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Small and Distributed Wind Energy in Argentina

Barriers and Development Strategies

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'No hay viento favorable para quien no sabe dónde quiere ir' – Séneca

'There is no favorable wind for those who do not know where they want to go'

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Abstract

This study aims to identify barriers to small wind energy in Argentina, and provide recommendations for Argentine stakeholders and policymakers for promoting the development of small wind. Argentina faces a serious energy challenge with its high dependence on fossil fuels (especially natural gas) in the face of rising global prices and decreasing reserves, challenges in domestic production and expected rate of economic growth. Argentina, with over 70% of its territory suitable for wind energy generation, has taken steps in recent years to diversify its energy mix and incentivize investment in wind energy. Significant amounts of wind energy have been contracted through renewable energy auctions, but progress has been slow due to a number of barriers.

Small and distributed wind can complement large-scale wind development and help Argentina move towards a more sustainable energy system. Analysis of literature and stakeholder interviews in Argentina identifies key barriers to small wind, related to a lack of an adequate regulatory framework for small wind, lack of demand, lack of financing, federal electricity/energy subsidies and macroeconomic considerations, high manufacturing costs, and the existence of competing or imported products/alternatives. Analysis of external case studies and best practices from the US, Spain, Uruguay and Thailand brings in insights and information related to overcoming barriers and promoting small wind development. Based on a discussion of the applicability of these strategies to Argentina, and comparative analysis of literature and stakeholder interviews, recommendations are made. These suggest that to promote small wind Argentina should enact small wind legislation that enables grid interconnection and exchange of electricity (net metering), explore the possibility of market instruments such as credits or tax incentives to help cover investment costs, strengthen access to finance and existing government loan programs, create an industry association/platform, improve marketing structures with networking and communication strategies, encourage industry development through joint demonstration projects and university partnerships, reform electricity/energy subsidies, and develop common certification and regional testing projects.

Keywords: Small wind policy and regulation, wind energy in Latin America, Argentina, net metering

Executive Summary

Introduction

Wind energy has emerged in the past decade as one of the most viable renewable energies due to its environmental performance, advanced technological state, contribution to energy security, declining costs of generation, and potential for job creation and regional economic development. South American countries are starting to prioritize wind energy development recent years.

Because investment conditions are volatile in Latin America, as a region characterized by unstable macroeconomic conditions, leaders in wind energy are countries that have driven growth through government investment. Brazil's wind development strategy is driven by a national policy support mechanism, called PROINFA, which is an innovative type of feed-in tariff tailored to unstable macroeconomic conditions. Brazil has also held large renewable energy auctions that set a competitive price for wind energy projects, backed by financing from the The Brazilian Bank of Economic and Social Development (BNDES). Mexico has received financial support from the World Bank's GEF to build out and strengthen transmission to its largest wind resource and incentivize two large wind projects. The country has not created a strong national regulatory and policy support framework, but this investment in transmission infrastructure has enabled significant wind energy development. Uruguay has a coherent and well-defined wind strategy, with intellectual, institutional, and some financial support from the UNDP and Global Environmental Fund (GEF). This program has made wind energy a priority for the country, situating Uruguay to be a regional leader in wind energy in the near term.

Argentina, with over 70% of its territory suitable for wind energy generation, is also positioning itself to be a regional leader in wind energy, but has faced significant barriers. Argentina faces a serious energy challenge with its high dependence on fossil fuels (especially natural gas) in the face of rising global prices and decreasing reserves, challenges in domestic production and expected rate of economic growth. Argentina has taken steps in recent years to diversify its energy mix and incentivize investment in wind energy, and has had success in contracting a number of large wind projects. The government held two renewable energy auctions, called GENREN I & II, which have contracted 954 MW of wind energy to come online by 2016 –a huge jump from the 60 MW of wind capacity installed in Argentina as of 2011. Despite this progress, bringing these projects online has been a challenging and slow process, as contracted projects still face many barriers. Among these are technical, financial, geographic, infrastructural, siting, transmission, regulation, and social. Argentina has a poor investment climate due to entrenched subsidies for fossil fuels; especially natural gas and unstable macroeconomic conditions, making financing for large-scale wind projects very difficult.

