries to create political influence on consuming regions (compare, e.g., gas production and distribution from Russia to Europe). The strategic choice of a region to stimulate business to recover raw materials from recycled products

and retaining these resources longer in the regional production–consumption chains, implies more control by this region on the supply of crucial materials and less dependency on the (instable) politics of the raw materials producing regions.

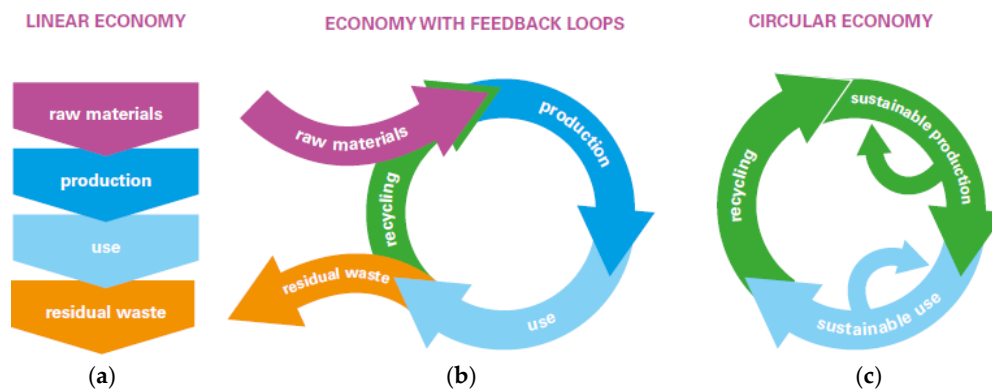


Figure 1. Differences between linear economy, economy with feedback loops, and circular economy [5].
(a) linear economy; (b) economy with feedback loops; (c) circular economy.

Secondly, circular economy has a great potential to generate new employment. Focusing on the recovery of raw materials from products in order to retain them in the economy for longer can result in job growth in the region due to the greater regional demand for reuse, repair, remanufacture and reclamation of raw materials. In the past, these kinds of activities were often shifted to low wage countries, mainly to profit from low wage costs. However, nowadays, the total chain costs are increasingly gaining in importance. This involves costs of purchase and production of increasingly scarce raw materials, quality control on the production process, organization of smart logistics, required technical skills, reduce delivery time, recalls and maintenance services, waste treatment and environmental protection [9]. Many production–consumption chains have become more complex due to more advanced designs to deal with more variety in consumer preferences, higher quality requirements, and more speed to cope with rapidly changing consumer preferences and less time-to-market. To reduce the costs of the entire chain and to gain better control on the chain of activities in that context has intensified the search for the design and testing of new business models in practice [1]. One remarkable observation in this context is that “near sourcing” is increasingly gaining ground: the strategic relocation by companies of activities related to recovery of basic materials, repair, reuse and end production close to the location where the end products are sold [4]. A circular economy furthermore creates more employment in the so-called “eco-industry”: the heterogeneously and broadly composed industry which provides innovative knowledge, advanced technologies and services in support of circular production–consumption chains and the area of environmental protection and recovery. Examples are technologies and services that optimize production of renewable energy, minimize energy use, prevent air or water pollution, decompose waste in reusable resources, etc. Between 2000 and 2011, the eco-industry in Europe grew by over 50 percent; it is one of the few industries that has had a healthy turnover and development in employment since the start of the financial crisis in 2008 [10].

The third major advantage lies in the potential of a direct and significant reduction of the environmental deterioration. The expanding world population is making ever-greater demands on natural resources causing more pressure on the environment: in the course of the twentieth century, the global population growth in combination with growth in welfare has resulted in 34 times more consumption of materials, 27 times more minerals, 12 times more fossil fuels and 3.6 times more biomass [11]. The demand for consumer products will increase further: according to [11], a tripling of the global use of materials in 2050 can realistically be expected in relation to the base year of 2000. Extracting raw materials, manufacturing, consuming and waste processing lead to the emission of

harmful substances, negatively impact on ecosystems and the need for large quantities of water and (mostly fossil) fuels. To fulfill the growing demand, less accessible and less efficient sources will need to be explored, requiring more energy, causing more waste and disturbance and deterioration of ecosystems. The negative impact on the environment is therefore exponentially larger.

Furthermore, worldwide still many materials are lost: they are not reused at the end of their first application, but labeled as “waste” and taken to landfills or incinerators. For example, in 2013, in Europe (knowing that major differences between EU member states exist), 481 kg of domestic waste on average was generated per person; of this, 31% was dumped in landfills, 26% incinerated, 28% recycled and 15% composted [12]. In addition, materials also directly pollute the ecosystem as litter. For instance, plastic litter is a global problem, as they contain toxic substances, decompose slowly into micro plastics and accumulate in the food chain. Currently, 5.25 trillion particles weighing about 269,000 tons are floating in the world’s oceans (so-called: “plastic soup”) [13]. These figures indicate that the potential of circular economy to reduce the total volume of waste, to significantly increase the average share of reusable waste and to reduce the share of dumped and incinerated waste, in combination with a significant increase of use of renewable energy has direct positive impacts on the environment.

