



Transformative Innovation Policy in Emerging Economies: What Does It Entail?

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6.1 INTRODUCTION

Making sense of ‘innovation’ as a noun is a continuous and everlasting challenge for scholars. The evolution of the concept has been marked by contestation and appropriation dynamics that derive in the emergence of adjectives and surnames for the term (see Godin, 2015; Godin & Vinck, 2017; Gaglio, Godin & Pfotenhauer, 2019). One of such new types (surnames) of innovations is *transformative innovation*, which is commonly associated with either sustainability transitions and/or

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sociotechnical change (Geels, 2005; Steward, 2008; 2012; Grin et al., 2010; Weber & Rohracher, 2012; Schot & Steinmueller, 2018).

This notion has recently pervaded scholarly discussions on innovation policy as well, raising new debates and highlighting rationales and advocating for institutional demarcations for government intervention under what is called *transformative innovation policy* (TIP) (Weber & Rohracher, 2012; Schot & Steinmueller, 2018; Janssen, 2019; Kern et al., 2019). These types of approaches have become popular lately, in the light of recent debates around environmental and societal challenges ('Grand Challenges', Sustainable Development Goals, responsible research and innovation, etc.) and more recently in the context of the Covid-19 pandemic. The common denominator is that the notion, however is used, urges for action to be taken in a more decisive, prescriptive and direct way all around the globe (Smith et al., 2010; Schot & Steinmueller, 2018; Kuhlmann & Rip, 2018), including emerging economies, where this trend of assessing the relevance of local innovation policies is arguably taking place in a particularly fast way (Kuhlmann & Ordonez-Matamoros, 2017).

The aim of this reflection chapter is to discuss the main features and logics underlying TIP implementation in emerging economies¹, taking Colombia as an illustrative case when it comes to its conceptualization and the challenges associated with its operationalization. The main contribution of the chapter is threefold: first, we track the breeding ground of the TIP approach on the evolution of global development and agendas; second, we review the state of the art of the TIP concept according to the

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¹ We are aware of the controversies behind this kind of notions. Nevertheless we have chosen to use the term 'emerging economies' interchangeably with the notion of 'developing countries', and 'global south', and instead of using notions such as 'post-colonial territories' for making our reflection accessible for readers who are not familiar

most influential literature on the topic so far; and third, we depict how the implementation of TIP and its related instruments looks like in the case of two ongoing public programs in Colombia.

With that in mind, we discuss the challenges and limitations of operationalizing the TIP concept as portrayed by literature so far from the point of view of an emerging economy contexts, such as the one found in Colombia. We argue that although the notion of TIP suggests a **bottom-up** perspective, and that transformative experiences and practices have been taking place **in emerging economies** for a while, it is presented in the scholarly and policy debates as both a rather top-down notion in epistemological terms, and as a naïf notion in political terms, mainly rooted in development **discourses** built by scholars and policy-makers from the global north, who have ignored and simplified policy and political realities proper to emerging economies.

Colombia is an interesting case for exploring the plausibility and rationales of TIP as understood in the global north for at least four main reasons: (a) it emphatically faces many of the challenges that inspire the global development agendas, where some economic and technological advances are taking place, while structural poverty and inequality problems remain, (b) the country is highly dependent on extractive and other non-sustainable industries that have caused environmental damage, requiring TIPs that addresses such challenges (c) Colombia is trying to cope with a long tradition of violence, social exclusion and environmental degradation caused by armed conflict, which is another grand challenge to be addressed worldwide, and (d) faces weak democratic institutions, high levels of corruption and incipient sense of public good, which characterizes many emerging economies. This context makes therefore Colombia a good candidate for discussing the operationality of TIP discourse as portrayed by dominant literature on the matter, where some self-reflection and action has already begun in a systematic way at both the academic (Ordóñez-Matamoros, 2018; Montero et al., 2018; Villa et al., 2020) and the policy spheres (c.f. ‘*Libro Verde 2030*’ (University of Sussex & COLCIENCIAS, 2018)).

An underlying assumption in this chapter is that the differences between TIP aiming at economic productivity, competitiveness, growth

with decolonial approaches, post-developmentalism perspectives and other radical criticism against academic discourses that reinforce and overshadow uneven power patterns in geographical, social and epistemological territories.

and ‘well-being’ versus TIP aiming social inclusion, peace, human development or sustainability, do matter when looking at its applicability, where the role of politics tend to outweigh other rationales. We in addition assume that this scenario is even proper to the case of emerging economies contexts (Cozzens et al., 2008; Bortagaray & Ordóñez-Matamoros, 2012; Dutrénit & Sutz, 2014) than in developed countries. In this regard, we claim that transformative innovation policy studies need to take into account not only policy issues but also political issues when addressing socio-technical transitions (Smith et al., 2010, p. 446) in emerging economies. This piece therefore aims at offering debates aiming at ‘opening the black-box’ of policy as affected by politics, where relevant discussions are offered for better understanding the ‘global governance’ context of a growing worldwide debate about the role of science, technology and innovation (STI) to be more responsive (and responsible) to social needs. We thus highlight issues associated with politics, legitimacy and governance arrangements, as they are seen not only absent in mainstream research despite its central role in emerging economies, but also because this discussion may be of increasing relevance in the ‘western world’ where, as we are witnessing in the current pandemic crisis, these countries are indeed not ‘shielded’ from trends towards radical change.

The reminder of the chapter is structured as follows: the next section explores the antecedents, motivations and evolution of what today is called TIP which, as will be shown, results from a narrative closely related from the beginning to debates on development. Section three examines how mainstream academic literature has conceptualized TIP in a more operational way so far. Section four presents the main features of TIP operationalization regarding the policy instruments needed to that end, and discusses how these instruments have tried to be implemented in the case of Colombia. Section five discusses some of the epistemological, conceptual, political and practical challenges and limitations for the implementation of TIP in the case of emerging economies as conclusion to the analysis of the Colombian case, and finally, section six, presents some final thoughts with implications and ideas for further research on the matter.

6.2 ORIGINS OF THE TRANSFORMATIVE INNOVATION POLICY DISCOURSE

Since the early twentieth century the notion of innovation acquired “a positive connotation because of its instrumental function to political, social and material progress of societies” (Godin, 2015, p. 220). As such, the intrinsic motivations and features of a so-called ‘transformative innovation’ can therefore be found in the evolution of critical discussions around the concept of ‘development’. In this section, we review this evolution from the global perspective on (sustainable) development discussions highlighting how it fuelled the emergence of the transformative innovation rationale the way it is used today.

Four phases characterizes this process. These are somewhat overlapping with the three innovation policy frames proposed by Schot & Steinmueller (2018), but here the four phases refer to the study and understanding of development (its features and processes), rather than referring to just innovation policy approaches.

The first phase relates to the mission-oriented nature assigned to science, technology and innovation activities, where between the early 1940’s with the beginning of the Manhattan Project and 1972 with the development of the Apollo Program, the main goal of innovation policies was to gain market supremacy. The central role of National Aeronautics and Space Administration (NASA) as well as the European Space Agency (ESA) in the space sector represents the main example at the time. In this context, a crucial element for the future of TIP was the discussion on how to translate broad (grand) challenges and political directionalities into ‘doable’ goals to be achieved (Fujimura, 1987; Barré et al., 2013; Robinson & Mazzucato, 2019).

In the so-called ‘peripheral’ countries, Truman’s exhortation (1949) about helping ‘backward societies’ set the tone of the post-war discourse that dominated during the 1950s, where technological change was portrayed as a necessary condition for economic growth and, indirectly, development. Since then, the linear model of innovation is seen as the main heuristic for thinking about technological advancement and market expansion. The model was institutionally fuelled by UNESCO in Latin America, where it was adopted in the economic theory idea of step-by-step development (Rostow, 1959). In the following years OECD played a key role in the evolution of the discourse around the role of

science, technology and innovation policy in society. In 1963, the organization released a report—prepared by Christopher Freeman, Raymond Poignant and Ingvar Svernilsson—claiming to rationalize science policy and link it to economic growth, i.e. giving science policy legitimacy outside the narrow circles of education and research agencies. It came at the same time with the Frascati manual for gathering R&D statistics and supporting more systematic policy-making on the subject.

The second phase can be placed from the 1970s to the 1990s. In this period, innovation was seen as a key determinant to growth, and growth was in turn understood as a key determinant to development. The IMF and World Bank programmes were to play the guiding role in such a perspective. Innovation policy in this context was mostly focused on providing the necessary systemic conditions for increasing productivity and competitive advantage, where even labour markets were to be adapted to facilitate growth as the main goal.

In the ‘periphery’, the notion of development itself started to be highly contested in the 1970s by authors from the global south (Santos, 2009), with growing criticism on how it represented a form of cultural, social, economic and political hegemony over countries that in those years were called ‘peripheries’ (Andrade-Sastoque & Jiménez, 2016).

The third phase emerged at the beginning of 2000s, from a reconceptualization of development as freedom to choose (Sen, 2009, 2014), where primary endowments (Rawls, 2012) or resources (Dworkin, 2017) were deemphasized. The idea of development went therefore beyond economic growth, and focusing on capabilities, giving rise to a new understanding of the relationship between development and innovation (Cozzens et al., 2008). Under this perspective, a development-driven fairer world is not about a better redistribution of revenues or equal resources (Sen, 2009). It is rather about the capacity of each subject to transform resources into opportunities and into freedom, whereby identical goods or resources could represent different things for different people around the world. It is more a matter of basic capabilities for developing different skills, to be able to reach certain performances in different levels of development according to the differences of each society. For example, in a quite ‘poor society’, equality could be based on the idea to improve very basic needs. This frames differently then, innovation thinking. As put by Sen, it is a matter of specific goals for specific functionings in specific societies (Sen, 2009), where it is not a matter of innovating for growing without determinations while social policy redistributes ‘the

grown cake'. On the contrary. The idea of redistributive justice started to appear more explicitly in innovation policy literature, drawing the attention to communitarian issues (Cozzens, 2007). Innovation policy debates started to move towards finding the appropriate innovation required, and on the unintended consequences of innovation on inequality and on the environment.

The fourth phase begins in the 2010's, when the Techno-Economic Paradigm (Pérez, 2010) and Multi-level Perspective (Kemp & Rip, 1997; Kemp et al., 1998; Rip, 2000; Geels, 2002) concepts gained predominance in evolutionary economics of innovation and in Science and Technology Studies (STS), respectively. Since then, these concepts started to be taken into account in heuristics for innovation policy, mainly because of the demands for expanding the frontier of knowledge in the innovation policy field, among other reasons.

