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Eco Efficiency and Circular Production: Cases from the Netherlands' Eastern Region

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Abstract

This chapter discusses three case studies of circular production in the eastern region of the Netherlands, where the Dutch Hanse tradition of craftsmanship and family business links up with modernity and care for the environment. The main goal of the firms in our case studies is to prevent waste and to use recycled and non-fossil resources in their own production processes. Moreover, attention is paid to the circularity of the whole supply chain by acting as orchestrator of that chain. Government should support these firms by facilitating knowledge spill-overs, providing proper education and internalising the positive externalities that the strategies of these firms bring about in terms of the circular economy and sustainability.

Keywords: Hanse tradition, circular economy, sustainability, eco efficiency, waste reduction, supply chain orchestration, recycling and reuse.

20.1 Introduction

The report 'Limits to Growth', published in 1972 by the Club of Rome, created awareness that further exponential economic and population growth with finite resources would eventually be harmful to welfare. The vision of the Brundtland Commission in 1987 shifted the focus to the environment and emphasised the trade-off between current and future economic growth, or alternatively the trade-off between people, planet and profit. The argument is that environmental degradation should be stopped in order to make (economic) development sustainable. The Brundtland Commission (1987, Ch 2) defined sustainable development as '*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*'. This definition introduced intergenerational equity as a point of concern. Later the concept of sustainability was operationalised in various policy proposals and treaties. For instance, on 25 September 2015, the United Nations launched a new Sustainable Development Agenda with 17 Sustainable Development Goals to end poverty, protect the planet and ensure peace and prosperity for all. To reach these ambitious goals all groups in society need to take responsibility: government, the private sector, industry and civil society.

A practical approach to bring about sustainability is to aim for circularity in the supply chain. Here circularity means that all resources used in the production process are recycled

and used again, so that no waste is left to pollute and degrade the environment. At the macro level such circularity would lead to a ‘circular economy’.

In September 2016, the Dutch Government published the report ‘Rijksbrede Programma Circulaire Economie’, which sets forth the aim that by the year 2050 the Dutch economy should be completely circular (Dutch Ministry of Infrastructure and Environment, 2016). It is an ambitious policy perspective for a future-proof and sustainable economy and a liveable planet. The ambition of the Dutch Government is to reduce the use of natural resources (minerals, fossils and metals) by 50% in the year 2030. The circular economy is regarded to provide a solid basis for resource efficiency, increasing the lifetime of products and materials and fostering ecological values. The Dutch government is not unique in its ambition for a circular economy. The European Commission (2015), the United Nations (2015), Scotland and Finland have made similar policy plans for circularity in their economies (Scottish Government, 2016; SITRA studies 100, 2015).

This chapter discusses how circular production is implemented in the eastern region of the Netherlands. The remainder of the chapter is organised as follows. The next section provides an overview of economic activity in this part of the Netherlands, with special emphasis on eight centuries of the regional Hanse tradition of craftsmanship and trade. Section 3 outlines a theoretical framework, inspired by neoclassical growth theory, for how sustainability, eco efficiency and the circular economy can function from the perspective of supply chain management. In sections 4, 5 and 6 these concepts are illustrated using practical cases of the production processes in three companies in the eastern region of the Netherlands. Section 7 concludes.

20.2 Circular Economy in the Eastern Region of the Netherlands: Overview

Many cities on the banks of the river IJssel in the eastern part of The Netherlands played an active role in the German Hanse, the history of which can be traced back to 1241 when the first trade contract between Hamburg and Lübeck was signed. The Hanse was a commercial federation of cities that dominated trade in the north of Western Europe for almost four centuries, and it still exists today. The river IJssel was an important water connection between the German hinterland and the Southern Sea, providing access to both the North Sea and the Baltic Sea. This geographical location stimulated twenty Dutch Hanse cities to act as intermediaries in the trade between the German and Baltic hinterland and the rest of the world (see Webers, 2015).

In modern terms one could argue that the Dutch Hanse cities were intermediaries between the Rhineland model and the Anglo-Saxon model of trade. A characteristic of the Rhineland model, as opposed to the Anglo-Saxon model, is the use of informal contacts, i.e., mutual trust through long lasting trade relationships and intrinsic motivation to cooperate, which played a major role. This is reminiscent of the famous ‘polder model’, that reflects the Dutch culture of open dialogue, interactive consultation, deliberation and participation. In this way of organising transactions and obtaining compromises between various interests, the implementation costs of effectuating decisions remain low. In this cultural setting trust based informal contracts may replace costly formal contracts such as those used traditionally in the Anglo-Saxon world (see Den Butter and Mosch, 2003, Den Butter, 2011).