Pursuing a circular economy implies a fundamental transition of society. Such a transition is complex and requires simultaneous changes in various subsystems, not only on a regional or national scale, but also on a European and global scale. Circular economy is one of the topics the European Commission is committed to. On 2 December 2015, the European Commission presented its Circular Economy Package [14]. This package, referred to as “Closing the Loop”, consisted of a European Action Plan for the circular economy in which a series of measures and monitoring tools were proposed which cover the complete cycle from production and consumption to waste management, and the analysis of the market for secondary raw materials. The Action Plan also spells out a rigid timeline when the actions need to be taken forward and/or completed.

It was at the time of the Dutch presidency of the European Union in 2016 that the Dutch government wanted to carry forward its plans for a circular economy in line with the European Action Plan. The Rli was asked to give insight into the opportunities of a circular economy on a local, regional and national scale, and to advise the Dutch government on these matters. The key elements of that advice are summarized in the next section.

3. Circular Economy in The Netherlands

As there exist a number of arguments why a shift towards a circular economy is beneficial on a global scale, an equal number of arguments can be provided why such a transition to a circular economy are needed and promising for a country like The Netherlands.

Firstly, The Netherlands depends greatly on the import of products and raw materials. The Netherlands imports 68% of its raw materials from abroad: in 2010, 161 billion kilograms of raw materials were imported. The indirect dependence on raw materials is even greater. If the raw materials for semi-finished and finished products are also included, then the amount of imported raw materials is three times greater [15]. The Dutch economy is strongly dependent upon and interwoven with the larger northwest European economy. Europe also depends on imports for its raw materials that are often essential to Europe’s economic activities, for example in the production of electronic devices. The European Commission has defined 54 critical raw materials for Europe; Europe depends on the import of raw materials from beyond the EU for 90% of these 54 materials. China is the main supplier [3]. That dependence leads to vulnerability. Shifting power balances and conflicts in key regions supplying these raw materials contribute to fluctuating raw material prices and uncertainty in terms of security of supply. In the period between 2000 and 2013, the volatility of raw material prices increased by a factor of three compared to the period 1990–2000 [16]. Moreover, increasing scarcity has caused prices to rise. Since 2000, raw material prices have more than doubled on average, while they were still falling in the twentieth century. This poses ever-increasing risks for companies that

depend on (non-renewable) resources. These developments make Europe vulnerable. Even now, it is already becoming apparent that major investment decisions, such as that of Siemens to sell off its lighting division Osram, are taken with raw material-related considerations in mind [17].

Secondly, it is constantly necessary to maintain and where possible improve the earning capacity of The Netherlands. In recent years, the economy has started to recover [18,19]. Due to the heavy dependence on raw materials, the Dutch economy, however, continues to be vulnerable to fluctuating raw material prices, scarcity and uncertain security of supply. By capitalizing on opportunities and reducing the vulnerability to these uncertainties, the earning capacity of The Netherlands could be significantly strengthened. A smarter use of raw materials can result in cost savings, innovations in the production and knowledge infrastructure and in new earning opportunities.

Thirdly, the Dutch industry has built up a good position en route to a circular economy. For example, The Netherlands leads the way in Europe in terms of separate waste collection, achieves good results with recycling, and various initiatives surrounding circular (logistics/business) chains are being adapted. In respect to the latter, this is not limited to traditional product delivery systems, but also includes new business models such as product sharing, leasing and outsourcing functionalities. Recent research shows that 25% of Dutch companies are familiar with and acknowledge the importance of a circular economy. In big companies (with 500 employees or more) this increases to 57%. Particularly companies in the chemicals sector, wholesale trade, industry and agriculture, forestry and fisheries are the most active and ambitious in this respect [20]. The main reasons are that they see huge advantages in terms of recycling and reuse, because it touches upon the very core of their businesses, and because it saves them on raw materials, and in the end, money.

For example, Desso, a Dutch carpet manufacturer, has already been working on the transition towards a circular company since 2008. Desso takes back used carpets from customers and competitors. The yarns are recycled into new carpets; the bitumen backing is recycled as a raw material for road construction and roofing. By 2020, Desso wants to be able to take back all of its products, after which the materials will be used to produce new, high-quality products [21]. Another company, Van Houtum (which manufactures toilet paper and paper towels), among other things processes residual waste paper flows from third parties into new products. In turn, the company's own residual flows are used as resources by other plants. This method of manufacturing has resulted in considerable cost savings (1 million euros in 2013 compared to 2009), thanks to the recycling of paper residues, a more efficient use of the paper machine, a lower consumption of chemicals, energy and water and a reduced loss of resources [22]. Companies have also developed new services to replace the ownership of products: for example, Greenwheels is a business that makes car ownership unnecessary by providing (shared) cars to its members across the country; the Dutch railway company NS provides and maintains easily accessible bikes to railway clients to make ownership and parking of bicycles unnecessary.