In 2014 the International Panel for Social Progress, whose Honorary Advisory Committee was led by Professor Amartya Sen, had its first meeting and Professor Johan Schot was invited to participate in the construction of the Social Progress report. He, simultaneously assumed by the suggestion of Carlota Perez, the direction of the Science Policy Research unit (SPRU), which facilitated that his work and colleagues inside the field of transition studies became the pillar of the new Transformative Innovation Policy (TIP) framework by launching the TIP Consortium using as a platform the 50 anniversary of SPRU in 2016 (Daniels et al., 2020).

The renewed version of the Millennium Development Goals (MDGs), the Sustainable Development Goals (SDGs) (also 2030 Agenda) (2016), impulsed originally by a former Colombian diplomat, Paula Caballero, was the perfect breeding ground for making fit the puzzle: the STS multi-level perspective as an underlying theoretical support for TIP, the demanding research changing agenda of innovation policy studies, and the long history of activism in academia of SPRU and of other European university research centres. The SDGs as a massive global political discourse represented a window of opportunity for the enrollment of several national Science Foundations and Science Ministries worldwide in the emerging innovation policy framework. Since then, a few southern countries have been involved in the consortium, among them some Latin American governments, universities and academic networks in Colombia, Mexico and Brazil. Today this is expressed in what is called the TIP Latin American HUB.

Here we told a superficial story about the configuration of the TIP rationale as a new framework for thinking innovation policy nowadays, nevertheless, we suggest to explore more in-depth current and old southern STS thinking in order to enrich the reflexive spectrum around the TIP overarching rationale. In what follows, we delve into a further exploration of the main tenets of the current use of the notion of TIP as it's understood today. As will be shown, the TIP approach builds from different bricks cemented in one way or another during the four phases described.

6.3 MAIN TENETS OF TRANSFORMATIVE INNOVATION POLICY

In this section we review the main tenets of TIP discourse as it is currently portrayed by its proponents. In so-doing, we first go over the defining features of transformative innovation, then discuss the role of the State and of the related policies characterizing this approach, and end by examining the guiding principles of TIP as we understand it today.

6.3.1 *Defining Features*

According to literature, TIP has a narrow and a broad interpretation regarding the innovation process (Steward, 2008; 2012; Diercks, 2019). The first conceives innovation as a linear process resulting from techno-scientific and techno-economic revolutions, in which societal challenges are “new priorities for R&D through dedicated mission-oriented public funding” (Diercks et al., 2019, p. 885). Here, notions such as ‘mission-oriented’ innovation policies and the ‘entrepreneurial state’ are regarded as central for a policy approach seeking to create and shape market transformations (Mazzucato & Semieniuk, 2017, p. 32).

Under the second broader interpretation, which we focus on, transformative innovations are major long-term changes in sociotechnical systems², including both production and consumption structures, in order to prevent threats to society (Weber & Rohracher, 2012). This

² Sociotechnical systems are defined as “a cluster of elements, including technology, regulations, user practices and markets, cultural meanings, infrastructure, maintenance networks and supply networks” where the technological and social realms are closely interrelated (Geels et al., 2004, p. 3).

notion moves beyond economics and traditional innovation studies, and builds on the need for an interdisciplinary knowledge base for addressing innovation. It is mainly based on the innovation systems approach and the multi-level perspective (MLP) of technological transitions, and grabs conceptual inputs from transitions management, strategic niche management, sustainability transitions and technological innovation systems literature (Markard et al., 2012; Weber & Rohracher, 2012; Grin et al., 2010; Schot & Steinmueller, 2018; Khöler et al., 2019).

Transformative innovations are “full system redesign and culture change in the way people think about products and services” (DEFRA, 2010, p. 5). According to Weber & Rohracher, (2012) and Schot & Steinmueller (2018), these changes are regarded from the point of view of sustainability transitions literature as broad-scope radical paradigm/systemic changes in societal functions such as transportation, sanitation, energy supply, etc., embedded in sociotechnical systems (Geels, 2004; Steward, 2008, p. 15), which over the years have hosted certain (dis)continuities leading to unsustainable industrial structures (Kanger & Schot, 2019).

As changes at the sociotechnical system level, transformative innovations are associated with *system innovations* (OECD, 2015): this is, “an interconnected set of innovations, where each influences the other, with innovation both in the parts of the system and in the ways in which they interconnect” (Mulgan & Leadbeater, 2013, p. 7). System innovations for sustainability transitions reconfigure the structure and boundaries of sociotechnical systems, and involve “fundamental changes in consumer practices and markets” (OECD, 2015, p. 6), i.e. they imply innovation both in technologies and people’s behaviour (Steward, 2008) and are characterized by their long-term, multi-actor and ‘coevolutionary’ character, involving both the demand and supply sides (Geels et al., 2004; Geels, 2005).

According to the MLP heuristic, system innovations arise in niches³ and gradually scale up to the sociotechnical regime level, which is embedded in a particular developmental landscape (Geels, 2005). In this process, system innovations involve “disrupting or complementary types of knowledge and technical capabilities” (OECD, 2015, p. 6).

³ According to the multi-level perspective, niches are “protected spaces that allow nurturing and experimentation with the co-evolution of technology, user practices and regulatory structures” (Schot & Geels, 2008, p. 538).

The type of knowledge needed for system innovations includes integrated, practice-based, context-specific, co-produced and locally situated knowledge, rather than just the conventional techno-scientific knowledge (Steward, 2012). Then, “creativity, resourcefulness, local capabilities, indigenous knowledge, social innovation and innovation for social inclusion” are relevant policy goals in order to overcome grand challenges in emerging economies (Kuhlmann & Ordóñez-Matamoros, 2017, p. 3).

Here, Grand Challenges are societal and environmental, rather than just technical or organizational, and difficult to address because of their heterogeneous and multicausal nature (Kuhlmann & Rip, 2018). Furthermore, transformative innovation defies the narrow economic bias of technological innovation, which have also contributed to the configuration of the current societal and environmental challenges that we face nowadays (Godin, 2015; Gaglio et al., 2019; Kanger & Schot, 2019).

6.3.2 *The Role of Government*

System innovations require entrepreneurial governments. As Weber & Rohracher (2012) posits “transformation-oriented innovation policies’ which strategically focus on the transformation of whole systems of innovation, production and consumption” (Weber & Rohracher, 2012, p. 1038), whereby, according to Janssen (2019), a *transformative policy* can be defined as any “policy approach that strives for diversifying an economy’s industrial structure and underlying capabilities” (p. 79). Based on Janssen, for a policy to be transformative, it has to have three properties: (1) it focuses on specific ‘techno-economic pathways’ to support experimentation (selectivity); (2) it includes adaptation as a central process (process-orientation); and (3) it is a policy mix that combines complementary instruments to achieve policy goals (multi-instrumentality) (p. 79).

According to Weber & Rohracher (2012), this kind of policy is issue-centred, i.e. it addresses particular problem areas or subsystems; and intends to align policy goals and strategies, facilitate joint societal visions, and foster experimentation and learning. According to Schot & Steinmueller (2018), given the long-term nature of transitions, anticipation is a central policy practice, in order to foresee future collateral consequences of policy intervention that might hinder transformation. In this framework, policy is not conceived here as an unequivocal unidirectional top-down type of intervention. Instead, it embraces reflexivity to enable

the ongoing learning process that a bottom-up implementation policy focused on the demand side of innovation implies.

Now, the question of what legitimizes innovation policy intervention is key for understanding the role of governments (Chaminade & Edquist, 2010). Regarding a TIP, the answer to the question is twofold: it is a matter of both policy goals and policy failures. On the one hand, regarding policy goals and priorities, which is in turn a political process, TIP has two main concerns: social inclusion and environmental sustainability. This is a substantial normative difference from previous innovation policy frames where economic growth and competitiveness were the main goal. Under transformative innovation, sustainability transitions require radical systemic changes on productions, consumption structures and cultural behaviour⁴. Societal and environmental goals cannot be achieved through traditional governmental interventions, since the failures that might hamper them are more complex and involve more actors and interests.

On the other hand, it is about the failures that need to be addressed through government intervention in order to enable the achievement of policy goals. TIP moves beyond the techno-economic way of thinking. It is no longer about traditional market and systemic failures when it comes to policy intervention (Woolthuis et al., 2005). Even though market and systemic failures⁵ are still important challenges for governments regarding the promotion of R&D and innovation, new failures need to be fixed when aiming at long-term system innovations for social inclusion and environmental sustainability (Weber & Rohracher, 2012). Table 6.1 synthesizes ‘transformational failures’, as proposed by Weber and Rohracher (2012) and by Schot & Steinmueller (2018).

Rather than just a regulator to address these ‘transformational failures’, the government operates as facilitator, mediator or enabling actor (Kemp et al., 1998; cited by Bugge et al., 2018). By means of policy, the government mediates between the elements of the sociotechnical regime and its

⁴ This is a major and complex endeavour, and TIP literature might eventually have to go deeper into the psychological features of human behaviour at the individual level (see for example Bögel and Upham, 2018; Oreg and Sverdlik, 2018).

⁵ Market failures are: information asymmetries, knowledge spillover, externalization of costs, over-exploitation of commons. Systemic failures are: infrastructural failures, hard & soft institutional failures, interaction/network failure, capabilities’ failure (Woolthuis et al., 2005).

Table 6.1 Transformational Failures

<i>Transformational Failure</i>	<i>Description</i>
Directionality	It is concerned with contributing with innovation to a particular direction or priorities for transitions
Demand articulation	It stresses the necessity to ensure that innovations are uptaken and appropriated by users
Policy coordination	It means that different policy levels must work together to contribute to transformation
Reflexivity	It refers to the need for constant monitoring and learning in order to introduce changes in the ongoing long-term process of transition

Source Own elaboration based on Weber & Rohrer (2012), and Schot & Steinmueller (2018)

different levels. In other words, the role of policy is, as OECD (2015) posits, “to (...) identify potential complementarities between parts of the system and make the needed connections, while over the long-term to raise ambition and push the boundaries of the system so as to facilitate an efficient and effective transition” (p. 44).

6.3.3 *Guiding Policy Principles*

The TIP process is guided by normative values that define the essence of policy design and implementation. According to some authors, these include directionality, participation and inclusiveness, reflexivity and experimentation, and interdisciplinarity (COLCIENCIAS, 2018; Chat-away et al., 2017).

While directionality refers to outline orientations towards alternative development pathways, participation and inclusiveness suggests a bottom-up perspective, where niches play a central role in scaling up innovations for sociotechnical transformation and where patient associations, users of STI, social movements, universities, local communities and associations, among others, play important roles. Reflexivity and experimentation in turn recognizes the bounded-rationality context where actors operate, so learning-by-doing emerges as a critical activity. Lastly, interdisciplinarity contributes to go beyond the underlying techno-economic rationales that have been predominant in innovation policies (Schot & Steinmueller, 2018).

