



Practice-based model for implementing circular economy: The case of the Amsterdam Metropolitan Area

Jacqueline M. Cramer

Utrecht Sustainability Institute, Utrecht University, Heidelberglaan 8, 3584 CS, Utrecht, the Netherlands

ARTICLE INFO

Article history:

Received 1 July 2019

Received in revised form

20 January 2020

Accepted 23 January 2020

Available online 27 January 2020

Handling Editor: Prof. Jiri Jaromir Klemes

Keywords:

Transition management

Circular economy

Practice-based model

Activity-based implementation scheme

Regional approach

Action-research

ABSTRACT

This paper questions how the implementation of the circular economy actually takes place and evolves over time, using the geographical example of the Amsterdam Metropolitan Area. This particular practice-oriented, regional focus is underexposed in the literature. Relying upon transition management literature, the analysis shows through five years' action-research that a pipeline of tailor-made circular initiatives, all at varying speeds, was created and when successful, scaled up. This is visualised in a 'practice-based model for implementing circular economy', which specifies the four-phase model by Rotmans et al. (2001). By developing a scheme which represents the activities needed in each phase of the implementation process, Loorbach's transition management cycle (2010) could be refined. Contrary to what Loorbach suggests, these activities largely follow not only a sequential order, but are also cyclic. Studies on similar initiatives in other regional contexts will allow for generalisation of the results gained in the study presented here.

© 2020 Published by Elsevier Ltd.

1. Introduction

The transition to a circular economy is seen as one of the major challenges our society is facing today. Overconsumption and the limited availability of resources are problems that need smart solutions leading to innovation and new business development. This means moving from a linear model – one that focuses on using raw materials to make a product then discarding it after use – to a circular economy, which is based on closing material cycles (Ready-Mulvey and Stahel, 1977; Ellen MacArthur Foundation, 2013; Murray et al., 2017). The strategic focus of the transition to a circular economy is reducing, reusing, recycling and recovering materials in production, distribution and consumption processes and simultaneously generating environmental quality, economic prosperity and social equity to the benefit of current and future generations (Kirchherr et al., 2017).

The European Union is one of the frontrunners in promoting the circular economy. In 2014 the European Commission launched the 'Circular Economy Package', which can be seen as the culmination of already existing EU policies on particular aspects of the circular economy, complemented by new insights (European Commission,

2014; De Römph, 2018). Moreover, particular bans on single-use plastics were introduced in 2018 (European Commission, 2018). Additionally, member states have implemented their own specific measures to stimulate the circular economy (McDowall et al., 2017). Notwithstanding the merits of these incentives, the implementation of the circular economy in the EU is progressing slowly. According to Kirchherr et al. (2018), this is primarily due not to technological barriers, but to cultural barriers such as limited consumer interest and a reluctant business culture. Despite these constraints, a growing number of initiatives have recently been set up in various regions and cities in Europe, including in the Netherlands. They aim to set inspiring examples for steps that can be taken towards a circular economy, benefitting the environment, economy and social well-being (Dobbs et al., 2011; Ellen MacArthur Foundation, 2013).

Generally speaking, much has been published about the circular economy over the past decade (Ghisellini et al., 2016; Winans et al., 2017; Merli et al., 2018). However, studies reflecting upon how such experimental examples in the field of circular economy are implemented are scarce (Kalmykova et al., 2018). The aim of this paper is to fill this knowledge gap by analysing the regional case of the Amsterdam Metropolitan Area (AMA). A large-scale circular economy programme has been running here, orchestrated by the Amsterdam Economic Board (AMEC) in cooperation with the

E-mail address: j.m.cramer@uu.nl.

private sector, research institutes and universities, and local government. The analysis focuses on how the actual implementation of circular economy evolves over time in this regional context.

The paper builds on transition management literature. Since the turn of the century, this field of research has gained momentum, especially among scholars in the field of sustainability (Markard et al., 2012). The main driver behind the emergence of transitions research has been the search for new insights and ideas to understand how to avoid being locked into unsustainable systems and how to mobilise and empower disruptive innovations and transformative capacity from the current system towards desirable sustainability transitions (Loorbach et al., 2017). Up to now, most studies on sustainability transition management have focused on designing, analysing or evaluating governance in transitions, while there has been little examination of how sustainability transitions are created in practice (De Jesus et al., 2016; Homrich et al., 2018). Rotmans et al. (2001) and Loorbach (2010) were the first to model the implementation process on the basis of real-life cases. Their models provide a general picture on the evolution of sustainability transitions but do not capture the complexity of the transition process in more detail. This paper aims to fill this knowledge gap by thoroughly analysing the implementation of the circular economy programme executed in the Amsterdam Metropolitan Area from its start (January 2015) until November 2019. Through 'action research' carried out by the author of this paper, it was possible to collect detailed data on the progress made.

Below, the research methodology will be described followed by a more detailed explanation of the theoretical perspective adopted. The results of the actual process of implementing the circular economy in the AMA will then be described, followed by a reflection on the results. Finally, conclusions and suggestions for further research will be formulated.

2. Material and methods

The Amsterdam Metropolitan Area (AMA) represents a wide variety of economic activities, has a population of about 2.4 million and is committed to its innovative and creative culture. The AMEC's circular economy programme has been implemented in close cooperation with local governments (32 municipalities and 2 provinces), as well as with industry, and research institutes and universities. The responsibility for orchestrating the transition process lies with the AMEC, a respected triple helix organisation which focuses on promoting innovation and new business development in key urban challenges, among them circular economy. Two AMEC staff members took the lead: a member of the AMEC Board (the author of this paper) and the AMEC's Circular Economy Challenge Lead. Both have acted as systemic intermediaries, guiding transitions from a whole-system perspective (Kivimaa et al., 2019).