This Hanse history, coupled with a tradition of craftsmanship in the regional industry which includes family businesses with a long term focus on continuity and decision making, has prompted the ambition of the eastern Netherlands to become a circular economy hotspot in Europe. The innovation profile of the region comprises two priorities: smart and sustainable industries (smart manufacturing and materials, smart food

production and biobased production) and concepts for a healthy life (healthy technology and delivery systems, healthy brain and personalised health and nutrition).

In the eastern Netherlands region three initiatives have been undertaken:

1. The foundation kiEMT, which was founded in 2005 and has 230 participants from industry, academic institutions and government, represents the innovation ecosystem EMT Valley (Energy and Environmental Technology Valley Eastern Netherlands). The EMT-sector comprises 1,400 companies, 30,000 jobs, 20,000 students; it has 2.2 billion Euros of added value, 73% of the companies are innovative and 76% are internationally oriented. EMT supports start-ups, cross overs and clusters, international collaboration (Nordrhein Westfalen) and has as its core activities: energy transition as well as the biobased and circular economy (Foundation kiEMT, VNO NCW, 2015, 2016) .
2. The Cleantech Region Stedendriehoek consists of seven municipalities (Apeldoorn, Brummen, Deventer, Epe, Lochem, Voorst, Zutphen) with a total of 400,000 inhabitants. The Strategic Board of the Cleantech Region chose cleantech as a major priority, setting forth the goal to be energy neutral in the year 2030.
3. Project Circles (Cluster for Innovation, Redesign of value Chains and other Circular Lifestyle Economy Solutions) is a Triple Helix collaboration with 12 partners. In this project 65 business meetings are programmed with the support of 146 companies. The plan is to make thirty-five business cases including the three circular economy pilot project cases reported in sections 4 to 6.

20.3 Theoretical framework

This section contains a stylized framework that illustrates the linkages between the concepts of eco efficiency, circular production and sustainability. The framework is used in the subsequent sections dealing with the cases to clarify which concepts are relevant and to what extent the firm in each case aims at achieving eco efficiency, circularity and sustainability.

We start with the traditional neo-classical production function from the theory of economic growth where volume y is produced with factor inputs labour (L), capital (K) and environment—or in practical cases energy—(E), which is included as an additional factor input to account for environmental issues in the analysis (see e.g. Hallegatte et al. 2012, Den Butter and Hofkes, 2001, 2006, Smulders and Withagen, 2012):

$$y = af(bK, cL, dE)$$

Here a , b , c and d represent various forms of technical progress, induced for instance by innovation. The parameter a is neutral technical progress; an increase in a implies that the whole production process becomes more efficient such that a higher volume of production y is achieved at the same factor inputs K , L , and E . The parameter b represents capital saving technical progress, c is labour saving technical progress and d is environment (or energy) saving technical progress. In the case of environmental issues, it is especially this last form of technical progress that is relevant. When, for instance, d increases due to a new, innovative environment saving technology, the same volume of y can be produced using less E . The consequence of this increase in *eco efficiency*, d , is that the *environment or energy share in production*, E/y , decreases. In other words, an increase in eco efficiency leads to a lower impact on the environment. However, enhancing eco efficiency is not the only way to decrease the environmental impact of production. When in the production process the use of E is reduced due to substitution of K and/or L , E/y also decreases without

a change in eco efficiency. Such substitution of factor inputs leading to a cleaner environment (or to less energy use) can be brought about by a relative change in the prices of the factor inputs, for instance by a tax shift from labour to environment/energy. Such a tax shift may, by the way, also imply that more effort is given to environment saving technical progress, d , and less to labour saving technical progress, c .

