Transition governance for just, sustainable urban mobility: An experimental approach from Rotterdam, the Netherlands

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ABSTRACT

Cities across the global are looking for structural systemic solutions to mobility related problems such as congestion, pollution, and lack of (public) space. Electrification seems to accelerate and address (local) environmental problems, but not necessarily contributes to just mobility by opening up public space, creating broader access to mobility and supporting health. In this paper we describe an experimental transition governance process in the city of Rotterdam, the Netherlands, in the context of the local climate agreement. It used transition governance to explore how the social, cultural, institutional and technological changes needed to achieve a just and sustainable mobility future could be accelerated. The politically supported but informal governance process mobilized public-private-civil networks of actors in the context of the local climate agreement to co-create a transition strategy based on zero-emissions, social and shared mobility in 2030, aiming for all vehicles left to be shared and free from tailpipe emissions. It accelerated a number of debates, actions and changes in the city and pushed local policies to further prioritize walking, cycling, sharing and public transport. Its ambitions have helped shape current formal urban spatial and mobility policies and institutional experimentation in the city, accelerated during the COVID pandemic.

1. Introduction

Urban mobility systems in developed countries are based on a mix of modalities that include public and individual/private transport options. Most major cities have extensive and well-used public transport systems (e.g. metro, bus, tram), decent infrastructures for walking and, sometimes, dedicated cycling infrastructure. However, individual car use is typically the most dominant modality in terms of physical presence with problems caused ranging from safety issues and parking to congestion and (air) pollution (Hickman & Banister, 2014; Santos, Behrendt, Maconi, Shirvani, & Teytelboym, 2010). As concerns over negative environmental and social impacts of current urban mobility systems mount and spatial pressures increase, more and more cities are seeking to facilitate a transition to sustainable mobility. In this paper we describe a transition governance process in Rotterdam, the Netherlands, that sought to change the dominant mobility discourse in the city and set in motion a shift towards collective and clean mobility.

Rotterdam (The Netherlands), like many other cities, has historically evolved with a car-based 'mobility regime' (Geels, Kemp, Dudley, & Lyons, 2011) with car-based cultures, structures and practices at the heart of it. This regime has historically facilitated growth of (auto)mobility and focused on managing safety and efficiency, but this was accompanied by significant costs to society and individuals. For example, the high economic costs of congestion that are in the Netherlands alone estimated at ±€3bn annually, or 0.5% of GDP (KiM 2017). Or the spatial impact of individual automobility: in the European Union on average 50% of the population own a car (Eurostat 2016), with an average public space use of 8–12m^2 for parking, and cars being parked for 95% of the time (Shoup, 2011). This links to the high public expenditure on (urban) parking; In the Netherlands parking costs €6–8bn in public money annually and generates <€1bn in public revenue (Voerknecht 2014). But even with subsidies the car comes with high household costs for owning and maintaining a car (the European average cost of owning a car is €616 a month according to LeasePlan's Car Cost Index). The

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negative economic aspects of car-based mobility are added to the well-known environmental and health effects. Ambient air pollution, mainly caused by combustion of fuels, is a leading contributor to the global disease burden (Cohen et al., 2017). And the emissions of CO2, NOx and other gasses significantly contributes to climate change (Moro & Lonza, 2018).

The negative impacts of the current mobility system are also seen to affect different parts of the population unevenly. Lower income groups generally live in neighborhoods closer to highways and are therefore more exposed to pollution (in Rotterdam, lower income groups life expectancy is 7 years below Dutch average of which 2 years are attributed to air pollution). The current mobility system also has unjust impacts on parts of the population that have limited or no access to mobility. Most prominent issues are transport poverty (lack of physical access, vicinity or affordability of mobility), health inequalities (impact of pollution on marginalized groups, unhealthy mobility) and spatial inequality (subsidized parking, uneven distribution of public space) (Banister, 2018; Mullen & Marsden, 2016; Sheller, 2016).

These persistent ecological, spatial and social problems related to the current mobility system create a context in which policy makers, business actors, and civil initiatives search for transformative change. They experiment with new applications of digitalization, automation, cycling, spatial planning, and public transport as solutions to urban mobility problems ; (Geels, Kemp, Dudley, & Lyons, 2011; Nykvist & Whitmarsh, 2008; Schwanen, 2015). The potential of such alternatives for urban sustainability transitions is widely recognized as cities across the world are experimenting with new and sustainable solutions to transport-related problems (e.g. (Shaheen, Cohen, 2013; Soares Machado, Marie de Salles Hue, Berssaneti & Quintanilha, 2018) and spatial pressures and injustice (Martens & Golub, 2018).

So far, analysis has pointed at the inertia of dominant (auto-) mobility regimes, with policy practice is mainly focused on experimentation and facilitating (technological) innovation through markets. Literature often identifies car use and its supporting socio-technical regime as persistently individual (Holden, Gilpin, & Banister, 2019; Schippl & Arnold, 2020). From the spatial and infrastructural context to the socioeconomic incentives and socially accepted norms and practices; all have developed to create a context within which an individual car is desirable, affordable, facilitated and normal. This explains the limited uptake of car-sharing, although its potential to contribute to sustainable mobility also has been established for long (Akyelken, Banister, & Givoni, 2018). Now that digitalization and electrification of automobility combined are disrupting and transforming the mobility sector, the question is whether this momentum could be aligned with the social, economic and institutional changes that can lead to radically less space-, material– and energy-intensive (sustainable) mobility systems that give more people access (just).