These intermediaries will be referred to here as 'transition brokers', as they act as agents mediating between different actors to prepare, negotiate and seal a circular business deal. In the experimental case, they catalysed the transition, organised the transition arena, helped create the necessary conditions to set in motion the change process, and built new circular initiatives jointly with relevant economic actors. They orchestrated both the process of the transition (learning, communication) and its content (feeding new information and seeking ambitious solutions). The two transition brokers were able to act as independent intermediaries, unhindered by particular institutional and political constraints or vested interests. In this way, they were considered as trustworthy in their effort to build coalitions with parties that were willing to make transformative steps forward. This role of

transition broker differs from the transition manager usually mentioned in the literature (Loorbach and Rotmans, 2006). The latter primarily coordinates the transition process from a policy perspective but usually leaves the creation of new circular initiatives to the market or other actors. In the AMEC's experience, however, an independent broker is often needed to help build a new consortium of market actors.

To examine the implementation of the AMEC circular economy programme, one of the two transition brokers (the author of the paper) followed an 'action research' approach (Dick, 2004). Being involved in establishing, facilitating and participating in mechanisms or dialogues for change and in reflecting upon the process as researcher, the author of this paper fulfils a broader role than that of a scholar (Wittmayer and Schöpke, 2014). This is not unusual; various scholars studying transition management follow a similar process-oriented approach (Kemmis, 2010; Loorbach et al., 2011; Wittmayer and Schöpke, 2014; Rauschmayer et al., 2015). While the transition brokers in the AMA case were able to define the objective of moving to a circular economy in general terms in advance, they needed to specify the steps towards that goal in the transformative practice itself. Critics may argue that this methodological starting point may distort the final objective of a circular economy (Rauschmayer et al., 2015) and lead to small changes. Aware of this risk, the transition brokers only invited those actors in the AMEC programme that expressed a willingness to engage proactively in circular economy initiatives, to be open to new ideas and to cross organisational boundaries.

The implementation of the AMEC programme will be analysed from its start until November 2019. Four phases have been identified. Phase 1 (2015–2016) concerns the preparation of the programme and, after negotiations, its adoption by local government and members of the AMEC. Phase 2 (starting in 2015) focuses on generating innovative, circular business development through building new consortia. Phase 3 (starting in 2019) entails the scaling up of successful examples. And phase 4 is the stage in which circular economy becomes mainstream, which is not yet reached.

Within the AMEC programme two strategies were defined: 1. Closing the loop of resource streams, and 2. Renewing product chains via circular procurement (Cramer, 2016).

Strategy 1 focused on nine resource streams. The streams were selected because of their high volumes, the scale in which they are a burden on the environment, and their potential for high-value recycling and, depending on the resource stream, also product reuse and redesign. Here, the AMEC often initiated the building of circular coalitions with actors that expressed a willingness to take the next steps in the transition to a circular economy.

Strategy 2 promoted the incorporation of circular requirements in procurement policies and practices. It was assumed that this could trigger a market demand for circular products and services. By involving network partners of the AMEC, it was possible to create a movement striving for circular procurement. Three communities of practice were organised in the 2016–2019 period, moderated by the author of this paper. The objective of these communities of practice was to gain knowledge about circular procurement, exchange experiences among the participants, coordinate procurement actions, and thus create market power for circularity. The communities, each consisting of six sessions, involved a total of 31 representatives of procurement or sustainability divisions of the private sector, local government, and universities.

Both strategies mentioned above aimed to search for the most innovative circular options that economic actors were willing to implement. In order to identify these options, the 'ladder of

circularity', also named the 'ladder of the 10 Rs' was used (Cramer, 2017). The highest priority is Refusing the use of raw materials ('prevention'), followed by Reducing the use of raw materials per unit of product. These are followed by Redesigning a product in view of circularity, and then all forms of product reuse options (Reuse, Repair, Refurbish, Remanufacture and Re-purpose). Where the latter options are not possible, or are no longer possible, high value Recycling is prioritised above Recovering (incineration of waste with energy recovery).

The analysis presented here is based on the following data sources:

DATA sources

Phase 1: Drafting the programme and obtaining support from relevant stakeholders (representatives of local government, the main industrial sectors in the region, and universities).

50 interviews, five group sessions with representatives of the main industrial sectors, and six meetings with representatives of local government in each sub-region of the AMA. (data source: minutes of interviews, five group sessions and six meetings).

Phase 2: Building circular consortia.

Strategy 1: 48 interviews and 14 round tables on the specific resource streams (data source: minutes of interviews and round tables); three circular economy labs on respectively mattresses, industrial waste streams (including the organic liquid waste stream) and metals (data source: live stream recording, transcriptions and summary reports). More than 70 follow-up, informal meetings (not recorded) to negotiate the actual plans. Four master's theses on electrical and electronic waste; metals; servers and textile focused on potential innovative options and removing barriers for implementation. Strategy 2: three communities of practice (data source: minutes of six sessions and final report/community) and two matchmaking events to connect niche actors with participants of communities of practice (not recorded).

In addition, 20 events were organised to communicate results. Finally, a meeting with key actors was held in January 2019 to evaluate the programme after four years and formulate follow-up activities, including scaling up successful examples and extending the programme to industrial resource streams.

Phase 3: Scaling up successful initiatives.

This phase started in January 2019 after a four-year monitoring and evaluation process. The focus is on scaling up the cases that could be replicated elsewhere in the region or could be extended in scope and/or ambition. 24 interviews and 2 roundtables have been held (all recorded) and 32 informal meetings (not recorded).

Alongside the activities of the AMEC, numerous other initiatives have been launched in the AMA since 2015 by other actors, from companies and local governments to universities and research institutes. In this way, a movement of actors has come into being that is jointly transforming the current economy into a more circular

one. Although initiatives by these other actors are not included in this analysis, the AMEC gears its activities to the broader ecosystem in which it operates.