Small and distributed wind energy can play an important role in complementing large-scale wind energy. Small wind can contribute significantly to meeting the energy demand of a country. Small and distributed wind have a number of advantages, among them that they can help overcome siting barriers, can provide power in rural off grid applications, and contribute to local economic development. Small and distributed wind can also enable significant energy savings due to reduced transmission losses, distributed economic opportunities for consumers, and a reduced demand for fossil fuels. Small wind can be categorized into systems that are grid connected, which are currently not permitted in Argentina, and isolated systems.

Small wind has significant applications in rural Argentina, where 2 million people live without access to electricity.

Objective and methodology

The objective of this study is to identify barriers to small wind energy in Argentina, and provide recommendations for Argentine stakeholders and policymakers for promoting the development of small wind in the country. Data is collected from literature and interviews with stakeholders in Argentina. Stakeholder inter3views are conducted with industry, government, individual investors and NGOs. Data is analyzed across multiple sources to identify barriers and key strategies.

Principal barriers to small wind energy in Argentina

- Lack of legislation for small wind
    - Lack of an adequate regulatory framework that enables the possibility for connection of generation systems to existing electricity networks, such as net metering
- Lack of demand
    - Small wind systems are not yet considered an alternative energy supply in isolated areas, and more competitive alternatives are available
    - Communities/households may be accustomed to living without electricity, with little interest in a small wind system
- Lack of financing
    - Lack of financing for development of new products, as well as manufacturing of existing designs
    - Lack of sources of capital on the client's side for purchase of the products.
- Federal electricity/energy subsidies
- High manufacturing costs
    - Lack of standardization for equipment
    - Lack of providers of basic components at reasonable prices
- Lack of institutional and technical support
    - Need for standardized certification, testing programs
    - Lack of adequate wind resource assessment resources
- Large geographic distances that create high maintenance and installation costs
- Negative prior experience with testing and demonstrations
    - Historical distrust with the government due to prior history of default and economic instability
- Lack of awareness of the importance of renewables
    - Little government attempt for education and outreach
- Poor marketing structures for industry

International Best Practices

Analysis of external case studies and best practices from the US, Spain, Uruguay and Thailand brings in additional insights and information related to overcoming barriers and promoting small wind development. States and countries utilize an array of different policy tools to incentivize small wind systems. These may be grouped in three primary categories: financial incentives, mandates, and education and outreach.

Countries and regions with strong small wind industries share a number of common characteristics. They typically employ a net metering program that is backed by a range of incentives (such as an RPS or tax incentives), loan programs, outreach initiatives, and technical support. Not all of these policies and strategies may be feasible for Argentina. Funding a wide range of programs and initiatives is costly and challenging for a country like Argentina where access to capital is very limited. Policies, initiatives and programs must be tailored to Argentine conditions.

Recommendations

Based on considerations of applicability to Argentine conditions, and comparative analysis of literature and stakeholder interviews, the following recommendations are offered.

To promote the development of small and distributed wind, Argentina should:

- Enact small wind legislation, specifically a net metering program that enables the grid interconnection of small wind systems
- Strengthen access to finance to help manufacturers to develop their products and investors to cover up front costs
    - Work with Argentine National Bank to open new lines of credit and strengthen existing programs
    - Solicit external sources of funding
- Form an industry platform/camera
    - Unify industry interests and create a communication platform to lobby government and strengthen industry visibility
    - Improve marketing through networking and communication strategies
    - Create an industry newsletter/market update
    - Develop an industry trademark/identity
- Create university and technical partnerships
    - Develop joint technology demonstration projects, especially in rural areas
    - Align projects with community development needs
- Reform and gradually remove energy subsidies
    - Continue to subsidize the electricity prices of the poorest households that would be most affected
    - Set energy prices that consider contamination and actual costs of externalities
- Develop common certification and facilitate regional testing in coordination with industry
- Strengthen existing programs
    - Strengthen and extend the reach of existing successful programs such as PERMER and INTI's Wind Platform

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Abbreviations

AAEE: Argentine Wind Energy Association

AWEA: American Wind Energy Association

BNDES: Brazilian Bank of Economic and Social Development

BPU: Board of Public Utilities

CADER: Argentina's Camera of Renewable Energy

CIA: Central Intelligence Agency

CIPIBIC: Camera of Industrial Engineering Projects and Capital Goods of the Republic of Argentina