Fourthly, the idea of circularity is also vivid outside the industry in civil society, e.g., among (groups of) private individuals and local service organizations. For example, there are growing numbers of local loan and repair companies and the reuse of products through thrift stores is also increasing. New forms of service rendering, such as clothes libraries, repair cafés and initiatives for joint energy supply, are emerging as well. The rapid growth of SnappCar, the consumer trade platform Marktplaats and other forms of sharing and lifespan extension rather than traditional ownership, also serve as indicators for a shift in mindset and behavior that is necessary for the transition to a circular economy. Alternatively, Amsterdam's claim to be Europe's first "Sharing City", which is, in essence, a collaboration between the city government, existing businesses and "sharing economy" start-ups, urging citizens to share skills, cars, office spaces, meals, washing machines, and other belongings.

Finally, important steps have been taken in public policy. The Dutch national government has been actively supporting bio-based economy, and subsequently, circular economy was included in the governmental agreement of the current coalition. It has become an important program within the Environmental directory, named "from waste to resources", and in the economic "green growth" policy. A governmental program has been developed in collaboration with sustainable business associations,

to explain and promote circular economy to SMEs across the country, to provide training and start-up support, and to communicate best practices. Budget has been allocated to scientific research into circular business models. Significant results have already been achieved. National end-of-waste criteria have been drawn up for the recycling of aggregates from construction and demolition waste, making them more attractive to use. To facilitate new circular business solutions, the government is willing to make specific changes in waste regulation. To illustrate, a guideline has been drawn up for the substance crude glycerin, a residue from the production of biodiesel, which clearly states when it can be considered a by-product rather than a waste product. A breakthrough has also been reached for the increasingly scarce raw material phosphate: the use of recovered phosphates as fertilizer is allowed. To stimulate consumer behavior befitting a circular economy and to promote waste separation not only at home but also in public, the State has entered into a Green Deal with the Dutch rail operators NS and ProRail regarding waste separation by rail passengers. Pilot projects have been initiated involving textile and food to experiment with instruments influencing consumer behavior to become more sustainable [23,24]. In addition to these national initiatives, several provincial authorities have incorporated the promotion of circular economy as a goal in their new coalition agreement as well, and various regions are fleshing out the circular economy in regional policy.

Summarizing, there appears to be a clear need and plenty of momentum in Dutch society in support of the required transition. However, transitioning from the still dominant linear economy to a circular economy requires an integrated approach that focuses on the long term: a system change. To set the change process in motion, many players are involved and their shared agenda includes working on vision and mind-set, organization and leadership, business models and necessary means and resources, the relevant institutions and rules of the game (see, e.g., [25,26]).

According to a very recent survey by UPS and GreenBiz [27] among sustainability executives and thought leaders the biggest growth in the adoption of the circular economy model will come from the technology sector, especially electronics such as computers and cell phones, as take-back systems and product reuse are most easily integrated in those models. However, the real enabler to implement a successful and sustainable circular strategy is the logistics industry. Logistics plays a critical role. According to the same survey, nearly unanimously, 97% of respondents claim logistics as either very important (87%) or somewhat important (10%) to transitioning to a circular economy.

The respondents stated that logistics companies can offer customers unique value by incentivizing greater participation in the circular economy through a seamless and convenient take-back model. Offerings such as pre-paid shipping labels, smart packaging and convenient take-back mechanisms help fuel market demand. Additionally, consumer and customer costs can be reduced through the use of backhauling as well as through load and route optimization [28].

In the next sections, we focus on the Dutch logistics industry and how this industry can contribute to the broader Dutch agenda to realize a more circular economy. It implies looking at the specific transition agenda for the logistics industry in relation to a circular economy, and what barriers may exist that might hamper such a transition.

4. Future of Dutch Logistics Industry: Contributing to Circular Economy

The logistics industry has always been a major player in the Dutch economy. Many products from abroad are moved to the European hinterland or elsewhere in the world, through The Netherlands and vice versa. Clearly, this is due to the unique positioning in the Rhine-Maas-Schelde delta. The Dutch logistics industry has developed strong transit and warehousing activities as well as related value added services and activities, up to the level of management of control of international freight chains and networks. The excellent transport infrastructure in The Netherlands for all transport modes plays a crucial role in this respect, notably the various seaports in the area from Antwerp to Eemshaven (with Rotterdam being the largest sea port in Europe measured in annual freight volume), the networks of inland waterways and freight rail lines that connects the seaports and business areas to the hinterland, and Schiphol airport (in terms of freight volume, the third busiest airport of Europe). The total amount

of freight transport in The Netherlands has grown from 1500 Mton in 2000 to about 1750 Mton in recent years. Various freight transport statistics (collected by the OESO or Eurostat) show that in the next three to four decades the total volume of freight transport at a global scale will significantly grow, possibly double. This growth will not be equally everywhere, but the trend creates great challenges for the logistics industry, among others because of the impacts on the logistics infrastructure and the significant negative consequences of the related doubling of CO₂ emissions for the environment.