3. Theoretical perspective

The analysis presented in this paper clearly links to transition management literature. This research area originated in the 1990s from the wider category of innovation research, including science and technology studies, history of technology, evolutionary economics and innovation policy (Loorbach et al., 2017). It was a response to innovation research, which at that time mainly focused on understanding innovation processes and not on methods for deliberately influencing socio-technical change (Avelino et al., 2011; Rauschmayer et al., 2015; Fischer and Newig, 2016). This criticism has led to a growing interest in transition management, coined by Rotmans et al. (2001). The research area focuses on the management of transitions in an operational sense: it is "flexible enough for adaptation but prescriptive enough to be functional in practice" (Loorbach, 2010: 172). Transition management has particularly been applied to practices relating to sustainability. This area of concern requires major changes along the entire production-consumption chain, its flows, its multi-level architecture, its institutions and structures, and – not least – the behaviour of the actors involved in it, from resource extraction to the final consumption of goods and services (Smith et al., 2010). This explains why, particularly over the last 10–15 years, sustainability scholars have paid increasing attention to the governance of transitions (Markard et al., 2012). Much of this research focuses on European countries, while studies relating to North America, Japan, China and India are still very much underrepresented (Markard et al., 2012).

Following on from the above emphasis on sustainability, transition management is usually defined as a deliberative process to influence governance activities in such a way that they lead to accelerated change directed towards sustainability ambitions (Kemp et al., 2007). This perspective brings a sense of urgency and societal engagement to the research as well as the necessity to engage deeply in practical contexts where actors deal with transitions. Therefore, transition management tries to utilise innovative developments more strategically by coordinating different levels of governance and fostering self-organisation through new types of interaction and cycles of learning and action for radical innovations offering sustainability benefits.

Originally the scientific debate about transition management focused on the theoretical side, also because empirical examples were not yet available. Gradually, the research has moved to implementing transition management in a structured coproduction process in various contexts. Scholars have described case studies in a variety of policy fields (Avelino et al., 2011; Verbong and Loorbach, 2012), on regional and urban scales (Wittmayer et al., 2014; Ernst et al., 2016)) and at sector level (Jackson et al., 2014). However, the way the transition towards sustainability (particularly towards circular economy) evolves in practice has hardly been studied. First insights are provided by Rotmans et al. (2001), who developed an evolutionary model of transition management, consisting of the following subsequent stages:

- "A pre-development phase where the status quo does not visibly change;
- A take-off phase where the process of change gets under way because the state of the system begins to shift;
- A breakthrough phase in which structural changes take place through an accumulation of socio-cultural, economic, ecological and institutional changes that react to each other.

- A stabilisation phase where the speed of social change decreases and a new dynamic equilibrium is reached" (Rotmans et al., 2001, p.17).

Complementary to the four phases model of Rotmans et al. (2001), Loorbach (2010) introduced an operational model for implementation: the so-called transition management cycle. The components of the cycle are: (i) structure the problem in question, develop a long-term sustainability vision and establish and organise the transition arena; (ii) develop future images, a transition agenda and derive the necessary transition paths; (iii) establish and carry out transition experiments and mobilise the resulting transition networks; (iv) monitor, evaluate and learn lessons from the transition experiments and, based on these, make adjustments in the vision, agenda and coalitions. According to Loorbach (2010) this cycle visualises the need to connect activities but should not suggest a sequential order of activities.

Both the models of Rotmans et al. (2001) and of Loorbach (2010) aim to structure the evolution of transition management, respectively at strategic and operational level. However, neither model reflects the complexity of how transitions can be implemented in practice. Multiple conditions and drivers can enhance or slow down the process of change. In managing the transition process, governments are considered to be key actors (Rotmans et al., 2001). They can formulate policies, implement appropriate instruments (e.g. economic and legal measures), facilitate innovation processes and create suitable conditions. In reality, it strongly depends on the willingness of the market to innovate (Fischer and Newig, 2016). However, individual economic actors, particularly those connected to established technologies, are often hesitant to take the lead in disruptive change which might conflict with their current business (Meadowcroft, 2009). Newcomers in the market are more inclined to adopt alternatives but are usually confronted with the problem of getting their product or service accepted. To overcome this stalemate, Fischer and Newig (2016) call for 'intermediaries' as potential influential actors that can fulfil an independent, mediating role in establishing innovative collaboration between businesses.

This paper builds on the insights provided by the models of Rotmans et al. (2001) and Loorbach (2010) and the work of Fischer and Newig (2016) on intermediaries. It aims to fill the knowledge gap regarding the way the implementation of a transition (here: the circular economy) through mediation of intermediaries actually takes place in practice and evolves over time. As it was possible to gather detailed data via a real-life experiment over almost five years, the model of Rotmans can be refined. Moreover, the action research approach adopted by one of the two intermediaries involved in the experiment allows for a more detailed description of the activities carried out in the regional circular economy programme. The analysis will identify the main activities involved in the transition process, which will lead to a more detailed discussion of the transition management cycle developed by Loorbach (2010). Finally, by taking the AMA as geographical example, the analysis also adds to the transition management literature, which usually lacks this territorial sensitivity (Coenen et al., 2012; Winans et al., 2017).

4. Results

Below, the results are presented regarding the way the circular economy programme in the AMA evolved over time. Subsequently, the four phases of the implementation process will be described from January 2015 till November 2019.

4.1. Phase 1: drafting a circular economy programme

The start of the AMEC's circular economy programme in late 2014 coincided with the appointment of the author of this paper as AMEC member. This timing was fortunate for various reasons. Firstly, the appointment came at a time in which the municipalities involved were searching for new methods in waste management, in order to achieve higher recycling rates that were in line with national policies. The waste management sector responded to this policy objective and gradually began to redirect its strategy from incineration to recycling. Secondly, the region's growing, innovative start-up community propagated more attention for the circular economy and had started to develop circular products and services as showcases. And finally, local governments expressed the wish to join forces in strategic areas, among them the circular economy.