But the existing approaches in policy and business are not likely to steer towards radical reductions of car use or large-scale behavioral change directly as these will either negatively affect income (either through taxes or sales) or meet strong societal resistance. We therefore mainly see incumbent markets supporting technological innovation leading to technological substitution within the existing context, partly reinforcing the path dependency and persistent problems of injustice and unsustainability of the current systems (Geels, Kemp, Dudley, & Lyons, 2011). Within this context we therefore argue that a sustainable and just mobility transition requires a different type of governance, committed to accelerating more radical and disruptive social innovations. In this paper we describe an experimental governance process supported by the formal political process that explored a new governance logic of back casting, selective participation and empowerment of transformative social innovation.

2. Sustainability transitions and transition governance

A transition is defined as a structural systemic change in a societal regime over the course of multiple decades (Grin, Rotmans, Schot, Loorbach, & Geels, 2010). Societal regimes are defined as the dominant cultures, structures and practices within a societal system, which can be functional (e.g. mobility, energy, health, education, finance), spatial (a region or city) or organizational (e.g. company, university or ministry). In such systems, people over time develop shared norms and values (culture), institutions technologies and networks (structure) and behavioral routines (practices). Societal regimes provide stability but also create path-dependency: made investments, career pathways, incumbent interests and societal acceptance support processes of optimization and gradual improvement along the dominant development pathway. Such regimes can be dynamically stable for longer periods of time (decades) but historically always periodically go through phases of more shock-wise and non-linear systemic change: transitions (Loorbach, Frantzeskaki, & Avelino, 2017).

Fig. 1 visualizes the dynamics of such transitions in a stylized way, based on the so-called multi-level model and insights from complex systems theory. In essence, transitions develop as actors within a regime context continue to improve upon the existing making things more efficient, while their societal context changes. This enhances path-dependencies and lock-in by investing more in the existing regime, decreasing diversity as well as the ability to change more fundamentally. This often leads to growing internal tensions and increasing pressures from society upon actors within the regime to accelerate change. In parallel, actors outside the regime start early on to develop radical alternative ways of thinking, doing and learning. These transformative innovations (practices that challenge, alter or replace regime practices, Avelino et al. 2017) over time evolve and become better, more competitive, less alternative over time. If external pressures, regime crises and rapid diffusion of alternatives coincides a relatively rapid shift towards a new regime can take place, often a recombination of old and new elements. But inherently leading to phase out and breakdown of obsolete and undesired practices, technologies and cultures.

This analytical transition framework is the basis for transition management and governance: a selective participatory approach aiming to influence the speed and direction of societal transitions by facilitating change agents in social learning processes (Loorbach, 2010). It emerged as an action research approach to counter policies and approaches that are typically focused on improvement of existing regimes, and rather seeks to challenge these and create space for transformative change to just, sustainable futures. Transition governance provides a set of guiding principles that are operationalized according to the specific phases of transition. The principles are:

- Systemic: engage with emerging dynamics across societal levels
- Back-casting: envisioning and scenarios as instruments for change
- Selective: focus on change agents, frontrunners to create transformative networks
- Adaptive: experimenting towards multiple goals and transition pathways
- Learning-by-doing and doing-by-learning: ensure monitoring and reflexivity

These principles are translated in an operational approach referred to as transition management, in which the so-called transition arena is a key instrument (Loorbach, 2007). Transition management explicitly seeks to challenge and influence existing path-dependencies of the current (urban mobility) regimes and their technological, institutional and behavioral lock-ins in early stages of transition processes. To destabilize existing societal norms, established structures and routines, requires creating new discourse and space for transformative innovations (Avelino et al. 2018). To achieve this transition management takes a directional, prescriptive and selective approach, distinguishing itself from how policies normally work with a focus on facilitating the market and implementing (technological) solutions (Loorbach, 2010). In the transition governance approach a normative starting point is taken: currently dominant (mobility) regimes are inherently unsustainable and experiencing transformative changes due to lock-in effects and a dominance
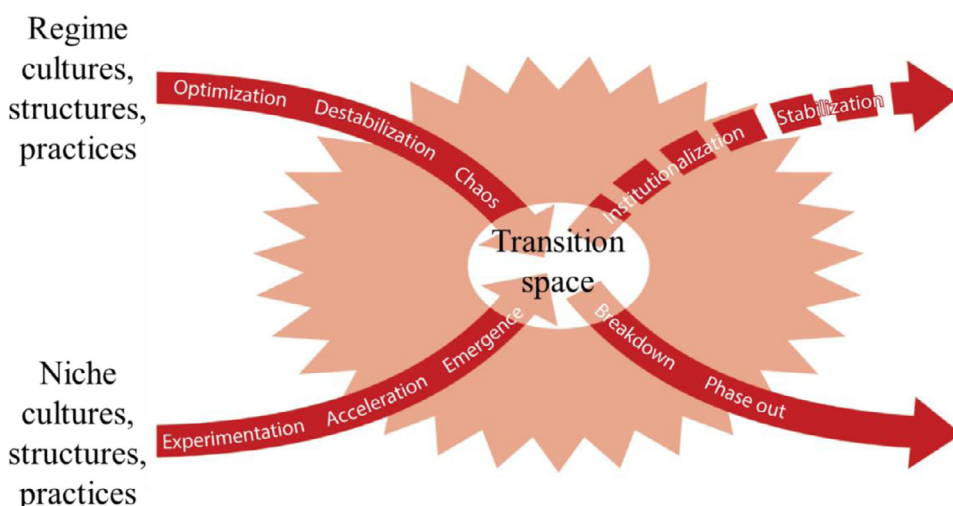
of optimization strategies (such as policies for increased fuel efficiency, road safety, or increasing road capacity).