To elaborate on global developments, the Rli [4] points to the consequences of this expected increase in freight transport at various spatial scales in The Netherlands. First, as indicated above, there will be a major impact on the use of the aforementioned Dutch internationally oriented transport infrastructures (Mainports), where main concerns regarding the level of congestion, safety and security, and emissions have to be dealt with in a context of maintaining sufficient economic benefits at state level. Secondly, a substantial share of freight transport manifests itself at a local and regional level, characterized by transport on relatively small distances. The volume of this transport is growing. This has to do with several simultaneous developments, such as the increasing number of companies in the logistics industry that choose to locate within The Netherlands to profit from the mature system for international logistics, the increased business-to-business relations in production–consumption chains and networks, the increasing attention for homemade production services (e.g., 3D printing), after sales services and reverse logistics, and the expanding e-commerce causing a complex last mile distribution (delivery at home or neighborhood distribution points outside the traditional shops). In 2012, the Dutch web shops processed orders for a total of about 10 billion Euros (almost a quarter of a million daily orders). The number of online orders has gone up ever since and The Netherlands ranks among the top in Europe in this respect. The major part of this type of local and regional transport is road-based and consequently implies an increasing burden for local and regional road networks, in particular in dense urban areas.

The added value of the logistics industry to the Dutch economy is significant (about 3.5% of GNP, with approximately direct 280,000 jobs). Moreover, in recent years [29], the ambition has been formulated to have The Netherlands in 2020 ranked as the number 1 of all European countries in the World Logistics Performance Index. This ranking should be based on a major extension of logistics services in the field of chain and freight network control, the attraction and location of more European distribution centers, a significant improvement of the utilization of transport means and physical infrastructures and investments in the underlying knowledge infrastructure aimed at an improved average competence level of professionals working in the logistics industry. This strategic horizon, formulated by the Topteam Logistiek, is still very much path dependently framed by the development of the Dutch logistics industry in the past decades, with a strong focus on transit and The Netherlands being the gateway to Europe.

The study by the Rli [4] provided a new framing for this top level ambition and argued that transport as such (notably the substantial amount of international transport), without clear links to value added logistics activities, should no longer be the main long term goal of development of the logistics industry: the environmental burden would in the end be too high. Moreover, the hidden assumption that trends in the past provide the context for the future might be wrong: the gradual shift to circular economy results in a stronger focus on near sourcing and results in major changes in the transit flows. Moreover, the traditional view tends to neglect the intensifying problem of fast growing local and regional transport. Instead of supporting the ambition to be the main carrier for Europe (business is bringing freight from A to B), alternatively the Rli pleads for a focus in the development of the logistics industry on becoming an indispensable enabler of circular economy: logistics as added value service to production–distribution–consumption chains of other industries that are already increasingly adopting the principles of circular economy or have the ideas, ambition and the power to make major steps in that direction in the near future.

The strategic ambition related to this different framing of logistics industry would be to have a significant impact on (that is: adding value to) the circular organization of chains of recovering and

using resources from used products and waste, energy low and smart production and distribution processes, after sales services and reverse logistics based on innovative concepts of ownership. With respect to transport activities this requires a strong focus on reducing avoidable transport, optimization of product flows in production chains and towards the end users, the organization of seamless and smart transport chains using environmental friendly transport modes that significantly reduce the energy-intensity of transport. However, the logistics industry can also contribute in other ways, such as turning waste flows from the one industry (heath or water production, various waste materials) into flows of resources for (optimizing) production by other industries and organizing services and activities that add value to products and the Dutch economy.

To substantiate this changed framing of development and the related ambition (“redesign Dutch logistics to last”), the Rli studied the role of logistics for three sectors: (a) agri/food industry, including life sciences (5.4% of GNP; 480,000 jobs; 100,000 companies); (b) chemical industry (2.2% of GNP; 106,000 jobs; 4000 companies); and (c) high tech industry (6.7% of GNP; 520,000 jobs; 39,000 companies). These sectors are all strongly export oriented, but vary significantly in terms of organization, type of products (from low value bulk to high value spare parts), batch volumes, environmental impacts and safety and quality requirements and control. By in-depth studying these sectors, a representative picture of Dutch producers that strongly depend upon the logistics industry good be built. Based on the analysis of the presence of circular economic principles in these sectors and their potential impact, four priorities are recommended [4].

A first priority for Dutch logistics industry is to critically reconsider the transit function of The Netherlands. This will change due to the earlier described trend towards near sourcing in combination with a higher level of competition from other parts of Europe, notably northeast and southeast Europe. Moreover, the societal costs might become too high (environmental impacts, costs of infrastructure investments and maintenance). The Rli specifically recommends the Port of Rotterdam to develop a strategy to gradually switch from a classical transit port for Europe to a European circular hub. This starts with a good analysis of opportunities for port companies to develop business models based on an explicit and growing involvement in e.g., being a focal point for return flows, attracting activities and technologies for the recycling of products and waste, organize the production and the supply of new biodegradable raw materials or raw materials for 3D printing, and the like. In particular, a gradual switch from oil processing to biomass processing seems to offer interesting new opportunities. Evidently, such a change in color of the seaport activities needs time and dedicated knowledge development. It requires a strong and broadly among stakeholders shared sense of urgency for transition and a long term vision and willingness for follow new avenues. This is a shared responsibility of state, regional and port authorities and those businesses in the area that can operate as change agents. At this moment the Rli is making an advice on the topic of the Dutch Mainports. The advice tries to answer the question: “does the position of the Dutch Mainports demand a different policy approach when viewed in the light of global trends?” and is circular economy one of these trends?