To start the AMEC circular economy programme, an introductory memorandum titled 'The Amsterdam Metropolitan Area as a circular resource hub' was written (Cramer and Nederstigt, 2015). Its aim was to structure the problem in question and formulate the overall objectives. Two months after issuing the memorandum and negotiating with relevant stakeholders, both the AMEC and the local governments (organised in a regional AMA Board) agreed on its content. The next step was to develop a roadmap, in which the priorities were formulated for the period 2015 to 2018 (Cramer, 2015). Moreover, the governance structure in terms of roles and responsibilities of local governments and the AMEC were specified (Cramer, 2015). This led to a division of labour, in which the AMEC devoted major attention to innovation and circular business development at (sub)regional scale, while local governments initiated activities at municipal level, for example the collection and processing of waste (including the logistics), promotion of circular start-up communities, and public outreach (Van Ratingen and Cramer, 2016). As the activities of the AMEC could not be carried out without the help of local governments and vice versa, the two bodies continued to cooperate, but each ran their own programme. The final step in drafting the programme was to formulate its strategic focus. This resulted in the transition agenda titled 'The resources transition in the Amsterdam Metropolitan Area: Added value for economy, social wellbeing and environment' (Cramer, 2016). In this document two transition strategies were formulated, including the priorities for the first four years. A year after its initiation, the circular economy programme could formally start. The key regional stakeholders had given the AMEC a clear mandate to carry out the programme in close cooperation with them.

4.2. Phase 2: building circular initiatives

The aim of phase 2 was to build circular initiatives via two strategies.

The first strategy, on closing the loop of resource streams, started with the selection of the following nine main resource streams, often consisting of two or more sub-streams: biomass, construction and demolition materials, electronic and electrical waste, end-of-life textiles, plastics, diapers, mattresses, data servers and metals. These resource streams were chosen because of their high volumes and large environmental footprint and their potential for innovative improvement in terms of recycling, and product reuse and redesign. First, priority was given to household waste streams, because more public data is available about those compared to business waste streams. The private waste streams of the IT sector (particularly data servers) and the building, biomass and metals sectors were also included, because they had been prioritised by AMEC partners. Next, the AMEC designed and adopted a generic approach in order to generate and select the most promising options for closing the loop of each resource

stream. Experience showed, however, that this generic approach had to be applied flexibly. The overall approach was as follows:

- a) Collecting insights: First, meetings were held with one or more experts to gain insight into the current situation of the management of the waste stream, and relevant documents were studied.
- b) Brainstorming circular solutions based on the latest insights in science and technology. Scientists, innovative technology providers and representatives of the particular value chain were asked in a brainstorming session and/or individually to assess innovative options for closing the loop both technically and economically. Understanding which of the ambitious options were possible led to the next step.
- c) Consulting the market: Potential investors were asked whether they would be willing to invest in new business development and if so, under what conditions.
- d) Selecting the investor(s): When market players had expressed their interest, a third party was involved to make an independent judgment as to the best candidate. This was an independent organisation, usually the owner of land, for example the Port of Amsterdam or a waste incineration company interested in diversification. After the selection of the best candidate or candidates, a consortium was set up that could jointly realise the initiative.
- e) Organising the necessary preconditions: In order to create a robust consortium, a number of general preconditions turned out to be crucial: an appropriate collection and logistics system, a guaranteed volume of waste, an articulated demand for the recycled material, and a quality standard for the recyclates accepted (Cramer, 2018). Moreover, local incentives (e.g. circular procurement) could speed up the transformative change. The AMEC assisted in organising the necessary preconditions in cooperation with local authorities and other relevant actors.
- f) Designing an action-plan: After the general preconditions were in place and the consortium partners had committed jointly to developing the new business, the AMEC handed over its task. During these negotiations, a plan of action, including timelines, an investment scheme, and roles and responsibilities of the consortium and of other relevant actors were defined. In a few cases, the AMEC did not coordinate this process in its entirety, but rather acted as sparring partner or supporter of the initiative.

The major aim was to build consortia that could jointly create a viable circular business case. As this implies the establishment of a long-term, mutual commitment, the consortia were not assembled overnight. Particularly when partners had difficulties with such commitments for political reasons – for example in the case of municipalities – this process took time. It required a lot of matchmaking activities to establish a consortium that would express its commitment to implementing the circular initiative. In the context of the nine resource streams selected, 22 consortia have been created to launch a circular initiative. Some consortia have already been agreed upon (in 14 cases) while others (three cases) are in preparation. In the latter cases, the consortium is still lacking a partner (for instance to guarantee sufficient supply and/or demand) or the new initiative needs further technological development before new equipment can be installed. Not all consortia were developed with the AMEC as lead actor. In five cases, others (particularly bidders or innovative lead companies) were in charge, but the AMEC was supportive. After the consortium was agreed upon, the business model had to be negotiated among the consortium partners. Moreover, investors often had to attract foreign

capital before the new plant or activity could be launched. The speed with which the entire process of building through to finalising the new circular initiative proceeded was case specific. Some were ready in a year while others took three or more years.

The role of the two intermediaries was to mobilise the most ambitious circular options that economic actors were willing to adopt. This led to innovative solutions, both for generating new products from recyclates (flavour additives, phosphate and calcite, insulation material, and regenerated clothes, and mattresses) and for reuse of products (building materials and data servers). These solutions represent a clear shift from current incineration to re- and upcycling and in some case to product redesign and reuse, and in one case to prevention (packaging waste in company canteens). New business models were frequently adopted too, namely in about 60 percent of all cases. The model most often applied was the 'shared costs and benefits model', in which key actors jointly estimate the overall cost-result ratio in advance and make a calculation that reflects the share of each actor in a well-balanced manner. Such an honest account of the costs and benefits was often needed to build a viable consortium that was economically attractive to all consortium partners. Other business models applied were a voluntary producer responsibility scheme and the formation of a cooperative, in which the profits of recycling the resource stream are shared.