In Rotterdam, an urban mobility transition arena was organized in 2015 (Jhagroe & Loorbach, 2018) that helped to shift the dominant discourse in mobility policy in Rotterdam from car-based to social mobility. In this process a small ands selected group of policymakers, entrepreneurs, citizens and researchers developed a first transition agenda challenging the dominant discourse and developing a new narrative of lean, shared and inclusive mobility. This process created space for policy experimentation, a broader societal dialog around desired mobility, spatial interventions in the city center prioritizing walking and cycling and a range of projects supporting social mobility including cycling education, shared mobility schemes and healthy mobility programs. As time moved on, technological innovation accelerated, bringing electric vehicles to market and multiple sharing schemes to the city of Rotterdam. With it a growing number of organisations, policymakers, entrepreneurs, citizens and researchers involved in pushing a just and sustainable mobility.

Taking the transitions perspective (Fig. 1), a context emerged with increasing pressures upon the regime and growing sense of urgency with policy makers, alongside emerging alternatives, both technical and social. In this context transition management shifts a focus from framing and envisioning a desired transition to connecting actors from the niche and regime. In this phase of transition, much more actors can be involved to focus on the actual process of transition and the potential breakthrough steps. In this context more emphasis can be placed upon institutional change and phase-out in a so-called transition governance mix. Developing a transition governance mix starts by identifying and translating guiding sustainability principles for a specific context. Guiding sustainability principles are often generic: within planetary boundaries, zero-emission, regenerative, inclusive, just, equitable, affordable. But these need to be translated into the given context, be it a place (city, region, area) or societal system (energy, food, mobility). By mapping dynamics across the transition X-curve (see Fig. 1), positive seeds for the desired direction can be identified as building blocks for the governance mix, consisting of:

- Build-up strategies that create networks and programs of emerging transformative innovations and develop insights into the conditions needed for discussion and scaling as well as the institutional barriers preventing this
- Transform strategies that incrementally innovate and adapt institutional and structural conditions to accommodate for the emerging alternatives and gradually close off space for undesirable practices

- Phase-out strategies that identify phase-out periods for unsustainable practices and structures and support the phase-out by creating just transition funds, legal frameworks and exit strategies.

The transition governance process described in this paper is a first large scale and experimental application of this transition governance mix. To produce the results presented in this paper we have used a mix of analytical and participatory, action research methods. we built upon the mobility transition arena narrative and the network established and combined this with the analytical work done within the TEMPEST project. This project, supported by the national research council of Norway, analyzed development and diffusion of car-sharing in Oslo, Malmö, London and Rotterdam. As the project was based upon the transition research perspective, analysis contextualized car-sharing and its (limited) uptake within a broader individual (auto-)mobility regime. A series of household interviews in different cities complemented the literature review to uncover similar path-dependencies and regime contexts across the different cities.

It led to the hypothesis that mainstreaming of car-sharing will probably only happen when individual car used is largely reduced or made more difficult. This will require a new type of governance as both regular policy and market approaches will mainly support innovation from within the existing regime. It helped build the transition analysis presented in Section 3, which was validated through a participatory workshop with policy and business professionals. This narrative formed the basis for the transition governance described in Section 4, which drew upon the transition governance mix. In essence it took a radical starting point (clean and social mobility in 2030) to then engage around 150 actors in exploring what needed to be broken down, built up and adapted to make that happen. Two of the authors of this paper were actively involved in shaping this process and by taking fieldnotes and building up an archive the process was documented. The whole process was ex ante reconstructed and evaluated by Spekkink et al. (2020), which was used in combination with the authors reflections. In Section 5 we reflect upon the process and its implications for the future.

3. Shared sustainable mobility as a lever for urban mobility transition

Urban mobility systems might still be often dominated by individual automobility, but the signs of transition dynamics are clear. Over the past decade, concerns over sustainability, climate change, health effects, and ecological degradation have become increasingly prominent in political and societal debates. The coming into force of the Paris Agreement, and numerous national and city-level strategies such as the C40 movement and the European Covenant of Mayors signal a

growing willingness to change. Increasing competition for space due to urbanization, increasing traffic flows, and related congestion, and resulting health concerns have led to calls for more sustainable urban development involving policies to reduce car use and support alternatives (Frantzeskaki, Broto, Loorbach, & Coenen, 2017). But despite the successful examples of support for cycling and walking alongside the electrification of automobility, so far cities are far from realizing full-fledged sustainability transitions that change the whole culture, practices and structures of our dominant urban mobility systems. Addressing the persistent ecological, spatial, and social challenges inherent to this mobility regime, implies a shift to just and sustainable mobility: not only (tailpipe) emission free but also accessible for everyone, as little use of resources and space use for mobility as possible, prioritizing fossil-free and healthy mobility (walking and cycling).