In order to include the concepts of circular economy and sustainability in the framework, we have to make a distinction between extractive use of the environment and renewable use of the environment (see Den Butter and Hofkes, 1995 for a related approach). To keep the discussion simple we can think of the use of fossil energy, E_f , and of renewable energy, E_r . Moreover, we must account for waste, W , caused by production and for the reuse of this waste in the production process, W_i , which is considered as an additional factor input. Now the framework reads:

$$y = a f(bK, cL, d_1E_f, d_2E_r, d_3W_i), \quad (20.1)$$

and
$$W = w y \quad (20.2)$$

Here the parameters d_1 and d_2 represent the fossil energy saving technical progress and the renewable energy saving technical progress, respectively. At the macro level these two forms of technical progress may, however, not be independent, as the use of renewable energy may require use of the fossil energy, or more broadly, of non-renewable resources in order to enable production of renewable energy through investing in, e.g., windmills, solar panels and related infrastructure. A shift from fossil energy to renewable energy can be brought about by price changes where fossil energy is made more expensive through taxation and renewable energy is made cheaper through direct subsidies or through subsidising innovations in the production and use (d_2) of renewable energy. However, in both cases there is the danger of the green paradox, as the owners of sources of fossil energy understand that prices of renewable energy will go down when subsidized technology progresses (Sinn, 2015; Van der Ploeg and Withagen, 2015). For this reason fossil fuel firms will lower the price of fossil energy and spur demand, which may lead to more instead of less pollution.

The parameter w in the above framework represents the extent to which production of y brings about waste. In order to make production more sustainable and circular, w can be decreased by extending the life of products, through reuse and making products easier to repair and by restrictions on packing and waste disposal. Moreover, the use of waste in production can be made more efficient, which translates in the framework as an increase in parameter d_3 . Examples of this include innovations in recycling technology and employing production processes which use recycled materials. It can be viewed as a special case of enhancing eco efficiency

The framework above allows for the following taxonomy of circularity and sustainability. W_i/W can be regarded as the *degree of circularity*. If $W_i/W = 1$, i.e., $W_i = W$, we have a *fully circular production process*, and a *full-fledged circular economy* at the macro level. *Full sustainability* is obtained when both $W_i = W$ and $E_f = 0$. Moreover, the framework indicates in what way and through which instruments and changes in the production chain a transition to these ideal states of circularity and sustainability can be achieved.

20.4 Case 1 Royal Auping Deventer

The mattress and bed manufacturer and retailer Royal Auping in Deventer (province of Overijssel) is a family business founded by Johannes Auping in 1888. The company started producing high quality and durable mattresses and beds for hospitals with an innovative bed base of woven steel in a metal frame instead of straw ('Auping's steel

health mattress'). Nowadays it is the largest Dutch sleep comfort brand and manufacturer which serves the high quality segment of the market with the slogan '*Auping nights, Better days*'. It has 300 employees and 130 flex workers with an annual turnover of 73 million Euros. In the last few years Auping has invested over 35 million Euros in state of the art sustainable production facilities, product and process innovation and in retail and digital capabilities. Auping has marketing and sales subsidiaries in Germany, Belgium and Denmark, and worldwide the company serves over 15 other markets through exclusive distributors. The company strives to develop a 'good & healthy' product design; an ambition that does not only relate to the look and quality of their mattresses and beds, but also to their desire to bring about a transition to circularity in their production process. To this end a new factory using cost-efficient, demand driven production processes was developed and realized in Deventer from 2013 till summer 2015. The redesign of the production process in the new factory caused total consumption of electricity to decrease by 45% and use of natural gas by 90% while maintaining the same product output levels.

By striving towards being passionate, transparent, innovative and better every day the main object of the production process in the new factory is similar to the sustainability definition of the Brundtland commission: '*... to meet the needs of the present without compromising the ability of future generations to meet their own needs*'. The idea is both to reduce the use of the environment in production ('eco efficiency') and increase the positive impact on the environment through reducing waste and recycling, which the company labels as 'eco effectiveness'.

In 2010, Auping published its Cradle to Cradle Vision 2020 and became a certified Cradle to Cradle company in 2012. The bed model 'Essential' was launched with the Cradle to Cradle Silver Award as the first sustainable bed model worldwide. As a practical indicator for how far the company has advanced on the way to full circularity it has set up the Auping Take Back System for mattresses, which has the target of 90% recycling. Auping takes old mattresses back on delivery of new ones and ensures that they are recycled by an external company (RetourMatras) and that they do not disappear into an incinerator (which is what happens every year to an estimated 1.2 million mattresses in the Netherlands). The return system does not only take back the company's own mattresses, but also other brands, supplying 300,000 kilograms of raw, recycled materials. These materials are *inter alia* processed into cleaning cloths, judo mats or insulation. The return system was praised by the Deputy Minister of Infrastructure and Environment and the Minister of Economic Affairs in a letter to the Dutch Parliament, calling Auping an '*outstanding example of circular thinking*' (Dijkstra and Kamp, 2016, p.8).