The second strategy, on circular procurement, aimed to stimulate procurement managers to incorporate circularity in their procurement policies and practices. After mobilising the network of the AMEC to participate in this strategy, three communities of practice were set up successively, comprising a total of 31 representatives of local governments, businesses, and universities. The participants learned from each other and acquired the necessary expertise to implement circular procurement within their own organisation. It was left to the participants themselves (many of whom were procurement managers within their organisation) to determine which circular procurement projects and contractors were selected. They were in charge of mobilising support for their ideas from key actors within their own organisations. Depending on these actors' willingness to help implement circular procurement, it was possible for new circular initiatives to get underway. The generic approach developed in the first strategy was also helpful for these procurement managers. Although the bidders took ambitious steps on the ladder of circularity, they were reluctant to take too many risks and usually lacked the knowledge, time, money and also the support from management to help build completely new circular product chains. As a consequence, most initiatives focused on innovative but proven solutions and/or new business models, particularly aimed at product redesign and reuse.

At the conclusion of the three communities of practice, the following was achieved: 31 municipalities (all AMA municipalities except one) and the AMA's two provinces signed a manifesto in which they committed to realising 10 per cent circular procurement by 2022, 50 per cent from 2025 to 100 per cent as soon after as feasible. Investments were made particularly in five product groups: demolition and construction, office furniture, road signs, catering, and data servers and IT business equipment. The initiatives recently taken on were relatively ambitious. Circular procurement often focused on the higher steps of the ladder of circularity. Product redesign and reuse received the most attention, followed by prevention. High value recycling was prioritised less, but was also included in all cases. New business models (leasing instead of selling, and sharing costs and benefits among the chain partners) were sometimes adopted, particularly in cases where these new business models had proven to be successful: office furniture and the building sector. The fear of taking too much risk was reduced by these successful examples, carried out previously.

4.3. Phase 3: scaling up

Based on the four-year evaluation of the AMEC programme in January 2019, the AMEC formulated next steps. The roadmap was updated and new priorities were identified within the two strategies adopted. The main focus shifted to scaling up the cases that could be replicated elsewhere in the region or could be extended in scope and/or ambition and also to strengthening the network of participants in both strategies. The assumption was that scaling up implies the acceleration of circular initiatives within and across sectors and product chains. Strategy 1 on closing the loop of resources was redirected towards scaling up the positive business cases being implemented and simultaneously building a broader ecosystem approach, in which also prevention, redesign and reuse were given greater priority. An example is the development of a 'circular textile valley' in which the broad spectrum of circular options is actively promoted. Moreover, after tackling mainly household resource streams, the attention shifted to industrial residual streams. Based on the experience gained in the first four years, the aim was not only to deal with the waste stage of these streams, but also to trace them back to the source ('the beginning of the product chain'). In the second strategy, more purchasing departments were motivated to participate and existing ones encouraged to continue their circular procurement efforts. At the same time, the AMEC will select together with the participants a limited number of product chains which can potentially be transformed more fundamentally through a joint effort. By collaborating in the renewal of product chains, procurement managers may feel more confident to take innovative next steps.

4.4. Phase 4: mainstreaming

This phase is not yet within sight. More circular initiatives should be scaled up within and across sectors and product chains before the mainstream phase is gradually breached. This process can be enhanced when specific regional barriers are removed and national and EU policies are more aligned to actively steer the transition to a circular economy.

5. Discussion

The implementation of the AMEC transition programme on circular economy between late 2014 and March 2019 comprised four phases. Phase 1, drafting the circular economy programme, and phase 2, building the first round of circular initiatives, have been concluded. The third phase, scaling up, has begun for those initiatives that have realised new business development. Phase 4, mainstreaming, is not yet in sight. As a result of the efforts of the AMEC, both strategies successfully got underway and achieved clear results. Due to the approach chosen by the AMEC, the initiatives in both strategies focused on innovative solutions. However, these should be seen as first building blocks on the road to a circular economy, but not yet mainstreaming. Coming close to a fully circular economy implies that a system change needs to occur in all respects.

While at the start of the AMEC programme in 2015, the number of circular economy activities was still limited, an explosion of initiatives subsequently followed. The AMEC programme is now part of the larger network of regional partners, involving local government, industry and neighbourhoods. Because local government and the AMEC have joined forces, their efforts are now closely connected, also in person. In executing their initiatives, they involve innovative business partners and active citizens as much as possible. In this way, the network of actors aims to work systematically and to create cohesion in building a robust circular

ecosystem. The latter is sometimes lacking in transition management, particularly when many experiments are carried out without coordination (Loorbach and Rotmans, 2006).

A reflection on the transformative change to circular economy in the AMA over time results in a complex picture. Compared to the transition studies on one particular technological system (from horse-drawn carriages to automobiles [Geels, 2005] and from cesspools to sewer systems [Geels, 2006]), the transition towards a circular economy is a multi-sector system change, covering a wide variety of product chains. Every circular initiative towards that goal is a building block that can be scaled up and extended to other initiatives in the same or another product chain. To cope with such a multifaceted approach, priorities of what to do first need to be set. In the context of the AMEC programme, the focus in the first four years was on nine major resource streams and on circular procurement with 31 participants. This resulted in a pipeline of circular initiatives, each of which proceeded according to its own tailor-made method and speed. While successful examples can be scaled up immediately, others need more time for implementation. In the meantime, a fresh round of initiatives can start, which will largely follow a similar sequence of phases. As the drafting phase will not begin from scratch, the activities in phase 1 may in part be skipped and/or shortened. However, in phase 2, which consists of building circular initiatives and which is the core of the transformative change, similar activities to those in the first round of initiatives need to be carried out. This also holds for the third phase of scaling up. It is to be expected that after the second round of initiatives, the entire process will be repeated multiple times before the final stage of mainstreaming comes within reach. The assumption is that when the urgency of moving to circular economy proliferates, the volume of circular activities enlarges and societal support increases, the pressure on local and national government will augment to remove specific fundamental barriers which will further drive scale. When the circular activities become dominant over linear activities, it will result in a willingness of regional and national government to remove remaining fundamental barriers. This process is visualised below in the graphic of a practice-based model for implementing circular economy (Fig. 1).

This model for implementing a circular economy differs from the four-phase model by Rotmans et al. (2001). The latter was designed from a national policy perspective, focusing on the fundamental societal changes to realise a new dynamic equilibrium. The model presented here structures the implementation process in practice (here: at regional level). The focus of the latter is on the actual realisation and scaling up of circular initiatives. Therefore, both models complement each other.