Sustainable mobility policies have been accelerated by the COVID pandemic (Griffiths, Del Rio, & Sovacool, 2021; Schmidt, Sieverding, Wallis, & Matthies, 2021) supporting modal shift introducing cycling infrastructures, removing parking places or facilitating shared mobility schemes. Like many other cities also Rotterdam's mobility department introduced changes such as that parking space was allocated for bars and green infrastructure, speed reduced in neighborhoods, and traffic lights changed to prioritize walking and cycling.[3] With these measured the policies play into the trends of modal shift: in Rotterdam car ownership and use is projected to decline by up to 10% over the next decade while use of cycling and public transport will double. The share of cars in the mobility mix will go from 42% to 32% in 2030 and 28% in 2040. It is replaced by cycling, which share rises from 29% to 36% in 2030 to 38% in 2040. Public transport, including walking to and in the inner city will go from 29% to 32% in 2030 to 34% in 2040.[4]

When it comes to the negative impact of cars in the city, two specific innovations stand out in this context: electrification and shared mobility. Each could support transformative change, combined they could revolutionize urban mobility systems leading towards a just and sustainable mobility future. Electrification already is accelerating with technological breakthroughs in electric vehicles, batteries, renewables, and ICT enable the development of radical new options, services, and business models in mobility (Kamargianni, Li, Matyas, & Schäfer, 2016). Projections of EV development are continuously revised upwards, ranging between 200 and 500 million EV's on the road by 2040 (BP, 2018).[5] Also, some countries, states, and/or cities have shown first signs of wishing to set clear end dates for selling new internal combustion engine (ICE) cars and a few have already done so.[6] While this shift to electric mobility is accelerating, it might very well lead to higher cost, resource use and spatial pressures. More recent literatures also start to relate these problems to the emerging socio-technical mobility transition and ask to what extent a shift to electric mobility will not even make these problems worse (Schwanen, 2020).

Car sharing, as compared to the rapid diffusion of electric cars, is still a very marginal phenomenon that only accounts for around 1% of the rides in many cities and is more of an add on to the existing mobility system: individual (auto)mobility is still the norm. The path-dependencies of user practices, car-industry business models as well as transport and mobility policies designed around individual (auto-)mobility imply much deeper cultural, behavioral, and institutional changes than necessary for electrification. Nevertheless, shared and sharing models are found to draw a lot of interest and investment from larger car compa-

nies over the past few years. Additionally, there is an acceleration of new technologies and business models (Julsrud & Farstad, 2020; Uteng, Julsrud & George, 2019), with shared mobility rapidly diffusing for example in urban centers in the Netherlands (doubling every year since 2014).

This rapid rise of shared mobility is facilitated by the widespread adoption of smartphones and new business models. What once started as small scale and local car clubs, now has become a market with business-to-consumer (B2C), business-to-business (B2B), and consumer-to-consumer or peer-to-peer (P2P) models. In the Netherlands P2P platforms like MyWheels allow individuals to rent out their car directly to other individuals and its registered users is doubling each year. Especially the last few years also the B2C market for sharind cars, bikes, mopeds or scooters is accelerating through companies like GO, Felyx, ConnectCar, DonkeyRepublic and Car2Go. Also more social and cooperative initiatives develop as a way to share an electric mobility with your neighbors such as Buurauto and Wijzijndeel. The current level of technology is furthermore enabling 'free floating models' such as Sixt Sharing and Juuve in which cars can be picked up and left anywhere within a certain geographic boundary (Firnkorn & Müller, 2015).

It is not surprising that business and government are interested in supporting shared mobility, as it already offers both a potential growth market already being the main transportation mode for over a million users worldwide (Dowling & Kent, 2015). From a transition perspective, shared mobility, and especially car-sharing, is a very interesting niche: it has the potential to disrupt the individual orientation of (auto-) mobility and all its spatial implications. Because even with the projected modal split in Rotterdam, there might be an equal number of cars in the city still taking up a lot of space and resources (now already cars stand idle for at least 90% of the time (Shoup, 2011)). If all these rides would be taken with shared cars, it could lead to over 50% fewer cars (The Economist, 2018) and 80% fewer on-street parking spaces (International Transport Forum, 2015). In other words: a transition from individual to shared (auto-) mobility could create the space and cultural and behavioral transformation that simultaneously address the persistent ecological, spatial, and social injustices problems in our urban mobility systems.

But the fact that carsharing is still a niche mostly for people that either have no alternative or are driven by ideals leads to discussions in the literature about the viability of carsharing (Dowling & Kent, 2015; Hampshire & Gaites, 2011). Usually, the main barriers against adoption are the behavioral change necessary to switch from a self-owned to a shared car, a (perceived) insecurity of access, having children with the need for special seats, not wanting to share private space, and being attached to the car as status symbol. The focus in these analyses is typically on individual car use as a practice that is embedded within a broader socio-technical regime and therefore extremely hard to change (Cass & Faulconbridge, 2016; Kent, Dowling, & Maalsen, 2017; Schwanen, Banister, & Anable, 2012). These studies however assume a very stable and inert regime, while in our analysis we see all the signs of destabilization and hypothesize that combining electrification with prioritizing healthy mobility and the shift to shared mobility can transform the existing urban mobility regime.