Transformative innovation in principle recognizes the possible negative externalities of R&D and technology, as stated before. This acknowledgment is a call to think about a more direct approach to development by innovation policies in addressing societal challenges (Arocena & Sutz, 2017) and a more responsible and responsive research and innovation practice in order to address sustainability and societal issues. Such responsive practices must follow principles like inclusion, moderation, deliberation, modularity and flexibility, subsidiarity, adaptability, human capabilities, institutional capacities, institutional entrepreneurship, culture of transparency, tolerance and last but not least, the rule of law (Kuhlmann et al., 2016)⁶.

6.3.4 *TIP Instruments*

New approaches to innovation policy demand alternative practices. According to Schot & Steinmueller (2018), TIP involves **policy practices such as anticipation; experimentation; learning; and intermediation to foster interaction among actors**. These practices require in turn a new set of policy instruments and combinations of them (policy mix) oriented towards sustainability transitions (Kivimaa & Kern, 2017; Kern et al., 2019). Even though there is a growing need for new (systemic) innovation policy instruments, traditional ones are still dominant today in policy practice, especially financial instruments in emerging economies (Smits & Kuhlmann, 2004, pp. 15–16). This type of instruments are important, but addressing grand societal and environmental challenges requires new and more appropriate innovation policy instruments, regarding the complex, multicausal, heterogeneous, contested and non-linear nature of these issues (Kuhlmann & Rip, 2018).

Moving from classical and systemic instruments, TIP would entail a new set of policy instruments. Some examples of these instruments are the **socio-technical experiment, innovation intermediation, transitions management, transition arenas, producer–user network, strategic niche management**, among others (Steward, 2012, p. 341). For instance, **strategic niche management (SNM)** has been discussed in the literature

⁶ An additional set of principles regarding the narrow approach on transformative policy can be found in Janssen (2019, p. 80), who outlines a normative framework to assess the design and potential impact of transformative policy in terms of policy organization and orientation.

as a broader policy strategy. It has the purpose to bring about sustainable innovation transitions by creating and modulating technological niches in a bottom-up perspective of endogenous steering, “or steering from within” (Schot & Geels, 2008, p. 538).

These new set of policy practices and tools could indeed be organized according to three main stages of the policy cycle: design, implementation and evaluation. Regarding policy design practices such as identifying transition arenas, experiments, visions development, or transition pathways backcasting processes, planning monitoring, evaluation and revisions are useful tools in envisioning transition management strategies (Voß et al., 2009). According to Voß et al. (2009), during policy design, identifying transition arenas might facilitate creative transition-oriented interactions among different actors to prompt second-order learning, discussing and exchanging knowledge, practices and experiences for transformation. Here, the authors claim, particular types of mediation between actors are needed, going beyond traditional bilateral mediation. Thus, systemic intermediation emerges as a practice to “connect, translate and facilitate flows of knowledge” and innovation across and within the niche, network or system levels (van Lente et al., 2003, p. 248; Fischer & Newig, 2016; Kivimaa et al., 2019).

In policy implementation, in turn, according to Voß et al. (2009), socio-technical experiments facilitate the exploration of possible transformative pathways according to the visions of actors in niches and to foster ‘learning-by-doing’ practices that contribute to adaptation and creation. Experimentation, of course, implies openness to both success and failure as possible outcomes of innovation practices, as part of a broader learning process (Vinck, 2017).

Finally, transformative policy evaluation is an instrument that contributes to policy learning and legitimacy. For the case of TIP, Boni, Giachi & Molas-Gallart (2019) propose a formative evaluation approach to assess and improve policy design and implementation in a participatory and inclusive way. The authors argue that this sort of approach might be more suited for the experimental and reflexive character of TIP, especially when this kind of policy includes multiple policy instruments that reinforce each other, making it difficult to clearly identify and accredit impacts to one or other instrument. According to the authors, a formative approach better addresses the worth of policy intervention in the making, paying more attention to the theory of change of TIP in the long-term. Evaluation models to assess innovation programs aimed at socio-technical

transitions must develop multi-level approaches in order to address the governance entanglements and complexity that come with the interaction of multiple interests and actors in sustainability transitions (Arnold, 2018).

Thus, based on the features taken from different works on the topic as the ones highlighted above, we propose the following definition for a TIP: **it is a set of public actions and instruments, through which governments mediate and mobilize resources towards more sustainable and inclusive sociotechnical systems via the promotion of knowledge and innovation production, diffusion and use with a long-term perspective.**

Having arrived at a comprehensive definition of TIP as the one proposed, in the following section we discuss the main challenges in translating TIP conceptual tenets into practice in the context of emerging economies. For so doing, we study the case of Colombia as an illustrative example.

6.4 FROM THEORY TO PRACTICE. TIP IMPLEMENTATION IN THE CASE OF COLOMBIA

Here, we depict how the implementation of the TIP approach looks like in the case of Colombia. We choose the Social Appropriation of Science, Technology and Innovation Policy (SASTI Policy henceforth) implemented in the country since 2005 as an illustrative case. Although this SASTI Policy was designed and implemented long before the TIP concept appeared in the academic and policy scenes, it was later presented explicitly *ex post facto* as such by the Administrative Department of Science, Technology and Innovation (COLCIENCIAS henceforth by its acronym in Spanish) in the framework of the National STI Policy launched in 2018 (*‘Libro Verde 2030’*, COLCIENCIAS, 2018), which had fundamental conceptual support from the SPRU’s consortium.

We believe that this SASTI Policy has indeed some key features of a TIP as the ones discussed above. For this reason we use it as a relevant case to be analysed regarding typical TIP operationalization challenges in emerging economies.

To develop this illustrative case, we consulted policy papers, scientific articles, legal documents and interviews with actors involved directly and indirectly in the design and implementation of the SASTI Policy in Colombia. In this case, we focus on two key elements for assessing

the plausibility of the TIP discourse in emerging economies as is understood in literature today: the role played by stakeholders and the intrinsic features of the corresponding policy instruments implemented in the period observed (2005–2019). While the first analysis is based on the concept of Institutional Entrepreneurs developed by DiMaggio (1988), the second followed the stages defined in the Path-transformative heuristic developed by Pinzón-Camargo, Ordoñez-Matamoros, & Kuhlmann (2020).

To have a better understanding of this case, we divide it into two stages characterizing the SASTI Policy. The first stage was the SASTI Policy as designed in 2010, and the second referring to its implementation up until today (2020).

The selection of the SASTI Policy as a TIP for the purpose of the intended analysis relies on the fact that it was originally conceived to address pressing grand societal and environmental challenges affecting Colombia for decades. It is now seen even more urgent in the context of the peace agreement achieved a couple of years ago after 50 years of conflict. The success of both sustainable and inclusive development goals aimed by such agreement requires indeed deep transformations, demanding tackling social concerns, and therefore new perspectives on the role of STI policies themselves (Ordóñez-Matamoros et al., 2018).

6.4.1 *Origins of the SASTI Policy*

The SASTI Policy could be understood as a path-transformative process that began with the emergence of the concept of ‘Social Appropriation’ in the framework of the first *Misión de Sabios* in the mid-90 s. There, the concept was referred to activities linked with processes of STI diffusion and communication. In 2005 COLCIENCIAS enacted the SASTI Policy following the understanding of the social appropriation from the *Misión de Sabios*. This policy was then endorsed in 2008 by the National Promotion Policy of Research and Innovation, (*Colombia Construye y Siembra Futuro* by its name in Spanish). These elements depict a preformation phase for the SASTI Policy in 2010.

From the organizational perspective of the field conditions (Battilana et al., 2009), a strong organizational heterogeneity featured the environment when the SASTI Policy began. At that moment, COLCIENCIAS was going through an institutional transformation. This entity

was moving from a Public Institute towards an Administrative Department, which meant an upgrading in the national institutional hierarchy within the executive branch. According to an interviewee, this modification meant a new unstable institutional environment for COLCIENCIAS, however. This entity was full of tensions both inside and outside for political reasons, as it was increasingly attracting much more political attention than in the past.

Elements in the preformation phase pointed out before, and the organizational heterogeneity at COLCIENCIAS were used by two actors as a critical juncture to introduce their vision of change through the SASTI Policy. These actors, we claim, played the role of institutional entrepreneurs (IEs) as the ones depicted by DiMaggio (1988). They belonged to the Directorate of Science, Communication and Culture Division at COLCIENCIAS and were crucial to design and foster the SASTI Policy.

These IEs were looking for an alternative vision to the idea of knowledge diffusion and science communication established in COLCIENCIAS for many years (De Greiff & Maldonado, 2011) in the preformation phase. This alternative vision introduced explicitly the intention to promote the active participation of the civil society in knowledge production according to their concerns (COLCIENCIAS, 2010; De Greiff & Maldonado, 2011). To introduce their vision, these actors used tactics such as discursive framing, allies finding (Battilana et al., 2009), networking (Brouwer & Huitema, 2018) and self-reinforcing mechanisms (Pierson, 2000). These tactics marked the formation phase in this path-transformative process. Table 6.2 describes these tactics.

These two IEs introduced a divergent change in COLCIENCIAS based on their vision of change. Two elements featured it. The first one was the development of a direct relationship between local communities in rural regions in Colombia, research groups and COLCIENCIAS, shaped by an active role from the local communities. The dominant institutional setting before the SASTI Policy gave a passive role to the local communities. The second element was the idea of using STI to address social concerns involving civil society directly.

The divergent change introduced by these two IEs fostered the emergence and realigning of practices inside COLCIENCIAS, with the research groups and local communities. For instance, inside COLCIENCIAS, budget and legal procedures had to be modified to acknowledge

Table 6.2 Institutional Entrepreneurs tactics at the SASTI Policy

<i>Tactic</i>	<i>Description</i>
Discursive framing	<p>The complexity of the political negotiations to approve a policy, fostered the two actors to use the label of ‘Strategy’ instead of ‘Policy’. Thus, it was easier and faster to have the approach approved, with policy guidelines and actions in a National Strategy rather than in a National Policy</p> <p>They used the logic framework approach promoted by the National Planning Department (DNP, by its acronym in Spanish)</p> <p>The team framed the SASTI Policy (‘Strategy’) in terms of efficiency and maximization to find support inside COLCIENCIAS by the decision-makers</p>
Allies finding	<p>They looked for allies to support their vision. Both inside and outside COLCIENCIAS. Some internal allies were the General Subdirector, and the directorate directors. Outside COLCIENCIAS, some allies were the Parque Explora from Medellín, the STI museum Maloka from Bogotá, the academia and the Inter-American Development Bank. These allies could be understood as coalitions</p>
Networking	<p>Processes of networking were carried out after finding strategic allies to support the vision of change. Among different activities which illustrate this strategy, the National Fora of Social Appropriation of STI was crucial to build and strengthen the Institutional Entrepreneurs’ networks</p>
Self-reinforcing mechanisms	<p>They reinforced the vision of the SASTI Policy including it in other relevant policy documents such as the National Development Plan for the period 2010–2014 (DNP, 2011^a; Salazar et al., 2014; Pinzón-Camargo & Ordóñez-Matamoros, Forthcoming)</p> <p>Although the vision of change introduced by the IEs diverged from the understanding of Social Appropriation before 2010, they kept the concept to <i>build upon the built</i>, which coincides with the self-reinforcing mechanism described by Pierson (2000) as the institutional density of politics</p>

Source Own elaboration.