Moreover, this paper shows that the four phases discerned in the practice-based model each represent a wide range of activities. Table 1 summarises these activities in a so-called activity-based implementation scheme for circular economy.

A comparison of this activity-based implementation scheme with the transition management cycle described by Loorbach (2010) shows that the former represents a wider range of activities. This can be explained by a difference in perspective. Loorbach (2010) views the transition process from a management perspective, while the AMEC's programme pays more attention to the actual implementation process, particularly the building and scaling up of circular initiatives by systemic intermediaries. Therefore, Loorbach's operational model for implementation needs refinement in terms of the activities to be carried out. Contrary to what Loorbach (2010, p.172) suggests, these activities largely follow a sequential order, but need to be repeated several times before reaching phase 4: mainstreaming. In that sense, the change process is not linear, but cyclic.

It should be noted that not all activities summarised in Table 1

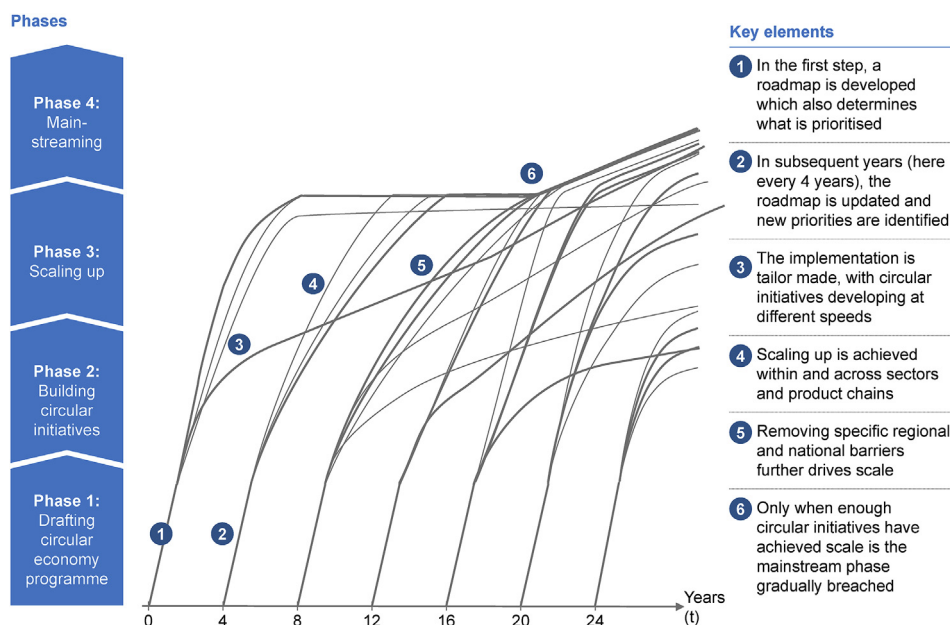


Fig. 1. Practice-based model for implementing circular economy.

Table 1

Activity-based implementation scheme for circular economy.

Phase 1: Drafting the circular economy programme	Phase 2: Building circular initiatives	Phase 3: Scaling up	Phase 4: Mainstreaming
a) Demarcating the transition arena b) Consulting key actors c) Formulating outline of the programme (content and process) d) Getting support from key actors e) Developing a roadmap and setting priorities f) Receiving mandate from key actors for execution of the programme	a) Collecting insights b) Brainstorming about circular solutions c) Consulting the market d) Selecting investors e) Organising the necessary preconditions f) Designing an action plan	a) Communicating and celebrating best practices b) Assessing the (in)direct merits of successful examples c) Creating similar or new circular initiatives in the same or another product chain d) Looking into possibilities for standardisation of successful examples e) Removing specific key barriers at regional and national scale	a) Attuning legislation to circular practices b) Removing remaining economic and institutional barriers c) Fading out linear technologies d) Prioritising circular behaviour of producers and consumers

need to be performed by one organisation (here: the AMEC). The process might also be a joint effort of multiple partners. In the course of time, this became the case in the AMEC programme too.

6. Conclusion

This paper examines the transformative change to a circular economy by taking the Amsterdam Metropolitan Area (AMA) as a geographical example. This particular practice-oriented, regional focus is underexposed in the literature of transition management and circular economy. The analysis is based on action-research performed within a large-scale, regional circular economy programme coordinated by two systemic intermediaries ('transition brokers') of the Amsterdam Economic Board (AMEC). The implementation of the AMEC programme consists of four phases: phase 1, drafting the circular economy programme; phase 2, building circular initiatives, in which the AMEC prioritised two strategies. After the first successful circular initiatives were implemented, preparations could be made for phase 3, scaling up. Simultaneously, new circular initiatives have started since January 2019 and follow a

similar trajectory to previous ones. Phase 4, mainstreaming, is not yet within reach.

As the circular economy covers a variety of sectors and product chains, the transformative system change is complex. The analysis shows that a pipeline of tailor-made circular initiatives is created which – if successful – will be scaled up and replicated or diversified in the same or another product chain. The assumption is that when the urgency of moving to circular economy proliferates, the volume of circular activities enlarges and societal support increases, the pressure on local and national government will augment to remove specific fundamental barriers which will further drive scale. Therefore, the transition to a circular economy can be seen as a continuous renewal and an accumulation of a variety of circular initiatives at different speeds, being accelerated through the taking away of fundamental barriers. Every step in the direction of a fully circular economy is a building block. However, this ultimate goal may perhaps never be achievable. At least, completing as many building blocks as possible can bring the circular economy much closer.

The practice-based model for implementing circular economy'

specifies the four-phase model by Rotmans et al. (2001), designed from a policy perspective. By focusing on the actual implementation of circular initiatives, the core activity is to build and scale up circular initiatives in cooperation with industry and other relevant partners (such as local government). This complements the process described by Rotmans et al. (2001).