A second priority of an innovated logistics industry is to systematically avoid unnecessary transport. To limit the steady growth in transport kilometers directly reduced logistics costs in production–consumption chains and has direct beneficial value for the environment. One way is to more intensively collaborate among transport companies to share transport means and to increase the load factor of transport modes, a strategy that already receives much attention. Another way to reach this goal is to strengthen the policy efforts to stimulate spatial clustering of industries that are (increasingly) dependent upon each other: spatial clustering is important to create local industrial ecology supported by linking infrastructures (e.g., for local transport of reusable waste water or heat) and shared service (e.g., shared waste treatment, quality and safety control, shared local renewable energy production (wind, solar or biogas) and distribution, shared research and training institutes). Such economic geographical concentration of interrelated industries and services, (e.g., for high tech, agrifood, or chemical industries) instead of geographically uncontrolled and dispersed location of

individual companies, increases the conditions for successful circular economic business models across the borders of the individual companies and thus reduces costly transport movements. It is evident that this strategy requires strategic collaboration between regional and local authorities as well as elaborated shared intervention policies.

The third priority for logistics industry framed as enabler of circular economy is to elaborate and implement at a large scale innovative concepts for city logistics, integrating last mile (delivery) logistics with service logistics and first mile (reverse) logistics. The major goal is to keep the ever extending urban metropolitan areas livable. This concern about livability is triggered by the combination of fast growing e-commerce, the rapidly growing problems of traditional retail structures (problems with accessibility, decreasing turnover, vacancy or surface use by alien businesses), and the ongoing concentration of population in urban areas. City logistics at present is a dynamic service in a highly unregulated free market with many transport suppliers and an extremely atomized demand. The societal impacts (road safety, emissions) in certain urban neighborhoods approach the level of unacceptable. Attempts in the past two decades to implement concepts based on collaboration between suppliers and the establishment of city distribution centers, has partly been successful and has definitively only effect on a small scale. It is therefore recommended that provincial and municipal authorities start applying innovative tendering for city logistics in many more urban neighborhoods, within the context of a goal-oriented regulations aimed at the promotion of livability in these areas. The State is advised to pursue administrative agreements with provincial and municipal governments about the harmonization of these goal-oriented regulations.

Business already anticipates on this development. For example, the start-up Picnic has set-up an online grocery delivery service with electric city vehicles designed for purpose, supported by high quality client services, based on new logistic and ordering software. The business case of Picnic is based on competitive pricing, cost reduction (no retail outlet), no loss of products, less packaging and a packaging return system, and high service level (delivery on time, and Picnic vehicles visible on a map).

Finally, a fourth priority is logistics sector is to start more systematically interacting with the industries served by them to stimulate a joint rethinking of the entire supply chain. One single link (a company) in the supply chain is able to optimize its own production process, but all these individual link optimizations do not necessarily result in an optimal closed loop supply chain with the greatest added value for consumers and society in general. Producers therefore should make a switch to multiple value creation in integrated supply chains, taking into account the entire lifecycle of each product (including sales and post-use phases). New business models including new alliances and instruments for risk and benefit sharing are needed here. To create such an environment for exploring new avenues, assumes a critical and open (less risk avoiding) mind-set, the elaboration of innovative views, good analytical competences and tools, the right competences to act as change agent, adequate education and training opportunities; in short: a significant investment in a higher level of professionalism.

The four above-mentioned priorities, elaborated by the Rli Council, to stimulate the logistics industry to develop as an enabler of circular economy are inevitably formulated in rather strategic terms. The Council's basic aim is to stimulate the debate in the field and to support those companies and initiatives that match the developments described in the Council's report. It is obvious that the priorities need further thinking, elaboration and implementation. To do so, various existing barriers need to be taken into account. The next section addresses some of these barriers.

5. Barriers to the Transition of Logistics Industry

Several barriers are in place that impede the transition to a circular economy. Although the logistics industry is strongly interwoven with various activities in production and distribution chains, not all barriers are of direct relevance for this industry. Therefore a selection of themes is made here.

5.1. Institutional Barriers

Institutional barriers are structural barriers that have taken root over the years in market structures and daily practices (rules of the game), and which in their entirety maintain the linear economy. For the logistics industry, we particularly refer to the dominant regulatory and financial frames.