We thus perceive shared mobility and especially carsharing not (only) as a technological niche but rather as a, potentially, transformative social innovation (Loorbach, Wittmayer, Avelino, von Wirth, & Frantzeskaki, 2020). Hypothetically it can contribute to a radically more just, inclusive and sustainable mobility system by freeing up public space and supporting more social, inclusive and just mobility systems. But as described, this will not likely happen automatically, as market actors seek economic business cases competing with individual car use, governments are reluctant to do more than facilitate markets and support small scale initiatives. Taking a transition perspective however we also signal changes in dominant discourse in cities (away from individual car use as the norm), structural conditions (zero-emission areas, cycling infrastructure) and practices (mainstreaming use of shared vehi-

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[3] https://www.rotterdam.nl/bestuur-organisatie/mobiliteitsplan/

[4] https://www.rotterdam.nl/wonen-leven/mobiliteitsaanpak/Rotterdamse-Mobiliteitsaanpak1.pdf

[5] http://energypost.eu/fast-market-electric-vehicles-grow/

[6] E.g. Norway has announced a ban on the sale of petrol and diesel cars by 2025, China and the UK by 2030, and France by 2040, the Dutch parliament accepted a (non-binding) resolution for a ban from 2025 onwards, and California is considering a ban. In addition, the city of Amsterdam is thinking about an ICE vehicle ban entering force in 2030.

cles) that suggest a period of deeper systemic changes in under way. In the next section we describe an experimental governance process that was based on this premise and sought to catalyze, accelerate and empower a transition to just, sustainable mobility by bringing together the actors already contribution to it on a small scale.

4. The Rotterdam mobility transition agenda

Rotterdam, after having its city center bombed during WWII, developed into a modern car-based city in the post-war decades. There are close to 200.00 cars on a population just over 650.000, which comes to 0,6 car per household. Quite below the national average (0,9) but the highest of all bigger cities. This, combined with the post-war reconstruction as a modern city modelled upon the American ideas created a car-based infrastructure and accompanying institutional support. As an industrial port-city it also has a traditional function as 'arrival-city' being home to over 190 different nationalities. Its population is diverse and large parts of it have lower income levels and challenges to participate socially and economically. This leads to both marginalization and lack of access to mobility, as well as strong attachment to private cars as symbol of independence, identity or welfare.

Inequalities in health (life-expectancy differences of up to 12 years) and income are related to more general problems like environmental and housing quality as well as access to public infrastructures and services (Lucas, 2012). The push for sustainability transitions in Rotterdam to which previous transition management processes have contributed therefore combine economically oriented concerns regarding congestion and inefficiency with environmental– air quality in particular – and social issues such as of physical inactivity and transport-related social exclusion (Lucas, 2012). The latter is particularly salient in Rotterdam because poor access to affordable mobility severely limits the freedom of movement and participation in society for lower income groups making inclusive, affordable, and accessible mobility besides and environmental agenda also a socioeconomic challenge. The new government program published in 2018, titled 'New Energy for Rotterdam', therefore aspired to create a new transition agenda with the city for a 'just, sustainability transition'.[7]

With this program the city government created an opportunity to expand upon the previous transition arena processes by developing a more encompassing governance process in the context of the Rotterdam Climate agreement (www.energieswitch010.nl). This Climate Agreement was initiated by the alderman for sustainability (Arno Bonte) and part of the coalition agreement to implement the Paris Climate goals. The lead author of this paper was asked to chair and facilitate the mobility part of this process. This role made it possible to explore how shared mobility could be a lever in a broader transition to just, sustainable urban mobility. In the process around 150 actors were engaged to create a transition governance agenda for social just mobility in which shared mobility is the norm in 2030. This process took place in 2019 and led to a policy document embracing this vision, a broad range of concrete experiments and projects and in general a community of policy-makers, entrepreneurs, activists, researchers, professionals and businesses with a shared agenda to create a positive mobility future.

The transition governance process, referred to as the 'mobility transition table',[8] was established based the vision of a just, social and sustainable mobility future. It encompassed a broad participatory process based on 'selective participation' involving only those actors and using a shared vision and back-casting to increase the transformative potential of short term actions and help policy-makers and market actors to co-create the necessary institutional conditions. The process design focused on identifying breakthrough 'transition deals' with actors already

working on desired, sustainable and social, shared mobility. This selective participation ensured support for the transformative ambitions and a practical engagement with mobility transition of actors involved. The process was organized by the 'transition team' composed of transition researchers and civil servants. Their role was to structure the participatory process but also to connect outcomes to other policy domains and the formal political and policy processes through monthly formal meetings and weekly informal updates.

Fig. 2 (Spekkink, Teisman, Muller & vanBuuren, 2021) gives an overview of the process and the iterations that took place. Between March and December 2019 over 150 participants were brought together in four larger meetings, dozens of working group sessions, and numerous smaller meetings to discuss a shared positive mobility transition. Included in the process were people from public transport, lease and car companies, energy companies and large employers as well as small cooperatives, public space initiatives, citizens, new businesses, and frontrunners in sectors like logistics, transport or shared mobility. A digital platform (Treble) was used to create a continuous online conversation and facilitate the development of transition pathways and concrete projects.

This ambition reflected the different dimensions of the challenges associated to mobility and the need to address as many as possible with an urban mobility transition. The political push for concrete plans to support achieving the Paris Climate agreement created institutional space for accelerating a shift to clean mobility through a transition governance process. This process started with the formation of a team of civil servants and a 'table chair', who developed a process design and selected participants. The chair drafted a starting note developed based on the transition analysis (Section 3) that formulated a vision on just, sustainable mobility (see textbox 1). This vision was discussed in a first meeting alongside a presentation of the envisaged process and the aim to develop 'Climate Deals' as concrete breakthrough initiatives to accelerate the desired transition. While there was some discussion about feasibility, there was general support and enthusiasm for the ambition to make clean and social mobility the norm for the city by 2030. But it was also acknowledged that this implies deep behavioural and cultural changes, in part because of economic and infrastructural implications. Individual ownership, and especially car ownership, is a deeply embedded value also in Rotterdam. And changing the dependence, ownership and attachment to it is often complicated by life events, given that many households routinely own an individual car and expect guaranteed car access (Kent, Dowling, & Maalsen, 2017).