Auping commits itself to the goal of a sustainable business model (Cradle to Cradle Gold) by 2020. By developing and producing manufactured goods that allow upcycling at the highest level (no waste but upcycle), full use of renewable energy (no fossil fuels used) and respect for natural systems (water). With respect to people as part of the people-planet-profit concept the aim is optimal working and social conditions for labour employment for all stakeholders in the supply chain. Considering four streams of the corporate circular strategy, namely (i) circular operations and eliminating waste, (ii) energy savings, (iii) use of renewable energy and (iv) radical transparency in the supply chain, Auping can be regarded as a frontrunner in the transition to both full circularity and sustainability.

The company is currently developing a Circular Economy Hub at their head office in Deventer. Auping has realised the importance of their Deventer roots in the Hanse tradition and made the production process LEAN and Cradle to Cradle in order to be more competitive and to become future-proof. The aim of making the production process fully circular also contributes to the profitability of the company and to its long run continuity. Moreover, Auping seeks cooperation with partners upstream in the supply chain that share

their standards and values of socially responsible production. For example, instead of importing aluminium from natural resources in Vietnam, Auping uses recycled aluminium from local suppliers in the Netherlands. It appears that this does not only lead to lower use of natural resources and lower use of fossil fuels for transport, but also to more flexibility in the production process. In this way it even amounts to a cost reduction as well as less risk in the supply chain.

From the perspective of the model described in section 3 Auping seeks to enhance circularity in its own production process by (i) extending the life of beds and mattresses, which involves a decline in w , (ii) using recycled waste in the production, which implies substitution in (25.1) from E_f to E_r and W_i , and (iii) innovating in ability to use recycled material in the production process, which is an increase in d_3 . In order to contribute to circularity in the economy Auping is also selective in choosing its upstream suppliers in the supply chain.

20.5 Case 2 SolidPack Loenen

In 1630, paper manufacturer, Vincent Schoonman, who was born in Mulhausen (Germany), built the first paper mill in the small city of Eerbeek (province of Gelderland) because of the excellent water quality of the springs of the Veluwe Massif. Nowadays, most of the Dutch paper and board factories are concentrated in this area.

The total recycling rate in 2013 in the Netherlands was 70.5%, which is relatively high compared to the European average (65.3%). For glass recycling the rate was 78.8% that same year and for paper and board it reached as high as 88.8% thanks to national collection systems and waste logistics (data from Eurostat, 2013). The main success factor is the separation of waste at source. The Dutch paper and board industry is well known for its efforts to reduce water and energy consumption in the last decades. Over the last century the production technologies used in the paper and board industry have become fully developed and mature and because of this they are relatively efficient. Yet, the development and introduction of new eco efficient technologies is expensive so that the risks in investing in these technologies are to be minimised. The branch organisation of the paper industry (VNP: Koninklijke Vereniging Nederlandse Papier en Karton Fabrieken) seeks to reduce the energy consumption in its entire production chain by 50% in 2020.

One of the innovative board companies is the privately owned SolidPack, founded in 1921 in Loenen with 178 employees (170 FTE) and a turnover of 55 million Euros (8 - 10% earnings before interest, taxes, depreciation, and amortization). SolidPack is an excellent example of a circular 24/7 company (365 days) *avant la lettre*, as it uses mainly recycled paper as basic raw material together with some virgin fibres and chemicals for the production of shelf and retail-ready packaging for worldwide applications. SolidPack produces high quality food-grade packaging solutions with high added value for specific applications. The solid board boxes cannot yet be reused but are recycled in the traditional way together with other board, corrugated, newsprint and magazines (for which the recycling rate in the Netherlands is very high). Whereas offices are becoming more digital and more paperless, the use of packaging by web shops is actually increasing. This poses a problem for the availability of recycled paper and board as input for the production. Therefore, SolidPack seeks to replace this raw material in the production process with inputs which are also non-fossil such as grass fibres ('grassbox') and other bio-based materials.