Current legal and financial frameworks have been drawn up within a historical context that is heavily dominated by a linear economic view. As a result, some aspects in (national and European) legislation and the way in which they are interpreted may impede the transition towards a circular economy. In their report [30] point out that circular leaders experience limited room for innovation due to a risk-avoiding interpretation of rules by the competent authorities. Three examples might illustrate this:

- One example concerns competition policy. Logistics in a circular economic view is very much focused on (re)organizing transport chains based on selected procurement focusing on near sourcing, collection and reuse of residual materials, limiting warehousing of (half) products, seamless multimodal transport using environmental friendly transport means, and the like. This organization is complex and might require involved companies to cooperate very intensively for a longer period, for example because of (developing) shared views, business principles and operational practices, investing in unique knowledge or equipment, and because of sharing risks. Intensive cooperation within such chains with a limited number of preferred partners on a structural base might however be qualified as cartel forming. Under the applicable Dutch and European legislation aimed at protecting consumer interests, such intensive cooperation is often not permitted [31] (p. 41).
- Another example concerns the fact that legally speaking, waste is not a resource. This is understandable from the standpoint of protecting the environment and public health, since pure waste is collected and treated differently from residual materials that have (potential) value as secondary raw material. There are also limitations on cross-border waste transport that do not apply to raw materials [30,32]. Fortunately, recent European waste legislation does allow member states to establish criteria at the national level (provided no European criteria are in place and provided that certain conditions are met) under which certain waste material may be considered a raw material. In The Netherlands, this recently happened for recycled aggregates from construction and demolition waste.
- The European Waste Shipment Regulation (EWSR) regulates the cross-border transport of waste materials: into, out of and within Europe. In the discussion on the circular economy, this directive is cited as a barrier to the international trade and transport of valuable secondary raw materials. Apart from the high administrative burden for companies, this directive has also been the subject of criticism due to differences in interpretation and enforcement in the various European countries. These differences result in an unlevel playing field: The Netherlands for instance is allegedly more stringent in this respect. Because of this, The Netherlands, in its capacity as a major transit country for waste, is being negatively impacted by the insufficient enforcement of the European Waste Shipment Regulation in other member states and by the fact that the so-called “green list”, which lists waste materials that are governed by a relatively lighter regime, is interpreted differently from country to country [24].

5.2. Economic Barriers

For the transition to a circular economy, good economic earning potential is crucial to companies. Is it profitable to operate circularly? Companies that adapt to the principles of a circular economy will expectedly need alternative business models with business processes that have been set up in a different way [1]. Several studies suggest that—barring some exceptions—parties are still insufficiently able to find one another for this and optimize business ecosystems [30–32]. Companies need to be aware of each other’s existence, interests and corporate strategies and this is still insufficiently the case

at present. We mention three barriers for fast breakthroughs in the development and implementation of new business models for the logistics industry in support of circular economy.

- **Vested interests.** The Netherlands Organisation for Applied Scientific Research TNO states that industry associations are often still focused on traditional chains due to vested interests and path-dependent behavior, which hinders the search for circular alternatives [30]. Parties with vested interest often are not inclined to act as change agent or might even develop resistance to a circular economic approach to preserve the status quo. For the logistics industry this for example applies to many transport companies: their business is strongly based on increasing the use of expensing transport capacity but generating transport of freight from A to B. Such companies (in The Netherlands alone about 11,500 in 2013) have no basic interest in a significant decrease of the amount of freight to be transported, or in sharing transport capacity. Moreover, at a European level, competition growths is due to the increasing number of transport companies from Eastern Europe that have an easy access to the transport sector, and often operate on the bases of a very traditional business model.
- **Lack of investment power.** Gearing the strategic and operational management in production–consumption chains towards circularity is in organizational terms a complex matter: more collaboration and arrangements between various stakeholders is needed. Managing many contracts and their related new sources of risks (for example when leasing services) is different from supplying products and consequently requires a different operational approach [32]. Hence, businesses according to the principles of a circular economy can require relatively high investments in the short term (in, e.g., knowledge, competences, setting up new arrangements, and new equipment) while the yields do not become apparent until the longer term. The fact that in many cases costs and benefits are currently still unevenly distributed across the chain contributes to this. The profit margins for production industries and retailers for example are many times higher than those for transport companies, among other things due to the fact that power is unevenly distributed among players in the production–consumption chains [30], and due to the large competition as result of easy access to the transport market. Hence, one party has a greater margin to make circular (pre)investments than another, but generally companies in the logistics industry receive a low ranking in this respect.
- **Insufficient challenge from producers.** As an enabler, the logistics industry supports production, distribution and selling industry. The main trigger for change comes from these industries, but as long as these industries do not start working on a large scale in a changed mode, insufficient incentives are given to the logistics industry to also change businesses. Such changes in the leading industries are complex: a company that wants to start working circularly may be dependent on other (supplying) companies and the pace at which these start operating circularly. Procurement and sourcing conform the starting points of a circular economy proves difficult for a company: other risks are involved, longer product lifespans with longer contracts, changed interdependencies and responsibilities, a more integrated approach to the costs of life cycles when determining the price [30,32]. Most business plans in a linear economy still assume three to five years with short cycles (fiscal years and quarterly budgets), whereas the cycles of a circular economy often span longer periods of time [32]. The higher costs of management and more complex planning still impede the transition to a circular economy [31]. Moreover, prices of some raw materials are still lower than the price of recycled materials. This makes it less profitable for companies to start working with secondary materials (recycled materials) or to provide a product that (by design) can be more easily repaired, reused or disassembled after use. These prices are often relatively low because the external costs of production of raw materials are not (fully) included in the costs [31,33]. The true price includes the external costs: the monetized social and environmental costs. If non-renewable resources and transport are given a true price, these costs are likely to be passed on in all links of the chain. As long as this is not fully the

case, the logistics costs that are charged in the chain are lower than the real costs, stimulating path-dependent behavior of all players.