^aNational Development Plans are the most critical policy framework for each period of government. They provide the compass to guide the design and development of different policy programs and tools.

the informality in rural areas of Colombia where some of those communities are placed; regarding researchers and local community leaders, the COLCIENCIAS' team had to improve their discursive skills to achieve an effective communication with those actors; finally, direct relationships between researchers and local community leaders emerged.

6.4.2 *SASTI Policy Implementation*

Once the SASTI Policy design was accepted by both COLCIENCIAS and other key external actors, who played the role of allies, its formal implementation began. The tactics promoted by the founding actors were crucial to sustaining the vision of change introduced in the Policy in its inception. Some of those tactics were oriented to contrast the vision before and after the Policy. First, they invested important efforts in making salient the advantages of the current one. This discussion was framed by academic articles (De Greiff & Maldonado, 2011; Lozano Borda & Pérez-Bustos, 2012). Second, they did public activities to open up discussions about the Policy (strategically called 'Strategy') to gain some legitimacy (COLCIENCIAS, 2011). Third, the Policy was formalized in print documents and spread among the current and potential allies at the national and local levels.

The central instruments in this stage were two key programs (**Programs** henceforth) called *Ideas para el Cambio* (IC) and *A Ciencia Cierta* (ACC). The first program began in 2012 to foster the application of STI to address social challenges directly (MinCiencias, 2018a), and it has had five versions. The second one was launched in 2013 to make visible experiences where communities had to use innovation to overcome challenges in their realm (MinCiencias, 2020). It has had four versions.

These Programs work by public calls giving public funds and technical support to the local communities. They were designed to develop and reinforce niches (just *à la* Schot & Geels, 2008). Thus, while IC is oriented to develop niches, ACC tries to identify niches to be supported. In table 6.3 below, some examples of projects funded by the two programmes with transformative potential are included.

In these programs, the participation of other public entities has been regular through institutional agreements, which is considered a key tactic. The added value of these Programs, according to community leaders and researchers involved, have been (a) the work based on the community concerns; (b) the incentives to develop links between researchers and local

Table 6.3 Examples of projects funded by the programs Ideas para el Cambio and A Ciencia Cierta

<i>Year</i>	<i>Program</i>	<i>Public Call</i>	<i>Challenge (C) /Initiative (I)</i>	<i>Project</i>
2012	Ideas para el Cambio	<i>Water</i>	C: Unemployment and inefficient water resources use	Food Security through fish farming under community participation model
2013	Ideas para el Cambio	Pacífico Pura Energía (<i>Pacific, pure energy</i>)	C: Communities without access to electric power	Solar energy for community development at Unión Balsalito
2016	A Ciencia Cierta	Sustainable use and biodiversity conservation	I: Strengthening initiatives linked with the sustainable use and biodiversity conservation which using STI solved a socioeconomic problem	Rescue and Conservation of Native Potatoes
2018	A Ciencia Cierta	Community Conservation of Strategic Ecosystems	I: Strengthening communities whose work contributed to the conservation of the ecosystem by the use of STI	Marine-Coastal protection of ecosystems at the municipality of Timbiquí, Cauca through sustainable use of solid waste derived from coconut production

Source Colciencias (2014, 2015), MinCiencias (2016, 2017, 2018b, 2019)

communities; (c) the appropriation of the role of STI in the community process; and (d) the empowerment brought by the COLCIENCIAS support. These Programs have evolved as an experimental process. An analysis of Terms of Reference (ToR) for each version of the Programs showed how each ToR included and corrected elements in the guidelines to achieve an improved version (Pinzón-Camargo & Centeno, In press). Some interviewees suggest that the ToRs have evolved in a trial and error process (i.e. experimentation *à la* Voß et al., 2009).

These Programs have worked as self-reinforcing mechanisms of the overarching SASTI Policy. Thus, first, the SASTI Policy has kept the Programs in recent years despite the COLCIENCIAS and Colombian Government political changes. Second, results by the public calls of these Programs contributed to sustain and legitimize the Programs, the SASTI Policy vision, and to engage former participants as new allies. Third, despite the multiple institutional changes that took place at COLCIENCIAS, the SASTI Policy kept its support not only by keeping the Programs alive but also the vision of change introduced by the two IEs at the Directorate in 2010. Finally, a legitimized SASTI Policy sustains the Programs and the other way around, where the loop is maintained as far as, according to interviewees from COLCIENCIAS, ‘the only way to keep the Strategy is showing results based on the Strategy programs’.

An analysis of this illustrative case shows that, (a) in the policy design stage, the SASTI Policy worked as a Transition Arena, providing the framework to provoke interplays among different actors (Government, Academia and Civil Society). The Programs could be classified as a form of strategic niche management considering their role to foster and enforce niches from a bottom-up approach in local communities in Colombia; (b) in the policy implementation stage it was illustrated in this case how ToRs contributed in the systemic intermediation of the visions from actors at different levels (actors at municipalities in Colombia, Universities, and Policy-makers at governmental entities), and to implement the public calls following an experimental process. We did not find information about the transformative policy evaluation pointed out in Sect. 3.4, and their corresponding lessons, however, as they have not been formally evaluated yet.

We want to remark the usefulness of the Institutional Entrepreneurship literature to study this case. It is because TIP not only relies on the policies and practices, but also in the tactics implemented by key actors, particularly those who want to change the rules of the game to bring about sustainability transitions (Farla et al., 2012; Pacheco et al., 2010).

6.4.3 *Main Challenges for Implementation and Success*

TIPs like the above presented are however challenged by the particularities of the Colombian context regarding policy-making. In the following sections we will briefly discuss some of the main controversies regarding SASTI policy to the date. We focus on three main policy milestones:

the 2010 version of the SASTI policy, the 2018 so-called ‘transformative innovation policy’ (*El y 2030*), and the new SASTI policy draft.

The 2010 Version of the SASTI Policy.

Since the beginning, the SASTI Policy lacks appropriate political support. It struggles indeed to be assigned enough financial resources for its implementation. The investment in calls for SASTI activities represented just 0.7% of the total COLCIENCIAS’ budget between 2011 and 2018, and out of 117 projects were submitted to the General System of Royalties (2013 to 2019), eleven (11) projects belong to SASTI (5) to Science Centers.

There has been in the last 10 years a high concentration of SASTI activities in the most STI-qualified regions (60.4%), but they have not been fully funded by COLCIENCIAS. In the case of SASTI activities funded by Colciencias, there is a concentration (30.3%) in emerging territories, such as Bolívar, Risaralda, Boyacá, Cauca and Cundinamarca. In the so-called, backwarded territories in terms of STI capabilities (Putumayo, Arauca, Guainía, Guaviare, Vaupés and Vichada) there is a low presence of development of STI appropriation activities according to the inquiry developed by FES foundation and Maloka (2019). This indicates that the policy deserves more implementation resources taking into account that it is not specially focused on ‘weak territories’, which can compensate the uneven balance of potential transformations that can be triggered on well-qualified STI regions driven by the private sector, or other non-governmental actors.

There are still important capability gaps between sub regional governments in Colombia regarding STI. Particularly, this reflects on a poor understanding of the scope and possible products, results and impacts of SASTI policies and projects. For example, in early 2020 La Guajira governor requested the Ministry of Science and Technology to disapprove a SASTI project, amounting to 18.000 million COP (approximately 5 Million US dollars), because it was considered inviable, impertinent and too expensive. Projects are often poorly designed or considered a misuse of resources, missing the transformative potential of SASTI Policy for local communities.

Another sign of lack of appropriate political support to a proper TIP in Colombia is the fact that there is still today an open debate on the plausibility of the name given to the SASTI Policy, and on the fact that its name does not match with what it really does. As explained before, the current

SASTI Policy has its roots in the first *Mision de Sabios* who, rather than directly advocating for and innovation policy for social inclusion and/or sustainable development, which at the time was seen as a ‘luxury’ left only developed countries, advocated for improving the national appropriation of STI via processes of STI diffusion and communication (Escobar, 2014). From that moment, policies, strategies, programs and policy instruments have been framed in such a way that they end up strengthening the use of the concept as a self-reinforcement mechanism (See table 6.2), increasing by so-doing the institutional density of politics around the concept of SASTI (Pierson, 2000).

Indeed, as presented in the previous section, both the concept of SASTI as framed in its associated ‘Strategy’ encompass a de facto broader range of instruments and goals involving a more active policy intervention aimed at direct social impact and transformation. In other words, the tactics of framing a truly TIP as merely a ‘SASTI Strategy’ reveal the difficult political and institutional environment characterizing Colombian STI (and development) policy arena, which would certainly oppose an STI policy aiming explicitly to social inclusion and/or sustainable development. For this reason, more than a concept, Social Appropriation is a label, a tag, a shield or a niche strategically framed by key IEs to protect the indented TIP. The reason behind: a dominating neo-liberal perspective at all levels of government and society, predominant back in those days and still today (Ordonez-Mamoros et al., 2018).

Despite the struggles to position the appropriation concept and the SASTI policy in the STI national institutional arrangement since the 90’s, the inquiry endeavours between 2008 and 2020 regarding this matter, just reached a systematic collection and analysis for following-up its programs and updating the policy in 2020. The purpose of such endeavours, from which even has produced indicators to evaluate the effect of SASTI practices (Daza et al., 2017), has not addressed any proper stringent policy evaluation. The policy, since 2010—when it was reinforced the 2005 policy under the name of strategy—has been implemented with a large margin of uncertainty and intuition, given that, the very local conceptualization about appropriation of STI and its operationalization in the policy-making, has been in a way, disconnected from the innovation policy and governance field. In terms of effectiveness, the broad indetermination of what a policy is, between the actors who have been concerned about this subject, has made impossible to understand what is at least an approximate state of the transformations produced by 15 years

of SASTI policy in Colombia. An *ex-post* policy assessment is necessary, otherwise the overshadowing of such local intuitive version of TIP given the massiveness of neoclassical economics underlying the Colombian STI policy-making, would remain pervasive in the STI national policy and institutional arrangement.