The activities carried out to implement circular initiatives show a more diverse picture than the transition management cycle described by Loorbach (2010). By indicating the set of activities needed in each phase of the implementation process, Loorbach's management cycle could be refined. Contrary to what Loorbach (2010) suggests, these activities largely follow not only a sequential order, but are also cyclic.

The focus of this paper enables insights into the territorial sensitivity of the field, which are lacking in the literature. Studies on similar initiatives in other regional contexts would allow for a more detailed comparison of the implementation processes to a circular economy and for generalisation of the results gained in the study presented here. Moreover, complementary to this study on the implementation process itself, it would be illuminating to analyse in detail the particular role of local governments in the transition to a circular economy. Finally, the analysis made here only covers about five years. In the future, when a longer timespan can be taken into account, more data will become available about phase 3, scaling up. Sharing this data might help to accelerate the transformative change and bring the final phase, mainstreaming, closer.

Authors contribution

I wrote this paper by myself without any assistance.

Declaration of competing interest

There is no interest involved in writing this paper. I am an independent researcher and did not receive any money to do the research.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jclepro.2020.120255>.

References

- Avelino, F., et al., 2011. Power in Transition: Empowering Discourses on Sustainability Transitions. Erasmus University Rotterdam. <https://hdl.handle.net/1765/30663>.
- Coenen, L., et al., 2012. Toward a spatial perspective on sustainability transitions. *Res. Pol.* 41 (6), 968–979. <https://doi.org/10.1016/j.respol.2012.02.014>.
- Cramer, J., 2015. Roadmap 'De Metropoolregio Amsterdam Als Circulaire Grondstoffenhub' 2015–2016. (Roadmap 'The Amsterdam Metropolitan Area as a Circular Resource Hub' 2015–2016). Amsterdam Economic Board, Amsterdam (internal report).
- Cramer, J., 2016. The Resource Transition in the Amsterdam Metropolitan Area: Added Value for Economy, Social Wellbeing and Environment. Amsterdam Economic Board, Amsterdam (internal report).
- Cramer, J., 2017. The raw materials transition in the Amsterdam metropolitan area: added value for the economy, well-being and the environment. *Environment* 59 (3), 14–21. <https://doi-org.proxy.library.uu.nl/10.1080/00139157.2017.1301167>.
- Cramer, J., 2018. Key drivers for high-grade recycling under constrained conditions. *Recycling* 3 (2), 1–16. <https://doi.org/10.3390/recycling3020016>.
- Cramer, J., Nederstigt, J., 2015. De Amsterdamse Metropoolregio Als Circulaire Grondstoffenhub (The Amsterdam Metropolitan Area as a Circular Resource Hub). Amsterdam Economic Board, Amsterdam. <https://www.amsterdameconomicboard.com/app/uploads/2016/02/Startnotitie-De-MRA-als-circulaire-grondstoffenhub.pdf>.
- De Jesus, A., et al., 2016. Eco-innovation in the transition to a circular economy: an analytical literature review. *J. Clean. Prod.* 172, 2999–3018. <https://doi.org/10.1016/j.jclepro.2017.11.111>.
- De Rômp, T.J., 2018. The Legal Transition towards a Circular Economy. Dissertation. Faculties of Law of KU Leuven and Hasselt University, Leuven. <https://www-law-kuleuven-be.proxy.library.uu.nl/home/algemeen/agenda-2017-2018/doctoraatsverdediging-thomas-j-de-romph>.
- Dick, B., 2004. Action research literature; themes and trends. *Action Res.* 2 (4), 425–444. <https://doi-org.proxy.library.uu.nl/10.1177/1476750304047985>.
- Dobbs, R., et al., 2011. Resource Revolution: Meeting the World's Energy, Materials, Food, and Water Needs. McKinsey&Company. <https://www.mckinsey.com/business-functions/sustainability/our-insights/resource-revolution>.
- Ellen MacArthur Foundation, 2013. Towards the Circular Economy; Economic and Business Rationale for an Accelerated Transition. Cowes, Great Britain. <https://www.ellenmacarthurfoundation.org>.
- Ernst, L., et al., 2016. Sustainable urban transformation and sustainability transitions, conceptual framework and case study. *J. Clean. Prod.* 112, 2988–2999. <https://doi.org/10.1016/j.jclepro.2015.10.136>.
- European Commission, 2014. Towards a Circular Economy: A Zero Waste Programme for Europe. Communication from the Commission to the European Parliament, the Council, the European and Social Committee and the Committee of the Regions, Brussels. <https://www.municipalwasteeurope.eu/sites/default/files/COR-2014-EN.pdf>.
- European Commission, 2018. Single-use plastics: new EU rules to reduce marine litter. Brussels. https://ec.europa.eu/commission/presscorner/detail/en/IP_18_3927.
- Fischer, L.B., Newig, J., 2016. Importance of actors and agency in sustainability transitions: a systematic exploration of the literature. *Sustainability* 8 (5), 21. <https://doi.org/10.3390/su8050476>.
- Geels, F.W., 2005. The dynamics of transitions in socio-technical systems: a multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930). *Technol. Anal. Strat. Manag.* 17 (4), 445–476. <https://doi-org.proxy.library.uu.nl/10.1080/09537320500357319>.
- Geels, F.W., 2006. The hygienic transition from cesspools to sewer systems (1840–1930): the dynamics of regime transformation. *Res. Pol.* 35 (7), 1069–1082. <https://doi.org/10.1016/j.respol.2006.06.001>.
- Ghisellini, P., et al., 2016. A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. *J. Clean. Prod.* 114, 11–32. <https://doi.org/10.1016/j.jclepro.2015.09.007>.
- Homrich, A., et al., 2018. The circular economy umbrella: trends and gaps on integrating pathways. *J. Clean. Prod.* 175, 525–543. <https://doi.org/10.1016/j.jclepro.2017.11.064>.
- Jackson, M., et al., 2014. Transitions in theory and practice: managing metals in the circular economy. *Resources* 3, 516–543. <https://doi.org/10.3390/resources3030516>.
- Kalmykova, Y., et al., 2018. Circular economy – from review of theories and practices to development of implementation tools resources. *Conserv. Recycl.* 135, 190–201. <https://doi.org/10.1016/j.resconrec.2017.10.034>.
- Kemmis, S., 2010. What is to be done? The place of action research. *Educ. Action Res.* 18 (4), 417–427. <https://doi.org/10.1080/09650792.2010.524745>.
- Kemp, R., et al., 2007. Transition management as a model for managing processes of Co-evolution towards sustainable development. *Int. J. Sustain. Dev. World Ecol.* 14 (1), 78–91. <https://doi-org.proxy.library.uu.nl/10.1080/13504500709469709>.
- Kirchherr, J., et al., 2017. Conceptualizing the circular economy: an analysis of 114 definitions. *Resour. Conserv. Recycl.* 127, 221–232. <https://doi.org/10.1016/j.resconrec.2017.09.005>.
- Kirchherr, et al., 2018. Barriers to the circular economy: evidence from the European union (EU). *Ecol. Econ.* 150, 264–272. <https://doi.org/10.1016/j.jecolecon.2018.04.028>.
- Kivimaa, P., et al., 2019. Towards a typology of intermediaries in sustainability transitions: a systematic review and a research agenda. *Res. Pol.* 48, 1062–1075. <https://doi.org/10.1016/j.respol.2018.10.006>.
- Loorbach, D., 2010. Transition management for sustainable development: a prescriptive, complexity-based governance framework. *Governance* 23 (1), 161–183. <https://doi.org/10.1111/j.1468-0491.2009.01471.x>.
- Loorbach, D., Rotmans, J., 2006. Managing transitions for sustainable development, chapter 10. In: Olsthoorn, X., Wieczorek, A.J. (Eds.), 2006. Understanding Industrial Transformation: Views from Different Disciplines. Springer, The Netherlands, pp. 187–206. <https://s3.amazonaws.com>.
- Loorbach, D., et al., 2011. A transition research perspective on governance for sustainability. In: Jaeger, C.C., et al. (Eds.), European Research on Sustainable Development. Springer Verlag, Berlin/Heidelberg, pp. 73–89. https://repub.eur.nl/pub/Metis_145092.
- Loorbach, D., et al., 2017. Sustainability transitions research: transforming science and practice for societal change. *Annu. Rev. Environ. Resour.* 42 (1), 599–626. <https://doi.org/10.1146/annurev-environ-102014-021340>.
- Markard, J., et al., 2012. Sustainability transitions: an emerging field of research and its prospects. *Res. Pol.* 41 (6), 955–967. <https://doi.org/10.1016/j.respol.2012.02.013>.
- McDowall, W., et al., 2017. Circular economy policies in China and Europe. *J. Ind. Ecol.* 21 (3), 651–661. <https://doi-org.proxy.library.uu.nl/10.1111/jiec.12597>.
- Meadowcroft, J., 2009. What about the politics? Sustainable development, transition management, and long term energy transitions. *Pol. Sci.* 42 (4), 323. <https://doi.org/10.1007/s11077-009-9097-z>.
- Merli, R., et al., 2018. How do scholars approach the circular economy? A systematic literature review. *J. Clean. Prod.* 178, 703–722. <https://doi.org/10.1016/j.jclepro.2017.12.112>.
- Murray, A., et al., 2017. The circular economy: an interdisciplinary exploration of the concept and application in a global context. *J. Bus. Ethics* 140, 369–380. <https://doi.org/10.1007/s10551-015-2693-2>.

