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## Status and future dynamics of decentralised renewable energy niche building processes in Argentina

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### ABSTRACT

Despite significant natural potential for renewable energy in Argentina and the political intention to generate 8% of electricity from renewable sources by 2017, by 2016 the share was only 1.95%. Although this aggregated picture appears unfavourable, several diverse initiatives promoting the development and application of decentralised renewable energy technologies are in place across the country. The aim of this study is to characterise those initiatives promoting decentralised renewable energy and to assess their potential role in inducing the wider transformation of the Argentinian energy system. To achieve this, we apply conceptualisations for the development of sociotechnical niches and use qualitative research techniques to characterise the sociotechnical dynamics of the decentralised renewable energy sector in Argentina. A niche in an advanced stage of development, in which lessons are systematically aggregated in networks, was identified and examples of generic lessons being used to frame new projects or programmes were also found. In addition to considering the internal niche development processes, we investigate how external factors affect the development of the niche. Finally, we suggest two possible development pathways by which the niche might exert stronger influence on the broader sustainability transformation of the Argentinian power system.

### 1. Introduction

Over the last ten years, Argentina's fossil fuel-based power system has faced many pressures. The current situation is characterised by a continual increase in electricity demand (3 GWh p.a. between 2005 and 2015, representing 140% over the period), an unreliable power supply, heavy dependence on fossil fuels and the rapid decrease in Argentina's domestic conventional natural gas reserves [1,2]. Fostering the transition towards higher shares of renewable energy in the Argentinian energy system offers a wide range of development prospects for the country. The opportunities arise from actions aimed at reducing dependence on fossil fuels imports, improving the reliability of the power supply, strengthening the existing innovative industrial sectors and ensuring access to reliable power services for around 1.1 million people living in rural areas without access to the national power infrastructure.

Despite significant natural potential for renewable energy and stated political aims to generate 8% of the country's electricity from

renewable sources by 2017, the current rate is just 1.95% [3]. Most of the initiatives carried out to date have related to centralised power grids. Although the overall picture seems to be a negative one, different initiatives promoting the development and application of decentralised renewable energy technologies<sup>1</sup> do exist in Argentina (in the private, public and civil society spheres) – and some of these have been in operation for decades. However, it can be hypothesised that this seemingly contradictory picture at a less aggregated level may reflect the struggle faced by emerging sociotechnical niches in renewable energy technologies to stabilise and grow within an environment dominated by firmly established energy regimes based on the use of fossil fuels.

The aim of the study is to characterise the current development status of the decentralised renewable energy sector in Argentina and to assess its potential role in inducing a larger transformation of the Argentinian energy system. To achieve this, we conceptualise the diverse initiatives promoting the development and application of decentralised renewable energy technologies in Argentina as an emerging

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<sup>1</sup> In this study, decentralised power systems are understood as technical configurations where power generation capacities are located close to the served loads. Decentralised power systems can be completely autonomous, i.e. not connected to other power systems (as in the case of so-called off-grid power systems). They can also be interconnected to other and larger power infrastructure [54].

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sociotechnical niche and ask: “What are the internal niche dynamics and the context-related factors that have been hindering or supporting the development of the decentralised renewable energy niche in Argentina?” We apply concepts from Strategic Niche Management (SNM) and the Multi-Level Perspective on sociotechnical transitions (MLP). We use these concepts to analyse the socio-technical configurations and the internal processes by which the presumed niche develops, and to assess how external contextual factors and interactions influence the niche development. Moreover, the study seeks to gain insights into ways in which the niche can further develop and induce the broader deployment of decentralised renewable energy technologies in Argentina. Thereby this article aims to contribute to the growing field of research about energy futures [4].

The article is structured as follows. Section 2 provides a general overview of the current status of the Argentinian power system and the development of renewable energies in the Argentinian context over recent decades. Section 3 sets out the theoretical framework and introduces the concepts of sociotechnical niches and transitions. In Section 4, the methods of data collection and the research strategy are presented. Section 5 presents the results from the analysis of the niche-internal processes which have led to the current diffusion of decentralised renewable energy systems in Argentina and describes the contextual factors that are hindering or supporting the development of the niche. Section 6 discusses the results of our analysis and the implications for future research. Finally, the conclusions are summarised in Section 7.