Next to the cultural and behavioral changes, the development of new institutional conditions to support social and sustainable mobility were identified as sector major challenges by the participants. Since knowledge and policy supporting mobility have co-evolved with the current automobility regime, they often are challenged by the introduction of new types of technologies, practices and business models. Shared bike schemes or mobility cooperatives, for example, face difficulties related to permits, parking licenses, ownership structures, responsibilities and insurance. The new regulatory and policy challenges that are part of this transition are related to new technologies and at the same time challenge the dominant discourse that revolves around optimization, support of individual choice, separation between public and private, and a broad set of rules and regulations that have developed around current infrastructure and their use (Schwanen, 2018).

Within the process of developing the mobility transition plan for Rotterdam, these barriers became increasingly obvious for participants. Iteratively the participants identified four guiding principles for the desired transition and the role of shared mobility in it:

1 Affordability: the societal benefits of shifting from individual to shared mobility can generate benefits for users such as greater liveability at street and neighborhood levels and greater physical activity. Cities should strive to distribute these benefits equally and, at the same time, help in moving towards internalizing negative ex-
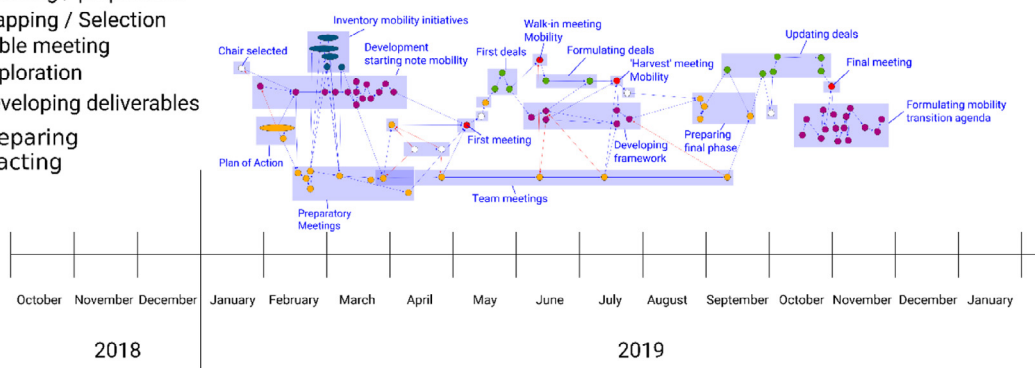

Fig. 2. Timeline Mobility Transition table, Rotterdam Climate Agreements (Spekkink et al., 2021).

Textbox 1
Starting vision for Rotterdams mobility transition plan (Translated from Rotterdam Municipality, 2019).

Towards social and sustainable mobility by 2030: Rotterdam's mobility transition vision

A sustainable Rotterdam is environmentally sustainable but also socially inclusive. Its economy and activities minimize ecological impact and resource use, while maximizing the production of social, ecological, and economic value. This implies high levels of circularity, low levels of energy use and no fossil fuel use, and a high density, enabling short(er) distances between facilities and a reduction of transport movement. High levels of resilience and climate adaptability are achieved through green and adaptive design. This city not only meets the goals of the Paris Agreement (net zero carbon emissions by 2050) but also maximizes the health and wellbeing of inhabitants, increases social interaction, and reduces socioeconomic inequality.

In such a city, mobility is free from tailpipe emissions, designed to facilitate movement and socioeconomic activity, accessible and affordable to all, and with a minimum use of resources. In Van Raak et al., 2018 only one pathway is in line with achieving such a future: a transition to shared electric mobility systems supported by extensive walking, cycling, public transport, and shared mobility services. In such a future mobility system, different modalities will be available that work together synergistically with priority awarded to walking and cycling for short-distance mobility. For longer distances, collective transport combines (electric) buses, trams and trains with new collective forms of transport by shared vehicles. In this scenario, there are hardly any individually owned cars but access for all to (automated) vehicles via service providers. The advantages of this scenario are resource reduction, air quality improvement, reduction of parking and space used for cars, and a reduction of the total costs of mobility in terms of individual and public expenses related to mobility in the broadest sense.

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ternalities of the use of individually owned, ICE-powered cars in a socially fair way.

2 Availability: the availability of shared mobility is now dependent upon a variety of business models that work well in high-density areas but less so in more peripheral, low-density settings. As there are often significant opportunities to expand in high-density neighborhoods, cities should create incentives and platforms to open up availability in the whole city.

3 Accessibility: multiple providers offer sharing schemes in different ways, often through digital platforms and apps. The city should seek to develop subscription and payment systems combined with public transport systems. The resulting scheme would function as Mobility-as-a-Service (MaaS), make use easier and enable reducing rates for lower-income groups.

4 Acceptance: broader public awareness around the cost and benefits of car ownership is needed, alongside strategies to demonstrate the attractiveness of shared and sustainable mobility, to support cultural and behavioral change. Community-based carsharing schemes that work cooperatively are an example of how enthusiasm of users on a local scale might persuade neighbors and friends to shift as well.