- Rauschmayer, R., et al., 2015. Towards a thick understanding of sustainability transitions — linking transition management, capabilities and social practices. *Ecol. Econ.* 109, 211–221. <https://doi.org/10.1016/j.ecolecon.2014.11.018>.
- Ready-Mulvey, G., Stahel, W.R., 1977. The Potential for Substituting Manpower for Energy: Final Report for the Commission of the European Communities. *Battelle. ECONIS - Online Catalogue of the ZBW, Geneva Research Centre, Geneva*.
- Rotmans, J., et al., 2001. More evolution than revolution: transition management in public policy. *Foresight* 3 (1), 15–31. <https://doi.org/10.1108/14636680110803003>.
- Smith, A., et al., 2010. Innovation studies and sustainability transitions: the allure of the multi-level perspective and its challenges. *Res. Pol.* 39, 435–448. <https://ideas.repec.org/cgi-bin/refs.cgi>.
- Van Ratingen, D., Cramer, J., 2016. Grondstoffen Transitieprogramma: De Metropoolregio Amsterdam Als Circulaire Grondstoffen Hub (The Resource Transition Programme, the Amsterdam Metropolitan Area as a Circular Resources Hub). The Amsterdam Economic Board, Amsterdam. <https://www.regiogv.nl/wp-content/uploads/2017/12/11d-grondstoffen-transitieprogramma-mra.pdf>.
- Verbong, G., Loorbach, D. (Eds.), 2012. *Governing the Energy Transition; Reality, Illusion or Necessity?* Routledge Studies in Sustainability Transitions. Routledge, New York. <https://research.tue.nl/en/publications/governing-the-energy-transition-reality-illusion-or-necessity>.
- Winans, K., et al., 2017. The history and current applications of the circular economy concept. *Renew. Sustain. Energy Rev.* 68 (1), 825–833 p:825-833. <https://EconPapers.repec.org/RePEc:eee:rensus:v:68:y:2017:i:p1>.
- Wittmayer, J.M., Schäpke, N., 2014. Action, research and participation: roles of researchers in sustainability transitions. *Sustain. Sci.* 9 (4), 483–496. <https://doi-org.proxy.library.uu.nl/10.1007/s11625-014-0258-4>.
- Wittmayer, J.M., et al., 2014. Making sense of sustainability transitions locally: how action research contributes to addressing societal challenges. *Crit. Pol. Stud.* 8 (4), 465–485. <https://doi-org.proxy.library.uu.nl/10.1080/19460171.2014.957336>.