## 2. The Argentinian power system and renewable energies

Over recent decades, Argentina has become highly dependent on hydrocarbons. According to the Ministry of Energy and Mines, hydrocarbons accounted for 87% of total primary energy sources in 2015. The electricity sector is highly dependent on the use of fossil fuel. By December 2016, 61% of total installed power generation capacity was from conventional thermal power plants, 32% from large hydro plants, 5% from nuclear plants and 2% from New and Renewable Energy Sources (NRES). The energy demand is distributed relatively evenly between the three main sectors: transport (29%), household (26%) and industry (23%); however, the mix of energy resources consumed by these sectors is quite different. Despite the fact that Argentina has one of the highest proportions of electricity coverage of all the Latin American countries (directly related to its urbanisation rate), 1.1 million people in rural areas nevertheless lack access to grid electricity and rely on conventional energy sources such as firewood, kerosene, batteries or generators [5]. Since mid-2004, the Argentinian energy sector has shown signs of supply problems directly related to the lack of availability of natural gas, which is Argentina’s key energy source. The root cause seems to lie in strategies implemented after the liberalisation process in the early 1990s and in public policy up to 2016 concerning energy prices and tariffs. As natural gas plays a critical role in Argentinian electricity production, its lack of availability has resulted in electricity shutdowns, scheduled interruptions to natural gas consumption for industry and an increase in energy imports – all of which have had significant macroeconomic impacts.

In terms of its potential for renewable energies, Argentina is second only to Brazil in the Latin American region [1]. Argentina’s energy potential includes huge wind capacity [6,7], favourable conditions for both large and small-scale solar projects [8], hydropower [9] and a significant volume of biofuels [10]. Argentina’s wind potential merits a special mention; the average wind speed across 70% of the country is 6 m/s [7]. With wind speeds of between 9 m/s and 12m/s, Patagonia is particularly well suited to harnessing wind power. In the coastal regions and in the region of Buenos Aires, which is the main centre of electricity consumption, average wind speed is also higher than 6.5 m/s [11]. Despite these conditions, as previously mentioned the actual installed renewable capacity in Argentina falls well short of the potential.

According to CAMMESA, in August 2016 NRES (predominantly wind and PV) accounted for less than 1% of public power capacity on the wholesale market.

Despite this limited development of renewable energies in the Argentinian power system, Argentina was one of the first countries in Latin America to develop policies and programmes to promote the diversification of the energy matrix. This originated in the mid-1970s and early 1980s, following a global trend in increased energy prices after the first oil crisis. In the power sector, the first regulations came into force with Law 25,019 (adopted in 1998 and covering wind power production). This was replaced by Law 26,190 (in 2006) and subsequently by Law 27,191 (in 2015). In terms of promotional instruments, Laws 25,019 and 26,190 established a scheme of Feed in Premiums (FIPs) for each technology in conjunction with different tax incentives for a 15-year period. Additionally, for the first time in Argentina, Law 26,190 set a target for NRES: 8% of electricity demand should be met by renewable energies by 2016. This regulation also created a fund called Fondo Fiduciario de Energías Renovables [2]. However, none of the instruments introduced by these two regulations were successful. FIPs from Law 26,190 were criticised for two main reasons: they were set at low levels and based on wholesale market prices which were frozen after the 2001 currency devaluation; and they were based on the Argentinian Peso. After years of slow but continuous devaluation of the national currency these FIPs became outdated [1]. The profitability and the incentive to invest in renewables fell, resulting in NRES attracting no investment.

To overcome these problems, in 2009 the government put out its first public tender for the purchase of 1000 MW of renewable energy (under the Program of Generation of Electric Power from Renewable Sources (GENREN)), which consisted of long-term purchase agreements nominated in US dollars, calculated at a fixed price project by project and adopting a Feed in Tariff (FIT) scheme. Despite the high levels of interest initially shown by private actors, most of the capacity contracted by GENREN was not used. Some of the problems faced by this programme related to Argentina’s macroeconomic, political and institutional context, rather than to the design of the instruments [1]. These aspects resulted in significantly higher prices for the Argentinian contracts than for similar agreements in the rest of Latin America, as well as a low usage rate (less than 20% by the end of 2015), which may have been due to a lack of funding and low national and international confidence in the development of an Argentinian power sector [1,2,9].

At the end of 2015, the government sanctioned Law 27,191, which replaced Law 26,190 and introduced some important changes. Firstly, the deadline for achieving the 8% target was moved to December 2017 (instead of 2016) and a new target of 20% by 2025 was established. This regulation also modified the definition of NRES for the purposes of the promotional incentives to include wave energy, solar energy and biofuels, and extended the capacity definition of small hydro to 50 MW.

More recently, in mid-2016, the government introduced a new purchase scheme: the Program for the Purchase of Electric Power from Sources of Renewable Energy (RenovAr Program). Although it is too early to evaluate the success of this initiative, preliminary results show that the price per unit of electricity in the concluded contracts was significantly lower than under the GENREN programme and there appears to be significant levels of interest from the private sector in the development of an Argentinian NRES market. By mid-2017, 59 projects had been approved under the RenovAr 1 and 1.5, amounting to 2423 MW of installed capacity (nearly 8371 GWh p.a.). Most of this capacity (71%) will come from wind power and PV will account for 26%, with only 3% coming from small hydro, biomass and biogas. On the downside, the programme is criticised for the lack of national capital and industries involved in the contracts, as well as for its failure to include small projects.

Most of the NRES regulations in Argentina have concentrated on centralised power generation capacity. However, in 1999, under the umbrella of the PAEPRA initiative, the Renewable Energies for Rural

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