These guiding principles were then used as a basis for the discussion of interventions along the lines of the transition governance mix described in Section 2. In this, the focus was on ongoing activities and how each actor could from her or his position contribute to this transition. This resulted in a broader picture (see Fig. 3) that identifies the:

1 *Building up emerging alternatives*

A systematic build-up of new mobility conditions such as social and electric sharing schemes, sustainable urban design (happy streets), car-free zones, healthy school environments, mobility service platforms, and support for cycling and walking. Such strategies need to go beyond pilots and temporary projects, but

can build on these, possibly starting in specific areas that already have a relatively high uptake of these new alternatives.

1 *Transforming existing institutions*

A gradual and dedicated reorientation of existing institutional conditions to support the build-up and institutionalization of the alternatives. Examples of relevant interventions including changes in taxation, parking policies, zoning and planning policies, contracting and tendering of project development, road regulations, and air quality regulations.

1 *Phasing out undesirable elements*

A managed process of phasing-out undesirable practices and structures such as subsidized parking and individual parking space, access for ICE-powered cars, and high(er)-speed roads in cities. Concretely, this can include stepwise reduction of parking in public space, premiums for giving up ICE-powered cars, or progressive congestion charging.

This governance mix was then translated in a series of meetings and iterations into twelve 'Climate Deals'[9]: concrete actions that were designed to accelerate changes in all three dimensions. These included private initiatives (employers pushing shared and sustainable mobility, electrification of transport and establishing 'mobility hubs') as well as civil initiatives (mobility cooperatives and creating public space) and public (lowering speed limits, creating zero emission zones, phasing out street parking). Examples of concrete deals that are now, towards the end of 2021 still in operation or development:

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[9] See for an overview (in Dutch): https://rotterdamsklimaatakkoord.nl/klimaatdeals?deal=mobiliteit#heading-mobiliteit
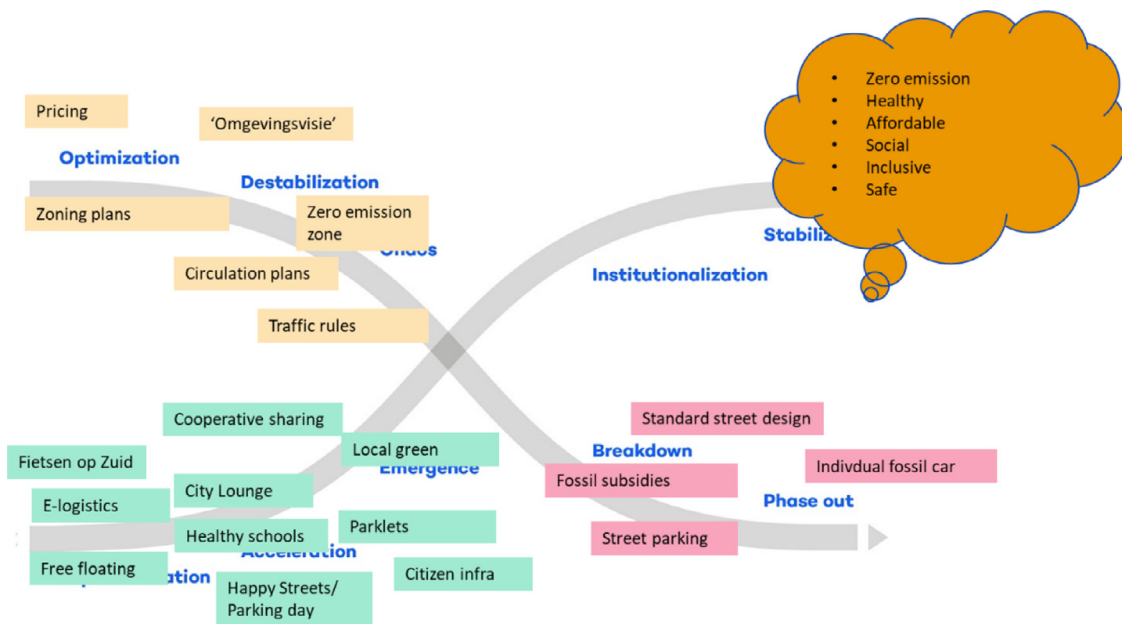
Fig. 3. Transition strategy for just, sustainable mobility future in Rotterdam.

- A city-wide social bike-sharing scheme
- Large employers and business coalition for mobility transition
- Municipal mobility zero-emission
- Zero-emission truck for heavy transport
- City wide permits for electric car-sharing schemes

This transition strategy[10] became part of the city's official Climate Agreement that was presented to the city council in December 2019.[11] It was more formally translated into the official 'Rotterdam Mobility Approach' which was approved by the city council in February 2020.[12] While the transition strategy itself does not have formal political implications or a legal basis, it has been a launching platform for all sorts of new initiatives and policy support for these. It influenced the formal policy to change the infrastructure and regulation (for example lowering speed limits, expanding bike lanes, closing off entire lanes for cars and removing parking). But it also created space and support for all sorts of micro-level experimentation, for example around car-free streets, 'parklets' (transforming a parking space into a garden, terrace or bike park) or mobility cooperatives.

The process itself helped to establish and strengthen a new discourse within the city of Rotterdam. A discourse around just and sustainable mobility transition, governance experimentation and delegitimization of fossil and individual (auto-) mobility. It also created a network of actors and a transition narrative around the shared ambition for a just sustainable mobility futures that prioritizes walking, cycling and shared and collective mobility. Combined with other transformative innovations, carsharing is a critical element to support the shift in cultures and practices needed. But this requires much more systemic and proactive policies to achieve changes in regulation, infrastructure as well as managed phase out of undesired (oil-powered, individual) mobility. The breakthrough experiments were not uncontroversial and led to heated debates in the city council, protest by citizens and local business. Interestingly the involved policymakers used the transition agenda and the governance philosophy as a basis for argumentation and response. Pointing at the urgency and potential of the transition they were able to introduce regulatory and infrastructural change, support more social innovation and experimentation and helped to scale a number of the existing initiatives. In this way the process in Rotterdam have led to a variety of actions and interventions that encouraged and accelerated the desired transition.