The 2018 SASTI/TIP - ‘El Libro Verde’ 2030

Before continuing the assessment of the viability of implementing TIPs in specific contexts such as the one of Colombia, it is worth mentioning that, as a typical ‘napoleonic’ State, where its institutional framework heavily depends on what is written and mandated by the constitution and other legal documents, policy documents play in Colombia very important roles to account for the existence (or lack thereof) of public policies and for producing (or not) effects in society from government interventions (Peters, 2008).

Having said that, in the el Libro Verde 2030, the main background document supporting the corresponding national STI policy, the SASTI ‘Strategy’ was explicitly regarded as a ‘Frame 3’ type of Policy (pp. 22), that is, in the jargon used by the SPRU consortium’s narrative a proper TIP. There, *Ideas para el Cambio* (IC) and *A Ciencia Cierta* (ACC) were seen as ongoing programs that had a transformative potential that needed to be both expanded (to broaden their scope and coverage) and accelerated (to eliminate barriers for speeding up its contribution to transformative change).

However, anything depicted in such a policy document (el Libro Verde) did not seem to have a clear implementation future. Six factors explain its weak situation. First, this policy document did not get enough support from external entities (beyond COLCIENCIAS) in other sectors besides the STI sector (and even there, only partially). Second, it had a strong normative tone making it more a rhetoric list of principles than a proper guidelines document, which makes it difficult to assess its specific intended contributions. Third, it did not define a clear implementation plan, lacking clear goals, targets, responsibilities assigned to specific actors or approximate budget. Fourth, this policy did not have a clear enforcement mechanism. Fifth, it was enacted using one of the weakest legal instruments in the Colombia legal and institutional framework: a mere conceptual rapport. Last but not least, it was officially launched a few months before the end of the incumbent government, which was then defeated in the presidential election by the opposing party. Only after

two years of its official launch event, the National Government has begun a National STI policy design, where the ‘green book’ does not appear to have a central role, and where its future therefore looks uncertain. The Libro Verde document has even disappeared from the COLCIENCIAS website...

The New SASTI Policy draft

At the time this chapter is written, there is a new background SASTI policy guidelines draft, which is in principle an important manifestation of the political will at least at COLCIENCIAS, (which at the beginning of 2020, under the new government, became the new Ministry of Science, Technology and Innovation) to continue with the implementation of this kind of TIPs policies in Colombia. Similar to the former Libro Verde background document, the new document has some limitations that are problematic from the policy viability point of view. First, the document, titled ‘policy guidelines’, does not provide a sufficient justification for the new guidelines, nor what are the improvements of these new guidelines with respect to the previous ones. Second, the document has a rather broad and abstract conceptualization of SASTI and the innovation practices surrounding it. Finally, the document has a rather normative character with little insights as to how to achieve its policy goals.

Despite efforts from the epistemic community supporting the SASTI Policy in Colombia, who advocate for performing an evaluation of the programme to visibilize its highly positive effects, in general a good understanding about its practices, experiences, and overarching rationales of the SASTI thinking and policy is still lacking. Daza et. al (2017) proposed 10 assessment dimensions for SASTI activities in Colombia, among them ‘Inclusion of vulnerable social groups’ however. The rest of the dimensions seem quite aseptic in political terms, which means that there are not clear or specific transformative directions or restorative intentions highlighted to support the SASTI TIP.

Arguably, the current 2020 SASTI policy guidelines share similar weaknesses of the former Libro Verde Policy document. The directionality for transformations are not clear. There are no explicit references to environmental or social justice, nor a reference to overcome inequality or poverty, which is at least a basic often present intention in transformative innovation policies. Additionally, the guidelines do not present an implementation plan, either instruments or prospective evaluation criteria. The only hope resulting from the current effort is that the policy document is

written and promoted by the ruling government. However, that is paradoxically the reason why the new version of the SASTI Policy will not have support from the new government after 2022. This is typical in the Colombian institutional and political framework and will arguably be the same in the decades to come...

The challenges posed by the current Covid_19 pandemic, which has led to increased even further poverty and inequality in Colombia, may represent a key opportunity for things to be done differently, around the world, including Colombia. This, however, is yet to be seen.

6.5 CONCLUSIONS

The analysis of any innovation policy approach involves the identification of key challenges, limitations and opportunities. In this section we highlight and reflect on some of them regarding the conceptual and practical dimensions of TIP, posing some questioning remarks regarding its tenets and applicability in the framework of the Colombian case, as depicted from the analysis of the SACS Policy design and implementation. For so doing, we first discuss the need for a sharper conceptualization of the TIP, especially considering the specific context of Colombia. Second, we discuss the challenges for transformative innovation policies to be effective in countries like Colombia. Finally, we discuss the role of politics in the policy process for transformation.

6.5.1 *Need for a Sharper Conceptualization of the TIP*

In our opinion, the transformative innovation policy literature has been discussing public policy without accounting for policy studies literature in depth. Furthermore, the ambiguity of some of the terms that emerge in TIP discussions might make it difficult to operationalize such an approach from a bottom-up policy perspective. This actually represents a constraint in the case of Colombia, a typical ‘napoleonic’ State where, in addition, language matters a whole lot, as Fischer & Forester (1993) would agree. The attempt to establish a national TIP approach in the country, the so-called *Libro Verde 2030*, lacked the material features that characterize a public policy applicable in the country: the definition of policy goals, strategies, instruments, indicators, resources, envisioned results and impacts, among other policy displays needed for operationalization (Ordóñez-Matamoros et al., 2013). In this regard, the implementation

of the *Libro Verde 2030* did not seem clear nor viable and, furthermore, it appears to be more of an abstract policy frame rather than a public policy in itself (Fagerberg, 2018), despite its meagre but positive effects.

Responsibilities, policy goals, resources, policy instruments and inclusive governance must be clearly established in the TIP design if it is to be successfully implemented. The Colombian national government must also support the operationalization of the TIP with enough resources and political will.

Recent efforts by the TIP Consortium were made in the context of the new international *Misión de Sabios*, in which prof. Johan Schot participated and managed to insert some TIP insights into the final report of this body. However, these recommendations are seen by local authorities as rather abstract and overly ambitious, and their implementation do not seem clear in the near future, as it happened with a previous *Misión de Sabios* in the 1990s.

A subsequent effort was a report prepared by the TIP Consortium⁷, highlighting the potential of the country to foster local transformative practices. In this case, we will ‘wait and see’ if the report receives enough attention by the national government. These are matters of both policy and politics in the operationalization process of TIP, which will be discussed later and in another paper further on.

Furthermore, despite the existing efforts to develop transformative experiments in the regions of Colombia (University of Sussex & Colciencias, 2018), regional capabilities must be further created or enhanced, so that local communities are able to define and manage their own transformational priorities based on highly territorial discussed needs and potentials at the niche level.

A lack of knowledge and understanding of the TIP challenges and opportunities is a constant in the Colombian context. There is indeed a growing need to build bridges between policy studies and sustainability transitions studies in our countries. A good example of this is the work of

⁷ See Schot, J. et al. (2020). Transforming Our World: Implementing the Sustainable Development Goals. Proposal for a Colombian Science, Technology and Innovation Policy Programme of Experimentation with a Strong Regional Focus. TIPC Extended Policy Report Prepared for.

the Colombian Misión de Sabios. Retrieved from: <http://www.tipconsortium.net/publication/transforming-our-world-implementing-the-sustainable-development-goals-proposal-for-a-colombian-science-technology-and-innovation-policy-programme-of-experimentation-with-a-strong-regional-focus/>.

Kern et al. (2019), who view in the discussion of policy mix and policy instruments a relevant unit of analysis that might contribute to integrate the above mentioned fields. This is, as a matter of fact, a growing concern in sustainability transitions literature (Khöler et al., 2019).

Next, we discuss some of the challenges for TIP on the practical ground, specifically related to the conditions for TIP implementation to be effective. Then, we will discuss the key role of politics in the process, which is considered a key challenge, inherent to the TIP logic.

6.5.2 *Challenges for Transformative Innovation Policies to Be Effective*

Successful implementation of TIPs will always remain a central matter. We highlight some ideas from Fagerberg (2018), who points out five challenges for such policies to be effective. For instance, according to the author, key factors affecting TIP include: setting direction, embracing opportunity, mobilizing stakeholders, holistic policy-making and improving governance. However, these challenges required to consider an additional lens, the role of the agency. Our reflection about the Colombian case shows how transformation endeavours do not emerge from an aleatory interaction of actors (Farla et al., 2012).

We suggest focusing on the role of institutional entrepreneurs to understand the role of the agency in TIP (Pinzón et al., 2020). Their analysis will contribute to identifying both enabling conditions and strategies (Battilana et al., 2009) that these agents will require to **set the direction** for the TIP's vision to mobilize resources. Among different applications from a better understanding of institutional entrepreneurs strategies, we can highlight at least two. First, it will explain how the actors will **embrace the opportunity** of using global trends concerned with sustainability to strengthen their narratives around transformation. Second, it will support the design policy tools to **mobilize** stakeholders to build collective action for transformative innovation.

Considering the role of the agency will bring a **holistic policy-making** approach, where the MLP and the Innovation System approaches will set the macro-level perspective, and the institutional entrepreneurship will cover the micro-level. Thus, it will be possible to get a broader perspective in policy-making and consider all the factors and actors that influence transformation processes.

Finally, it is necessary to **improve or reshape the governance** for a TIP. Therefore, considered tentative governance for TIP will be required (Kuhlmann et al., 2019). It is because tentative governance will help to explain and unfold, as the authors posit, the “provisional, flexible, revisable, dynamic and open approaches to governance that include experimentation, learning, reflexivity and reversibility” (p. 1091). Regarding the Colombian case, the lenses of tentative governance will give fine-grained detail to fulfilling complementarities between techno-scientific large tendencies (landscape) and small-based indigenous innovative networks (niches).

6.5.3 *The Role of Politics in the Policy Process for Transformation*

Sociotechnical and system transformations, such as those resulting from sustainability transitions, are growing global concerns that need special attention by political science. That is the reason for the growing interest to better understand this topic from that perspective (Avelino et al., 2016; Khöler et al., 2019). After all, the definition of priorities and policy objectives is indeed a political process. When moving from traditional priorities such as economic growth and competitiveness, to new challenges like social inclusion, peace and environmental sustainability, the political variables become crucial as the policy processes become even more complex, where new losers and winners will result as a consequence of fostering sociotechnical sustainability transitions (Smith et al., 2005; Meadowcroft, 2009).