5.3. Social and People-Related Barriers

Generally speaking, gaining public acceptance for the principles of a circular economy constitutes an important condition to achieve this transition. Although this seems to develop in the right way, three issues are still rather problematic:

- On average, awareness and sense of urgency among consumers, producers and logistics companies still too limited to trigger a large scale shift towards a circular economy and circular actions [30,31]. As these actors become more aware of (the consequences of) their behavior, the behavioral preferences change [34], and willingness to act [35], increases [36]. Where logistics companies may feel themselves locked in a system that is dominated by producers and selling industries, and the last mentioned industries feel their operating mode determined by consumer preferences, at their turn consumers may feel that the contribution an individual can offer in terms of sustainability is far smaller than that of the business community or the government. Moreover, people love convenience and low costs [30,37]. Creating a breakthrough in this situation starts with providing good information, sharing knowledge and ideas and good practices. For example, the general public is on average unaware of what value waste may have, and they are generally insufficiently aware of the consequences of the increasing popularity of Internet buying and the related home delivery for the city distribution. People are more likely to act circularly when they think that people who are important to them expect them to do so [38]. Furthermore, people are more inclined to act circularly when they see others doing this [39].
- At present, property, material consumption and the values associated with these are deeply embedded in society. Property is part of the self-consciousness of people. Ownership may be associated with expression of the most individual and basic preferences and as such “doing the right thing” (and thus making people feel good about themselves). Property is often status-related and the susceptibility of people to fashion and trends may cause consumers to make choices that are less optimal from a circular perspective [30–32]. The message of a circular economy may come across as “what you have is only temporarily yours” [32], thus not conveying the same values as are currently associated with property. Furthermore, it is often more difficult for consumers to think in terms of functionality rather than products, and especially this is necessary when products are rented, leased or reused [32]. Consumers still have a dominant preference for “new” instead of “used, recycled, second-hand”: new is “still the best”. Used products are often considered more or less inferior, an idea that is strongly supported by marketing of new products [32]. This preference limits the potential of organizing local collection and exchange of goods, although the number of initiatives is growing (e.g., with regard to second hand furniture, books and clothing). These are mostly low costs local initiatives, with a positive impact on the amount of transport needed.
- It is important to realize that change in behavior can only be expected when several specific aspects for various relevant groups of individuals have been taken into account, and a combination of measures is tested and evaluated. Unlike the mainstream assumption, most behavior does not follow from rational and “economic” evaluation of options, but a more satisfying, sub-optimal decision-making process is adopted. From a policy perspective, often top down projections and rationalizations are used to define how to influence behavior, without proper analysis from the perspective of the end-user. In the Rli report “Influencing Behaviour” [37], many studies have been assessed on effective measures to change behavior. A behavioral model is developed to explain what factors are important to address. Individual behavior is influenced by many factors, including abilities, motives, circumstances, and choice processes. In practice, research shows that behavior largely depends on factors such as the social norm, habits, attractiveness, new technologies, and condition of the surrounding environment [40]. Some people attach

little or no importance to the quality of the environment; others simply cannot appreciate the consequences of poor environmental quality. Some believe that acting in an environmentally responsible—or “sustainable”—manner is more difficult or expensive than the alternative. Furthermore, sometimes, sustainable behavior may not be the obvious choice. In short, human behavior is complex and variable. The public’s response to policy measures cannot always be predicted using traditional assumptions about the rationality of behavior. If current knowledge regarding how people respond to certain situations and why they respond in a certain way is used in a (more) deliberate and systematic way, it will be possible to enhance the effectiveness of environmental policy.