The company's circular strategy is based on the following priorities: zero waste, the reduction of water consumption and the reduction of its carbon footprint. The company searches to use alternative minerals for its own biological waste water treatment plant. In

a 1.5 year pilot project SolidPack searches more specifically to use both phosphorus and nitrogen from municipal waste water instead of phosphorus from phosphoric acid and nitrogen from urea. To be successful these alternative mineral sources must be located in the neighbourhood of SolidPack. Moreover the company searches for new ways of processing 2,000 tons of plastic (reject from waste paper defibration) into products with added value. However, for SolidPack the Achilles heel of sustainability is the use of fossil fuels and energy consumption. Therefore, the aim is to substitute fossil fuels with renewable energy such as bio-fermentation.

SolidPack collaborates successfully not only with the Water Authority Vallei and Veluwe in the field of industrial waste water treatment but also with the National Forestry Commission in the field of alternative raw material (grass). Company facilities (buildings, appliances and the waste water treatment plant) are shared with others to exploit economies of scale and to decrease the cost base. Through these kinds of new coalitions the various partners contribute to make the total value chain more circular.

In the province of Gelderland, ten paper and board companies with 1,372 employees have an total annual energy consumption of 11 million Gigajoules (Quickscan Gelderse papierindustrie. Duurzamer door Samenwerken, October 2010). SolidPack is currently exploring possibilities to reuse its steam and waste heat from the wastewater for municipal applications. In this way it also intends to support the Cleantech Region of Stedendriehoek to become energy neutral in 2030.

In terms of the model outlined in section 3, SolidPack is substituting E_f for E_r in its production process and trying to enhance d_3 , given the fact that the company already uses, with recycled paper and board, a considerable amount of ‘waste’ (W_i) as input. Moreover, efforts could be made to make the packaging more durable and reusable in order to decrease w , contributing to downstream circularity and sustainability. The plan to bring about a circular solution for the large amount of plastic as residual of the production process would also translate as a decrease of w in terms of the model.

20.6 Case 3 Interface Scherpenzeel

In 1956 the modular Heuga carpet tile was developed by Petrus Johannes van Heugten, who until then had produced saddle pads and felt hand warmers. For many years he experimented with waste material and through innovative product development he was able to use the waste material for the production of carpet tiles. In 1987 Heuga was taken over by the American company Interface. The story of Interface began in 1973, when founder Ray Anderson, who passed away in 2011, realised that at the time the office environment was changing dramatically and there was a need for flexible floor covering. Anderson’s vision was: ‘..., *showing it’s possible to create a better world, being restorative by the power of our influence...*’ (see Anderson 1998, 2009). Since its takeover of Heuga, Interface has become the worldwide leader in modular flooring. With a market share of one third of the global carpet market, Interface leads the market in terms of design, durability and innovation. Worldwide Interface has 3,500 employees in 110 countries (5 production sites) and an annual turnover of 900 million Euros. The Dutch site in Scherpenzeel (in the province of Gelderland) acts as the European headquarters for production and distribution. It has 315 employees, a turnover of 353 million Euros and net profits of 26 million Euros.

In 1994, Interface was one of the first companies to reverse its strategy towards sustainability. The company promises to be fully sustainable by 2020. The strategy is called Mission Zero® and it is challenging all parts of the business, throughout the supply chain. The aim is ‘*to become restorative by eliminating any negative impact our company may have on the environment by the year 2020*’. The company’s sustainability strategy is

based on learning from nature (biomimicry) (see Benyus, 1998). This integrated approach following the way ecosystems function leads to circular business models, corporate social responsibility, green energy, sustainable production and clean and efficient transport. TacTiles® are an appealing example of biomimicry being put to use. TacTiles® are innovative adhesive-free installation system based on the feet of a gecko with zero VOC (Volatile Organic Compound) emissions. Interface aims not only to be fully sustainable by 2020 but even to be restorative, putting back more than the company takes out from the environment and the community. A good example of the inclusive circular business model is the Net-Works™ initiative, which collects discarded nylon fishing nets in the Philippines to be processed as a raw material for new carpet tiles. Thus, the Net-Works™ initiative is restorative because it supports social communities and makes a positive contribution to society.