We argue, however, that current literature on TIP still does not account deeply enough for the *real politic* that strongly influence agenda-setting and implementation processes in the context of highly unequal and contested democracies like Colombia. Furthermore, the notion of technological innovation systems had already received several criticisms for overlooking the role of politics in sociotechnical transitions processes (Smith et al., 2005; Smith et al., 2010; Markard, 2015; Bergek et al., 2015). This situation is more salient if, like in the last section, we consider the relevant role of actors.

For so doing, we must consider the centrality of actors to innovation in countries like Colombia. Some of them can often get involved in political practices, seeking to maintain a powerful privileged position that can eventually harm other actors and the environment (e.g. multinational enterprises) (Giuliani, 2018; Kanger & Schot, 2019). This is relevant

since as OECD (2015) acknowledges, “system innovation entails not just winners, but also losers, especially when old systems are replaced by new systems. Organizations with interests linked to old systems may resist and oppose the changes” (p. 11). Therefore, as Schot & Steinmueller (2018) claim, “the governance of transformative innovation should be recognized for what it is: a political process which should provide room for appraising and negotiating the development of a diverse set of pathways as well as making choices for specific ones” (p. 1562).

The Colombian case illustrates this claim. This country is featured by a ‘natural resource-based economy’ (Andersen et al., 2018), deeply rooted in extractive and unsustainable industrial practices. Hence, transformations are much needed. Efforts like the National SASTI Policy studied were implemented and showed possibilities to embrace a new path, and a new organizational and institutional arrangement brought hope in that sense with the transformation of COLCIENCIAS into the Ministry of Science, Technology and Innovation in 2019. However, the new Ministry itself does not seem to count on enough support and political will by the President. Also, the Minister lacks the political clout to mobilize the various stakeholders interested in setting a new direction for STI in the country towards social inclusion and sustainability paths. The bitter cherry on the cake: as mentioned before, the first attempt to officially embrace a TIP framework (*Libro Verde 2030*) did not resist the change of administration in 2018, and the possibility of strengthening the Policy was forfeit.

Further research on TIP needs to go deeper into the understanding of power dynamics in the context of TIP design and implementation and on how power interacts with knowledge and social challenges (Avelino et al., 2016), including the political endeavours needed for prompting just transitions in emerging economies (Swilling et al., 2016), particularly when it comes to TIP design and implementation (Ordóñez-Matamoros, Pinzón-Camargo, Centeno and Andrade, forthcoming). Also, as mentioned before, literature on policy mixes for sustainability transitions (Kern et al., 2019) is a possible bridge to contribute to a better understanding of the political devices deployed by governments in order to address the sort of challenges that concern transformative innovation, and to integrate the policy language into innovation studies, particularly into transformative innovation.

The case of Colombia analysed here therefore provided key new insights about what Transformative Innovation Policy entails in emerging

economies, where it became clear that institutional and political variables, traditionally overlooked by mainstream literature, tend to play determinant roles. Since the debates addressed here leaves more questions than answers, in the following section we discuss some potential venues to better grasp the topic at hand.

6.6 FURTHER RESEARCH ON TIP MATERIALIZATION AND PERSPECTIVES

In this chapter we reviewed and discussed the main features of TIP, bringing up the case of Colombia as an example of how it looks in such a contested and complex context of an emerging economy. The main contribution of this chapter is threefold: first, it contributes to the deconstruction of the developmental discussions that motivated the emergence of TIP, which would need to be contrasted with some insights from Latin American STS thinking that might nourish the ongoing construction of the concept. We will come back to this later. Second, the chapter reviews the main features of the TIP concept, as framed in the early literature on the topic. Finally, we intended to make a contribution by outlining how a *de facto* TIP looks in reality when it comes to implementation through specific policy instruments.

Further research must address the issue of what is the relevant transformative innovation governance framework where *politics* are considered as a relevant variable. Such a governance framework has to take into account new heuristics, actors, knowledge, arenas, discourses, reflexive processes, principles, interactions and institutions. Also, there is further research needed regarding the scope and reach of transformations prompted by TIP, especially from a multi-level governance approach and institutional entrepreneurship on policy networks (Orozco et al., 2019).

How to measure transformations is a remaining research challenge. Besides production and consumption structures, we believe that transformations can have an impact on local levels, setting conditions for inclusion and wellbeing. In other words, transformative innovation might not always be about huge radical systemic transformations, but local context based changes that improve people's lives.

One critique that may arise for transformative innovation is that it could be regarded as a fashionable concept or buzzword added to the long list of existing adjectives for innovation (technological, social, responsible, inclusive, etc.), i.e. the so called X-innovation terms that

emerge out of a continuous appropriation and contestation process (Gaglio et al., 2019). We acknowledge that the use of this new notion of transformative innovation might generate confusion among scholars considering the plethora of ‘X-Innovation terms’ that exist nowadays. We consider, however, that such appropriation and contestation dynamics can be fruitful for setting the agenda towards urgent challenges such as social exclusion and environmental degradation.

From an appropriation point of view, TIP helps to channel off such challenges to policy and decision makers in a rather intelligible and strategic fashion. It is a process that seems to have had some effect in Colombia considering the growing popularity of TIP among academic circles. TIP narratives can be regarded as a vehicle for the popularization and diffusion of the idea of radical systemic change for sustainability transitions. This, however, is not a neutral endeavour, since TIP might entail the blind adoption by governments of global development agendas and policies not necessarily suited to the Colombian context. Therefore, public awareness is much needed.

Regarding contestation, transformative and systems innovation is a reaction to the hegemonic techno-economic bias of innovation policies. Thus, TIP serves as a coherent narrative to challenge the dominant policy paradigms that give priority to competitiveness and economic growth over social inclusion and environmental sustainability (Cozzens et al., 2008).

In addition, TIP must take distance from ‘solutionist’ happy-ending sort of narratives. It should rather focus on the normative substance of its process and the multiple directionalities that become possible towards social inclusion and sustainability.

Following, three possible examples of epistemic referents for southern TIP whose transformative character has been somehow darkened by the inertia of geopolitics and economics of knowledge of the innovation policy field:

- 1) Since eleven years ago, the idea of Sumac Kawsay (good or pretty living) (Ortiz Fernández, 2009) has been a buzzing word in the academic world that denotes another way of social existence. This idea is an ancient worldview, a kind of philosophy that leads to the production and reproduction of democratic practices radically different to modernity and capitalism, laying down on the importance of collectivities, reciprocity and ontological equality regarding non-human beings.

- 2) An upgrade of ideas from a considerable amount of ‘old’ Latin American authors⁸ framed as PRACTS (*Pensamiento Latinoamericano en Ciencia Tecnología y Sociedad*) can help to the epistemic turn for TIP in the south. These thinkers, proposed practical and political solutions coherent with a future of justice, equity and environmental responsibility for Latin America. For example, (i) a renewal of the idea of scientificism from Varvasky, (ii) an integration of more actors to the triangle government < - > S&T < - > productive structure from Sabato and Botana, and (iii) a broader Herrera’s S&T National Project could offer alternatives to contemporary versions of neo-Malthusian and neo-Schumpeterian perspectives (Sabato, 1975).
- 3) Latin American feminist STS (Pérez-Bustos et al., 2019), Social Ecology reflecting on science (Gudynas 2002, Gudynas, 2018) and Latin American STS on environmentalism (Vara, 2004, 2007, Delvenne et al., 2013) are few of the contemporary referents that present empirical cases, reality tests and theoretical reflections which would help to think on more pertinent innovation policies for transformations in countries like Colombia. Policies that often are static and promote entrepreneurship and productivity among other economic growth logics.

All of the referents above can be useful for reflecting on more pertinent innovation policies taking into account the history of the continent, the geopolitics of knowledge and the current political economy of Latin America. Likewise, the work of current prominent scholars from South Africa⁹ about the transformative character of innovation policy, are in our opinion, more accurate for the understanding and intervention of realities in emerging economies than global agendas of TIP.

One epistemological challenge for further research in TIP for the south can be oriented for the following questions: (i) is it fruitful or sterile to think innovation policy with aspirational transformative characters that

⁸ Amílcar Herrera, Jorge Sabato, Oscar Varsavsky, and Natalio Botana in Argentina; José Leite Lopes and Helio Jaguaribe in Brazil; Miguel Wionczek and Luisa M. Leal in Mexico; Francisco Sagasti in Peru; Máximo Halty Carrere in Uruguay; Marcel Roche in Venezuela, Osvaldo Sunkel in Chile, Félix Moreno in Colombia, among others.

⁹ Such as Rasigan Maharajh from Tshwane University of Technology and Stellenbosch University, and Erika-Kraemer-Mbula from University of Johannesburg.

renews the idea of liberation of denied alterities? or (ii) are we in a time that poses an opportunity for those historically denied alterities to enforce their own transformations based on their knowledge, and practical ongoing emancipatory innovation boosted by respectful policies, and more sensitive ways of the encounter between governments, scholars, scientists, engineers and communities? These questions are open to be addressed conceptually and empirically.

REFERENCES

- Andersen, A. D., Marìn, A., & Simensen, E. (2018). Innovation in natural resource-based industries: A pathway to development? Introduction to a special issue. *Innovation and Development*, 8(1), 1–27. <https://doi.org/10.1080/2157930X.2018.1439293>
- Andrade-Sastoque, E., & Jiménez, J. (2016). Trayectoria socio-técnica de las relaciones entre extractivismo y desarrollo sostenible: El caso de la Colosa en Colombia. *Redes*, 22(43), 33–64.
- Arnold, E., Åström, T., Glass, C., & De Scalzi, M. (2018). How should we evaluate complex programmes for innovation and socio-technical transitions? Technopolis Group. United Kingdom
- Arocena, R., & Sutz, J. (2017). Science, technology and innovation for what? Exploring the democratization of knowledge as an answer. In S. Kuhlmann, & G. Ordóñez-Matamoros (Eds.), *Research Handbook on Innovation Governance for Emerging Economies* (pp. 377–404). Cheltenham: Edward Elgar.
- Avelino, F., Grin, J., Pel, B., & Jhagroe, S. (2016). The politics of sustainability transitions. *Journal of Environmental Policy & Planning*, 18(5), 557–567.
- Barre, R., Henriques, L., Pontikakis, D., & Weber, K. M. (2013). Measuring the integration and coordination dynamics of the European Research Area. *Science and Public Policy*, 40(2), 187–205.
- Battilana, J., Leca, B., & Boxenbaum, E. (2009). How actors change institutions: Towards a theory of institutional entrepreneurship. *The Academy of Management Annals*, 3(1), 65–107.
- Bergek, A., Hekkert, M., Jacobsson, S., Markard, J., Sandén, B., & Truffer, B. (2015). Technological innovation systems in contexts: Conceptualizing contextual structures and interaction dynamics. *Environmental Innovation and Societal Transitions*, 16, 51–64. <https://doi.org/10.1016/j.eist.2015.07.003>
- Bögel, P. M., & Upham, P. (2018). Role of psychology in sociotechnical transitions studies: Review in relation to consumption and technology acceptance. *Environmental Innovation and Societal Transitions*, 28, 122–136. <https://doi.org/10.1016/j.eist.2018.01.002>