The value of creating space and policy support for experimentation related to a transformative discourse proved its value when the COVID pandemic hit. Public space and healthy mobility rapidly mainstreamed and the city of Rotterdam was able to scale significantly to transform public space.[13] This included support for larger scale introduction of carsharing in different ways. Rotterdam, together with other cities (Amsterdam, The Hague and Utrecht) introduced a city-wide permit for free floating electric carsharing. The city started to support development of cooperative sharing in neighborhoods. And the current climate mobility policy focuses on shared mobility with large employers, introducing one digital shared mobility platform and scaling neighborhood initiatives. Combined with the scaling of other sharing concepts (scooters, bikes, two-seaters), shared mobility is gradually becoming more accessible, affordable and available. It is however far from frictionless: the experiments lead to congestion at places and resistance from inhabitants. The growth of sharing schemes in the public space leads to complaints and political debate. And the policies to reduce parking spaced and speed limits are politically very controversial. The future of the mobility transition is thus also still open: the destabilization of the individual car-based mobility regime is evident as is the emergence of just and sustainable alternatives, but the future pathway will depend on the collective transformative governance capacities of the community, policy and business.

5. Reflections and outlook

Cities around the globe have been accelerating efforts to stimulate healthy and sustainable mobility, accelerated buy the COVID pandemic. But literature as well as policy practice underlines the persistence of our

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[10] https://www.energieswitch010.nl/application/files/6715/7434/0709/ 20191121_Klimaatdeals_Mobiliteit.pdf

[11] https://en.rotterdampartners.nl/wp-content/uploads//2019/11/Factsheet-Climate-Agreement.pdf

[12] https://www.rotterdam.nl/wonen-leven/mobiliteitsaanpak/Rotterdamse-Mobiliteitsaanpak1.pdf

[13] (in Dutch) https://www.rotterdam.nl/bestuur-organisatie/sterker-door/Rotterdam-Sterker-door.pdf

dominant urban mobility regimes and the central position of the car in it. The dominant transition pathway that seems to emerge are electrification combined with adding more space for cycling, walking and green. The path-dependencies of the individual automobility regime are evident: social, cultural, institutional and infrastructural factors that have historically developed to make individual automobility the norm and normal. Any approach that aims to address the persistent social, ecological and spatial sustainability problems associated with this individualized mobility system needs to start by addressing this. This in itself requires a governance approach that challenges the incumbent logic in society, policy and markets as it would imply a radical reduction in cars, affecting government and business income and requiring large scale behavioral change.

This paper presented and experimental transition governance process used to accelerate a transition to a just, sustainable mobility in Rotterdam, the Netherlands. The transition governance process in Rotterdam mobilized around 150 different actors involved in mobility to explore the concept of a just, sustainable mobility future in which healthy, clean and social mobility is the norm. In this context the ambition was further developed and translated into concrete actions to ultimately end up being embedded in regular policies and business and community initiatives. It created a context within which different actors from niche and regime together converged on a shared radical ambition and identified the guiding principles for future actions. Furthermore, they formulated a number of 'transition deals' and individual actions. As COVID soon after the process led to momentum in the public space, a large number of ideas could be implemented and involved actors could quickly push forward in transforming parking spaces, reducing car access and sustainable ravel policies for employees.

The relevance of such a more informal approach that is in different ways supported by and linked to the formal policy process became visible during COVID. The established networks, developed narrative and confidence around it as well as the developed actions quickly came to the forefront as the lockdown led to space for experimentation and policy intervention. But perhaps more fundamentally did the process develop a broadly shared commitment to a more ambitious approach and a support base for policy interventions. The inspiration policy makers drew from the process translated in a new and enhanced mobility plan that was formally approved. The positive effects of the informal approach are obviously also countered by the negatives: a lack of mandate to implement outcomes top-down.

The influence of the process thus depends largely on commitment, creativity and facilitation skills and in future cases such a process can benefit from more time, a more structured process design and most of all an even stronger political commitment. The transition governance process helped push the transition forward but to actually implement especially the most controversial elements will require political leadership and even more societal momentum. But it is certainly foreseeable that this pressure will continue to increase. The problems related to individual car use will persist with people increasingly dissatisfied. Simultaneously will the alternatives become more visible, affordable and normal. The transition governance process described is a way to anticipate this future momentum and develop the networks, agenda and actions that can be quickly scaled when time comes.

This in itself will require consistent, proactive and ambitious transition governance that combines action in support of build-up, transformation, and phase-out. Ideally these are developed within a community of actors that are on an every-day based influencing the desired mobility transition rather than those that have vested interest in the existing regime. To guide and accelerate such a new discourse and collaborative effort requires strategy: a combination of analytical leadership (what do we need to aim for) based on science with experimental governance (how to get there) dedicated to change the cultural, structural and behavioral context within which citizens move around in the city. The ability of urban government and local actors to develop such integrated transition approaches will decide whether the urban mobility transition will lead us towards electrification without addressing fundamental socioeconomic issues, or help to achieve major environmental, social and economic improvements in urban transport towards just, sustainable futures.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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