5.4. Professional Barriers

The transition to a circular economy requires knowledge development, knowledge dissemination and innovation, here summarized under the label professionalism. If these elements are insufficiently present, this may impede the transition. In general, knowledge development with regard to the issue of circular economy is characterized by fragmentation in the organization of it and an insufficient focus on cross-sectoral knowledge development. The switch to circular economy is relevant for various sectors and debates in these sectors follow identical patterns. The observable lack of cross-sectoral knowledge exchange is from that perspective highly unproductive. Structural cooperation in this field between companies, knowledge institutes and government bodies is not guaranteed, causing best practices and clear failures not or insufficiently to be shared. With that the question arises as to how knowledge development can be organized and how acquired knowledge can be properly brought to the market [30]. In addition to these questions, it is a challenge to improve the dissemination of knowledge among companies. A lack of trust between companies and the confidential nature of information limit the exchange of information and, with that, the transparency and average improvement of the system [30–32]. Despite the growing interest and the strong starting position of The Netherlands in the field of design and logistics, knowledge development in the field of circular business models is still in its infancy. Finally, a coherent approach to education and the development of relevant skills and competences (such as knowing to perform chain and network analysis, having knowledge of the principles of circular economy, being able to develop new business models for logistics industry, think multidisciplinary, etc.) is still largely lacking [30]. However, the good news is that there is an awareness of the problem and it is being tackled. Evidence of this can be found in such programs like “Nederland Circulair”, a Netherlands Organization for Scientific Research (NWO) program on circular business models; Green Deals, a Dutch Governmental initiative to make concrete steps towards a sustainable economy, coupling more green energy with economic growth; The Netherlands Circular Hotspot Campaign, a “living lab” that provides inspiration to governments and international businesses all involved in a movement towards a more circular economy.

6. Conclusions

Circular economy is a system change that is necessary because it will make Europe less dependent on raw materials. European economics will benefit and the environmental problems of Europe will be reduced. The debate on and practice of circular economy is essential, and we are still far from completing the transition. This paper—which draws heavily on two recently conducted studies on the impact of a transition towards a circular economy, as well as the consequences for strategic changes in logistics and for the logistics industry executed by the Rli—provides insight into the complexity of this issue. It acknowledges the importance that it is necessary for all stakeholders involved to move in the same direction. Institutional and economic barriers will therefore have to be taken down. At the same time, consumers, producers and logistics companies have to be encouraged and supported in changing their social and personal behavior. In The Netherlands, more and more companies, authorities, citizens and research institutions are working intensively together trying to implement the circular economy, which has resulted in interesting new initiatives. Communication of the success and advantages of

those initiatives is essential to make the system change work. Only then can the circular economy proceed from an experiment to common practice. As described in the Rli study “Circular economy: from wish to practice”, a joint vision, able to spot the horizon, is required for moving in the right direction. After all, being able to spot the horizon will show the finiteness of the current (linear) paths and will give companies the time and opportunity to gradually prepare. Figure 2 gives a schematic representation of what needs to be done: develop a vision, formulate overarching goals, and develop a strategy [5].

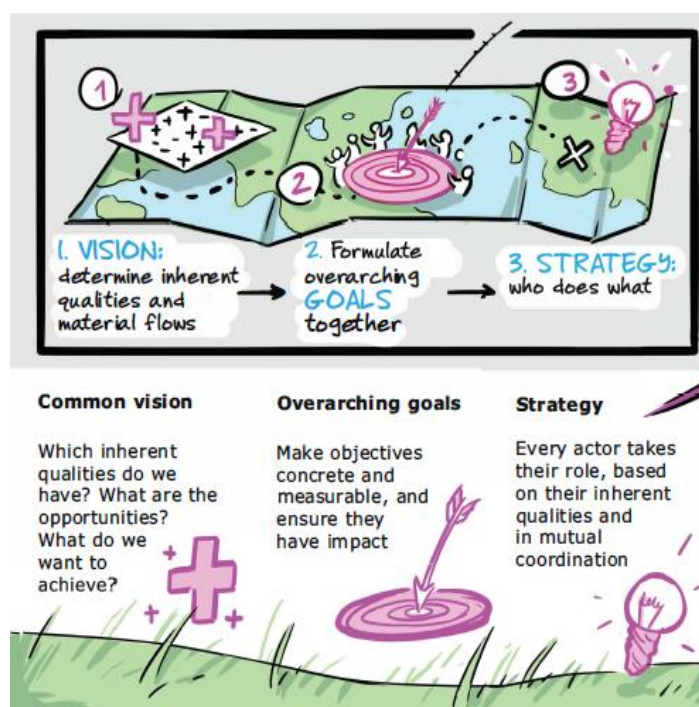


Figure 2. Circular economy: from wish to practice [5].

The government has an important role to play in this. The circular economy therefore has to be one of the strategic issues of governmental policy for the short and long run/term. Companies would be willing to change their investment strategy if this policy were to last for more than one cabinet term. For companies, this means that short-term economic profits no longer dominate their business strategy. New business models are needed for risk and benefit sharing. These changes will bring new opportunities to the logistics industry. However, The Netherlands is not able to act on its own. The economy of The Netherlands is heavily intertwined with many northwest European countries. With the European Circular Economy package, it would be an exciting challenge to act together as members of the European Union, learning and helping each other in our path to a circular economy, each using their inherent qualities or strengths and creating more coherence together. It will be a long path, but the prospects are good and we are optimistic about the possibilities.

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Abbreviations

The following abbreviations are used in this manuscript:

Rli	The Dutch Council for the Environment and Infrastructure (in Dutch: Raad voor de leefomgeving en infrastructuur).
NS	Nederlandse Spoorwegen (in English: Dutch Railway company).
SMEs	Small- and Medium-size Enterprise(s).

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