- Boni, S., Giachi, S., & Molas-Gallart, J. (2019). Towards a framework for transformative innovation policy evaluation. TIPC Research Report. Ingenio (CSIC-Universitat Politècnica de València); SPRU, University of Sussex.
- Bortagaray, I., & Ordóñez-Matamoros, G. (2012). Introduction to the special issue of the review of policy research: Innovation, innovation policy, and social inclusion in developing countries. *Review of Policy Research*, 29(6).
- Brouwer, S., & Huitema, D. (2018). Policy entrepreneurs and strategies for change. *Regional Environmental Change*, 18(5), 1259–1272. <https://doi.org/10.1007/s10113-017-1139-z>
- Bugge, M., Coenen, L., & Branstad, A. (2018). Governing socio-technical change: Orchestrating demand for assisted living in ageing societies. *Science and Public Policy*, 45(4), 2018, 468–479.
- Chaminade, C., & Edquist, C. (2010). Rationales for public policy intervention in the innovation process: Systems of innovation approach. In R. Smits, S. Kuhlmann, & P. Shapira, *The Theory and Practice of Innovation Policy: An International Research Handbook* (pp. 95–114). Edward Elgar Publishing Limited.
- Chataway, J., Chux, D., Kanger, L., Ramirez, M., Schot, J., & Steinmueller, E. (2017). *Developing and enacting transformative innovation policy*. School of Business, Management and Economics, University of Sussex.
- COLCIENCIAS. (2010). Estrategia Nacional de Apropiación Social de la Ciencia, la Tecnología y la Innovación. COLCIENCIAS.
- COLCIENCIAS. (2011). Foro Nacional de Apropiación Social de la Ciencia y la Tecnología. Ciencia, Tecnología y Democracia: Reflexiones en torno a la apropiación social del conocimiento (p. 142). COLCIENCIAS; Universidad EAFIT.
- COLCIENCIAS. (2014). Ideas para el Cambio: Agua. Colciencias.
- COLCIENCIAS. (2015). Ideas para el Cambio: Pacífico Pura Energía. Colciencias.
- COLCIENCIAS. (2018). Libro Verde 2030: Política Nacional de Ciencia e Innovación para el Desarrollo Sostenible. COLCIENCIAS. <https://minciencias.gov.co/sites/default/files/libroverde2030-5julio-web.pdf>
- Cozzens, S. E. (2007). Distributive justice in science and technology policy. *Science and Public Policy*, 34(2), 85–94.
- Cozzens, S., Gatchair, S., Kim, K.-S., Ordóñez, G., & Supnithadnaporn, A. (2008). Knowledge and Development. In E. Hackett, O. Amsterdamska, M. Lynch, & J. Wajcman (Eds.), *The Handbook of Science and Technology Studies* (pp. 787–812). MIT Press.
- Daniels, C., Schot, J., Chataway, J., Ramirez, M., Steinmueller, E., & Kanger, L. (2020). Transformative innovation policy: Insights from Colombia, Finland, Norway, South Africa and Sweden (Chapter 2). In M. B. G. Cele, T.

- M. Luescher, & A. Wilson Fadji (Eds.), *Innovation Policy at the Intersection: Global Debates and Local Experiences* (pp. 9–30). Cape Town: Human Sciences Research Council.
- Daza-Caicedo, S., Maldonado, O., Arboleda-Castrillón, T., Falla, S., Moreno, P., Tafur-Sequera, M., & Papagayo, D. (2017). Hacia la medición del impacto de las prácticas de apropiación social de la ciencia y la tecnología: propuesta de una batería de indicadores. *História Ciências Saúde-Manguinhos*, 24(1), 145–164. <https://doi.org/10.1590/s0104-59702017000100004>
- DEFRA. (2010). Defra's Evidence investment strategy 2010–2013 and beyond. Department for Environment Food & Rural Affairs. https://assets.publishing.service.gov.uk/government/uploads/uploads/system/uploads/attachment_data/file/69292/pb13346-eis-100126.pdf
- Delvenne, P., Vasen, F., & Vara, A. M. (2013). The “soy-ization” of Argentina: The dynamics of the “globalized” privatization regime in a peripheral context. *Technology in society*, 35(2), 153–162.
- Diercks, G., Larsen, H., & Steward, F. (2019). Transformative innovation policy: Addressing variety in an emerging policy paradigm. *Research Policy*, 48, 880–894.
- DiMaggio, P. (1988). Interest and Agency in Institutional Theory. In L. G. Zucker (Ed.), *Institutional patterns and organizations: Culture and environment* (pp. 3–21). Ballinger Publishing Co.
- DNP. (2011). Plan Nacional de Desarrollo: Prosperidad para todos—Más empleo, menos pobreza y más seguridad (2010–2014). Departamento Nacional de Planeación.
- Dutrénit, G., & Sutz, J. (Eds.). (2014). *National innovation systems*. Edward Elgar Publishing.
- Dworkin, R. (2017). *Equality of resources* (pp. 113–170). Routledge.
- Escobar, A. (2014). Sentipensar con la tierra: nuevas lecturas sobre desarrollo, territorio y diferencia, Ediciones Unaula.
- Fagerberg, J. (2018). Mobilizing innovation for sustainability transitions: A comment on transformative innovation policy. *Research Policy*, 47(9), 1568–1576.
- Farla, J., Markard, J., Raven, R., & Coenen, L. (2012). Sustainability transitions in the making: A closer look at actors, strategies and resources. *Technological Forecasting and Social Change*, 79(6), 991–998. <https://doi.org/10.1016/j.techfore.2012.02.001>
- Fischer, F. & Forester, J. (Eds.). (1993). *The argumentative turn in policy analysis and planning*. Duke University Press.
- Fischer, L.-B., & Newig, J. (2016). Importance of actors and agency in sustainability transitions: A systematic exploration of the literature. *Sustainability*, 8(5), 476. <https://doi.org/10.3390/su8050476>

- Fujimura, J. H. (1987). Constructing do-able problems in cancer research: Articulating alignment. *Social Studies of Science*, 17(2), 257–293.
- Gaglio, G., Godin, B., & Pfötenhauer, S. (2019). X-Innovation: Re-Inventing innovation again and again. *Novation*, 1, 1–16.
- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy*, 31(8–9), 1257–1274.
- Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research Policy*, 33(6–7), 897–920.
- Geels, F. W. (2005a). Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective. *Technological Forecasting and Social Change*, 72(6), 681–696.
- Geels, F. W. (2005b). *Technological transitions and system innovations. A co-evolutionary and socio-technical analysis*. Edward Elgar Publishing.
- Geels, F., Elzen, B., & Green, K. (2004). General introduction: System innovation and transitions to sustainability. In B. Elzen, F. Geels, & K. Green (Eds.), *System Innovation and the Transition to Sustainability Theory, Evidence and Policy* (pp. 1–16). Edward Elgar Publishing.
- Giuliani, E. (2018). Regulating global capitalism amid rampant corporate wrongdoing—Reply to “Three frames for innovation policy.” *Research Policy*, 47(9), 1577–1582.
- Godin, B. (2015). *Innovation contested: The idea of innovation over the centuries*. Routledge.
- Godin, B., & Vinck, D. (2017). *Critical studies of innovation*. Edward Elgar Publishing.
- Grin, J., Rotmans, J., & Schot, J. (2010). *Transitions to sustainable development: New directions in the study of long term transformative change*. Routledge.
- Gudynas, E. (2002). “Ciencia, Incertidumbre y pluralidad.” *Ecología, Economía y Ética del desarrollo sustentable*. Buenos Aires: Edit. EMV-CTERA.
- Gudynas, E. (2018). Múltiples paradojas: Ciencia, incertidumbre y riesgo en las políticas y gestión ambiental de los extractivismos. *Polisemia*, 14(25), 5–37. <https://doi.org/10.26620/uniminuto.polisemia.14.25.2018.1-33>
- Janssen, M. (2019). What bangs for your buck? Assessing the design and impact of Dutch transformative policy. *Technological Forecasting & Social Change*, 138, 78–94.
- Kanger, L., & Schot, J. (2019). Deep transitions: Theorizing the long-term patterns of sociotechnical change. *Environmental Innovation and Societal Transitions*, 32, 7–21. <https://doi.org/10.1016/j.eist.2018.07.006>
- Kemp, R., Schot, J., & Hoogma, R. (1998). Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technology Analysis & Strategic Management*, 10(2), 175–198.

- Kern, F., Rogge, K., & Howlett, M. (2019). Policy mixes for sustainability transitions: New approaches and insights through bridging innovation and policy studies. *Research Policy*, *48*(10), 1–15.
- Kivimaa, P., & Kern, F. (2017). Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. *Research Policy*, *45*(1), 205–217.
- Kivimaa, P., Boon, W., Hyysalo, S., & Klerkx, L. (2019). Towards a typology of intermediaries in sustainability transitions: A systematic review and a research agenda. *Research Policy*, *48*(4), 1062–1075. <https://doi.org/10.1016/j.respol.2018.10.006>
- Köhler, J., Geels, F. W., Kern, F., Markard, J., Onsongo, E., Wieczorek, A., & Wells, P. (2019). An agenda for sustainability transitions research: State of the art and future directions. *Environmental Innovation and Societal Transitions*, *31*, 1–32. <https://doi.org/10.1016/j.eist.2019.01.004>
- Kuhlmann, S., Edler, J., Ordóñez-Matamoros, G., Randles, S., Walhout, B., Gough, C., & Lindner, R. (2016). *Responsibility Navigator. Governance framework for Responsible Research and Innovation*. Res-AGorA Project.
- Kuhlmann, S., & Ordóñez-Matamoros, G. (Eds.). (2017). *Research handbook on innovation governance for emerging economies*. Edward Elgar Publishing.
- Kuhlmann, S., & Rip, A. (2018). Next-generation innovation policy and grand challenges. *Science and Public Policy*, *45*(4), 448–454.
- Kuhlmann, S., Stegmaier, P., & Konrad, K. (2019). The tentative governance of emerging science and technology—A conceptual introduction. *Research Policy*, *48*(5), 1091–1097.
- Lozano Borda, M., & Pérez-Bustos, T. (2012). La apropiación social de la ciencia y la tecnología en la literatura Iberoamericana. Una revisión entre 2000 y 2010. *Redes*, *18*(35), 45–74.
- Markard, J., Hekkert, M., & Jacobsson, S. (2015). The technological innovation systems framework: Response to six criticisms. *Environmental Innovation and Societal Transitions*, *16*, 76–86. <https://doi.org/10.1016/j.eist.2015.07.006>
- Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, *41*, 955–967.
- Mazzucato, M., & Semieniuk, G. (2017). Public financing of innovation: New questions. *Oxford Review of Economic Policy*, *33*(1), 24–48.
- Meadowcroft, J. (2009). What about the politics? Sustainable development, transition management, and long term energy transitions. *Policy Sciences*, *42*(4), 323–340. <https://doi.org/10.1007/s11077-009-9097-z>
- MinCencias. (2016). 2016—Uso sostenible y conservación de la Biodiversidad. Retrieved August 18, 2020, from A Ciencia Cierta: <https://acienciacierta.minciencias.gov.co/index.php/concursos/bio-2016>