For Interface co-innovation is a way of working that connects ideas, people and resources, removing barriers to progress and enabling to achieving goals together. In order to realise the goal to make the whole supply chain circular and sustainable Interface often plays the role of orchestrator of the supply chain.

December 2015 data from the company show that this strategy to make the production process fully circular and contribute to sustainability has already been very effective; Mission Zero® really works. Indicators of success include (compared to baseline 1996): zero waste to landfill, 98% reduction of direct GHG emissions, 95% renewable energy use, 50% reduction in transportation, 50% of the materials are recycled or bio-based and 50% reduction in product carbon footprint. In order to achieve these reductions Interface developed various circular business concepts and inclusive business models such as: buy with full service contract and return, leasing of carpet tiles, Tile ReUse, Tile Recycling (ReEntry 2.0), Tile ReEnergy, Tile Reclaim, Cool Tile (CoolCarpet®), Tile Take-back Guarantee, I Owe You, TacTiles® and in the future, subscription systems.

According to Interface the sustainability strategy is financing itself through the improvement of non-labour resource efficiency, investments in sustainable inputs and the commercialisation of competitive advantages. Customers become Interface ambassadors for life.

In relation to the modelling framework of section 3 it seems that the strategy of Interface uses aspects of circularity mainly to reach the final aim of sustainability. The company realises that, in accordance with our taxonomy, circularity is a necessary albeit not a sufficient condition for sustainability. From that perspective, making not only its own production process but also the whole supply chain more circular is part of Interface's strategy. The use of recycled materials and efforts to reuse the tiles and prolong their lives by licensing, maintenance contracts as well as reclaim and take back programs can be seen as ways to reduce w and cause substitution from E_f to W_i in the production process. But the main part of the strategy is directed at substitution from E_f to E_r in production. Moreover, by making the employees of Interface intrinsically motivated to comply with the company's strategy and philosophy, the efficiency of labour (c) as factor input is enhanced.

20.7 Conclusion

The circular economy is a way to reduce the use of raw materials and significantly improve ecological values. The minimization of waste and fossil fuel use, prolonging the life of products and the use of waste as an input factor in the production process are all ways in which the economy can become circular. A transition to a circular economy, however, involves more than just less waste (Janssen and Stegeman, 2016). This is even crucial for an economy that aims to be both circular and sustainable. To achieve a circular

and sustainable economy we need to re-think the current business, organization and commercial models (Van Arkel and Jonker, 2012).

This chapter describes three cases of companies in the eastern region of the Netherlands which are frontrunners of the circular economy. They have indeed thoroughly changed their business strategy and the organization of the supply chain. The first two cases, Auping and SolidPack, focus on making the production process more circular by reducing waste and using recycled material instead of virgin material as input for production. The fact that sustainability of production is increased can be thought of as a side-effect of this focus. Moreover, in order to make the full supply chain more circular these companies take the role of orchestrators of the production chain. Control over the production chain is also part of the strategy of Interface. However, unlike the prior two companies, Interface focuses directly on sustainability, and circularity is seen as a means to comply with the Mission Zero[®] aim for full sustainability in 2020.

Making the production process and supply chain more circular and sustainable, and thereby making the economy more eco efficient, is also beneficial to welfare at the macro level of the economy. Thus, the government has a role to play in promoting the transition to circularity and sustainability. According to the Dutch Ministry of Infrastructure and Environment (2016) the government can shape the transition through five instruments or interventions (see also Janssen and Stegeman, 2016). The first intervention is the removal of legislation that hinders the development of a circular economy where innovation is required. The second intervention is to implement smart market incentives. Market incentives increase the demand for circular products (such as bio-based and recycled materials) and encourage circular innovations and business models. The third intervention is to offer support and insight in investments in circular products and services. These have a different risk profile than traditional products and services, and a better understanding of the costs and benefits could stimulate further investment. The fourth intervention is organising knowledge spill-overs. The last intervention is to promote international partnerships and make arrangements that create the right conditions for the circular economy. It seems that the initiatives taken in the eastern region of the Netherlands, discussed in section 2, mainly relate to these latter forms of intervention. In fact, the theory of public sector economics provides us with a main reason for government intervention: the positive externalities that the pioneering strategies of front running companies in circularity bring about should be internalised. This should be an underlying motive of the five interventions discussed above.

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