- MinCiencias. (2017). Rescate y Conservación de Papas Nativas (Ventaquemada – Boyacá). Retrieved August 18, 2020, from A Ciencia Cierta: <https://bit.ly/34i4hYe>
- MinCiencias. (2018a, January 26). *¿Qué es Ideas para el Cambio?* Retrieved July 9, 2020, from Ideas para el Cambio: <https://ideasparaelcambio.minciencias.gov.co/articulo/que-es-ideas-para-el-cambio>
- MinCiencias. (2018b). 2018—Conservación comunitaria de ecosistemas estratégicos. Retrieved August 18, 2020, from A Ciencia Cierta: <https://acienciacierta.minciencias.gov.co/index.php/concursos/eco-2018>
- MinCiencias. (2019). Protección de Ecosistemas Marino—Costeros del Municipio de Timbiquí, Cauca Mediante el Uso Sostenible de Residuos Sólidos Derivados de la Producción de Coco. Retrieved August 18, 2020, from A Ciencia Cierta: <https://bit.ly/3h8i1bR>
- MinCiencias. (2020). *¿De qué se trata?* Retrieved July 9, 2020, from A Ciencia Cierta: <https://acienciacierta.minciencias.gov.co/index.php/que-es-a-ciencia-cierta/que-es>
- Montero, S., García, J., Arond, E., & Medina-Garzón, A. (2018). Desarrollo económico local, competitividad e innovación: Una mirada desde Colombia. Documentos de Política N°7. Universidad de los Andes.
- Mulgan, G., & Leadbeater, C. (2013). Systems innovation. Discussion Paper. *Nesta*. London. https://media.nesta.org.uk/documents/systems_innovation_discussion_paper.pdf
- OECD (2015). System Innovation: Synthesis Report. Paris.
- Ordóñez-Matamoros, G., Tadlaoui, S., Porras, S., Duarte, J., López, L., Martínez, L., & Calderón, G. (2013). Manual de Análisis y Diseño de Políticas Públicas. Universidad Externado de Colombia.
- Ordóñez-Matamoros, G., Centeno, J. P., Arond, E., Jaime, A., & Arias, K. (2018). La paz y los retos de la política de ciencia, tecnología e innovación en Colombia. In C. Soto I. (Ed.), Seguimiento y análisis de políticas públicas en Colombia – Anuario 2017 (pp. 137–168). Universidad Externado de Colombia.
- Oreg, S., Sverdlík, N., & Back, M. (2018). Translating dispositional resistance to change to the culture level: Developing a cultural framework of change orientations. *European Journal of Personality*, 32(4), 327–352. <https://doi.org/10.1002/per.2152>
- Orozco, L. A., Villaveces, J. L., Ordoñez-Matamoros, G., & Moreno, G. (2019). Innovation policy and governance networks on national innovation systems. In G. Catalano, C. Daraio, M. Gregory, H. Moed & G. Ruocco (Eds.), 17th International Conference on Scientometrics & Informetrics, ISSI 2019—Proceedings (Vol 1, pp. 541–553). Sapienza University. Available at <http://www.issi-society.org/publications/issi-conference-proceedings/proceedings-of-issi-2019/>.

- Ortiz Fernández, C. (2009). *Felipe Guaman Poma de Ayala, Clorinda Matto de Turner, Trinidad Henríquez y la teoría crítica—Sus legados a la teoría social contemporánea*. Revista electrónica de la Universidad Ricardo Palma.
- Pacheco, D. F., York, J. G., Dean, T. J., & Sarasvathy, S. D. (2010, July). The coevolution of institutional entrepreneurship: A tale of two theories. *Journal of Management*, 36(4), 974–1010.
- Pérez-Bustos, T., Sánchez-Aldana, E., & Chocontá-Piraquive, A. (2019). Textile material metaphors to describe feminist textile activism: From threading yarn to knitting to weaving politics. *TEXTILE*, 17(4), 368–377. <https://doi.org/10.1080/14759756.2019.1639417>
- Pérez, C. (2010). Revoluciones tecnológicas y paradigmas tecno-económicos. *Cambridge Journal of Economics*, 34(1), 185–202.
- Peters, B. G. (2008). The Napoleonic tradition. *International Journal of Public Sector Management*, 21(2), 118–132. <https://doi.org/10.1108/09513550810855627>
- Pierson, P. (2000). Increasing returns, path dependence, and the study of politics. *The American Political Science Review*, 94(2), 251–267.
- Pinzón-Camargo, & Ordóñez-Matamoros. (Forthcoming). A study of innovation policies and governance structures in emerging economies under the path-dependence framework. The case of Colombia. 1–34.
- Pinzón-Camargo, M. A., Ordóñez-Matamoros, G. H., & Kuhlmann, S. (2020). Towards a Path-Transformative Heuristic in Inclusive Innovation Initiatives. An illustrative case in rural communities in Colombia. *Innovation and Development*, 1–20. <https://doi.org/10.1080/2157930X.2020.1832029>
- Pinzón-Camargo, M. A., & Centeno, J. P. (In press). Políticas de innovación inclusiva y tensiones en torno a su implementación y evaluación en Colombia: el caso de ‘A Ciencia Cierta’. *OPERA*, 1–35.
- Rawls, J. (2012). *Teoría de la justicia*, Fondo de cultura económica.
- Rip, A. (2000). There’s no turn like the empirical turn. *Research in Philosophy and Technology*, 20, 3–18.
- Rip, A., & R. Kemp (1997). *Technological change*, Battelle Press.
- Rostow, W. W. (1959). The stages of economic growth. *The Economic History Review* 12(1).
- Robinson, D. K., & Mazzucato, M. (2019). The evolution of mission-oriented policies: Exploring changing market creating policies in the US and European space sector. *Research Policy*, 48(4), 936–948.
- Sábato, J. A. (1975). *El pensamiento latinoamericano en la problemática ciencia-tecnología-desarrollo-dependencia*, Paidós.
- Salazar, M., Lozano-Borda, M., & Lucio-Arias, D. (2014). Science, technology and innovation for inclusive development in Colombia: Pilot programmes

- developed by Colciencias. In G. Dutrénit, & J. Sutz (Eds.), *National Innovation Systems, Social Inclusion and Development. The Latin American Experience* (pp. 133–168). Edward Elgar Publishing.
- Santos, B. d. S. (2009). Una epistemología del sur: la reinención del conocimiento y la emancipación social, Siglo XXI.
- Schot, J., & Geels, F. (2008). Strategic niche management and sustainable innovation journeys: Theory, findings, research agenda, and policy. *Technology Analysis & Strategic Management*, 20(5), 537–554.
- Schot, J., & Steinmueller, E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. *Research Policy*, 47(9), 1554–1567.
- Sen, A. (2009). *The idea of justice*. Harvard University Press.
- Sen, A. (2014). Development as freedom (1999). Roberts, JT, Hite, AB & Chorev, N. *The Globalization and Development Reader: Perspectives on Development and Global Change*, 2, 525–547.
- Smith, A., Stirling, A., & Berkhout, F. (2005). The governance of sustainable socio-technical transitions. *Research Policy*, 34(10), 1491–1510. <https://doi.org/10.1016/j.respol.2005.07.005>
- Smith, A., Voß, J. P., & Grin, J. (2010). Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. *Research Policy*, 39, 435–448.
- Smits, R., & Kuhlmann, S. (2004). The rise of systemic instruments in innovation policy. *International Journal of Foresight and Innovation Policy*, 1(2), 4–32.
- Steward, F. (2008). Breaking the boundaries. Transformative innovation for the global good. NESTA's Provocations 07. National Endowment for Science, Technology and the Arts (NESTA).
- Steward, F. (2012). Transformative innovation policy to meet the challenge of climate change: Sociotechnical networks aligned with consumption and end-use as new transition arenas for a low-carbon society or green economy. *Technology Analysis & Strategic Management*, 24(4), 331–343.
- Swilling, M., Musango, J., & Wakeford, J. (2016). Developmental states and sustainability transitions: Prospects of a just transition in South Africa. *Journal of Environmental Policy & Planning*, 18(5), 650–672.
- University of Sussex & COLCIENCIAS (2018). Orientaciones para la formulación de políticas regionales de innovación transformativa en Colombia. <https://ocyt.org.co/wp-content/uploads/2018/07/orientaciones-formulacion-politicas-regionales-transformativas.pdf>
- van Lente, H., Hekkert, M., Smits, R., & van Waveren, B. (2003). Roles of systemic intermediaries in transition processes. *International Journal of Innovation Management*, 7(3), 247–279.

- Vara, A. M. (2004). Transgénicos en Argentina: Más allá del boom de la soja. *Revista Iberoamericana De Ciencia, Tecnología y Sociedad-CTS*, 1(3), 101–129.
- Vara, A. M. (2007). Sí a la vida, no a las papeleras. En torno a una controversia ambiental inédita en América Latina. *Redes*, 12(25), 15–49.
- Villa, E., Cardona Valencia, D., Valencia-Arias, A., Hormechea, K., & García, J. (2020). Transformative Innovation Policy, SDGs, and the Colombian University. In G. Nhamo, V. Mjimba (Eds.) *Sustainable Development Goals and Institutions of Higher Education*. Sustainable Development Goals Series. Springer.
- Vinck, D. (2017). Learning thanks to innovation failure. In B. Godin, & D. Vinck (Eds), *Critical Studies of Innovation. Alternative Approaches to the Pro-Innovation Bias*. 221–231. Edward Elgar Publishing.
- Voß, J.-P., Smith, A., & Grin, J. (2009). Designing long-term policy: Rethinking transition management. *Policy Sciences*, 42(4), 275–302.
- Weber, M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change. Combining insights from innovation systems and multi-level perspective in a comprehensive ‘failures’ framework. *Research Policy*, 41, 1037–1047.
- Woolthuis, R. K., Lankhuizen, M., & Gilsing, V. (2005). A system failure framework for innovation policy design. *Technovation*, 25(6), 609–619.