CREE: Argentina's Regional Center for Wind Energy

DOE: US Department of Energy

IEA: International Energy Agency

INTI: Argentina's National Institute of Industrial Technology

IOU: Investor Owned Utility

ITC: Investment Tax Credit

ENRE: Argentina's National Regulatory Authority for Electricity

FERC: US Federal Energy Regulatory Commission

FONTAR: Argentina's Technical Fund

GEF: Global Environmental Fund

GW: Gigawatt

GWEC: Global Wind Energy Council

kW: kilowatt

kWh: kilowatt-hour

LAWEA: Latin American Wind Energy Association

MW: Megawatt

MWh: Megawatt hour

MWeq.: Megawatt equivalent

NGO: Non-Governmental Organization

OECD: Organization for Economic Cooperation and Development

PEEU: Uruguayan Wind Energy Program

PEMEX: Mexican Petroleum

PERMER: Argentina's Project for Renewable Energies in Rural Markets

PETROBRAS: Brazilian Electricy Power Company

PROINFA: Incentive Programme for Alternative Sources of Electrical Energy (Brazil)

PROINGED: Argentina's Provincial Program of Incentives for the Generation of Distributed Energy

RE: Renewable Energy

RPS: Renewable Portfolio Standard

SWOT: Strengths-Weaknesses-Opportunities-Threats

UNDP: United Nations Development Programme

UTE: Uruguay Public Utility

1 Introduction

Wind energy has emerged in the past decade as one of the most viable renewable energies for its environmental performance, advanced technological state, contribution to energy security, declining costs of generation, and potential for job creation and regional economic development (GWEC 2012). Recent years have seen a shift with developing countries beginning to take the lead in installed wind capacity, and many countries Asia and Latin America are rapidly developing their wind energy industries and driving market growth. For the past two years, the majority of new wind energy installations were outside of the OECD (Global Wind Energy Council 2011).

Wind has especially exploded recently in India and China, with these countries leading most of the growth. South American countries are also starting to rapidly develop wind energy recent years. The region's wind capacity is expected to increase fourfold by 2016m from 2.3 GW in 2011 to 10.9 GW (Place 2012). South American countries share many of the same challenges and barriers to wind as OECD countries, but some are especially acute in the region. These include poor investment climate due to uncertain regulatory and macroeconomic conditions, transmission and grid infrastructure challenges, and technical capacity (LAWEA 2010) (Hight 2009). Development banks, international, regional or national, are increasingly driving investment in wind energy in emerging and new markets (Global Wind Energy Council 2011). However not all countries have access to these funds, and many countries are left outside of access to these important sources of funding. Other countries may not have the technical capacity to incorporate large projects into their grids, or may only need energy in fragmented, rural areas that are far away from transmission lines. Often, lack of transmission capacity is the main reason why a developing country has no utility scale wind power (Hight 2009) For all renewable energies, there are two tendencies: concentrated and distributed generation. For the first, large quantities of energy are injected into the grid at a fixed point in the national electric system. This type of production requires large investments and large transmission networks for high voltage. Distributed generation on the other hand proposes that production occurs in the same place as demand, in quantities that are sufficient for the energy demand of a small group of users. (INTI 2011)

Argentina has a need for both concentrated and distributed wind generation. Argentina has a very concentrated electricity demand, which can benefit from the development of large-scale wind energy. Argentina also has dispersed and isolated rural populations that have limited access to electricity. Large-scale production is advancing in Argentina and barriers are well documented (Barragán 2012) (Pardo 2012) (Spinadel, Pasado, presente, y futuro de la energia eolica 2011)). Small wind, is less discussed, and can be equally important for a developing country.

Small and distributed wind energy can play an important role in complementing large-scale wind energy and even leading industry growth in some cases. This type of wind energy can contribute significantly to meeting the energy demand of a country (DNETN/MIEM 2012). Small wind has a number of advantages. Small wind can provide a more resilient investment model, lower costs, utilize a diversity of building materials, help overcome siting barriers, provide power in rural off grid applications, and provide local economic benefits. Small and distributed wind can also enable significant energy savings due to reduced transmission losses, distributed economic opportunities for consumers, and a reduced demand for fossil fuels (Spinadel, Micro-generación distribuída: Barreras y logros 2011).

This work provides an overview of barriers and strategies for small and distributed wind energy in Argentina. First addressed is general experience with wind energy in developing countries, discussing country-by-country experiences and identifying some of the major barriers to wind energy in these countries. Data gathered from Argentina provides empirical discussion, and an analysis follows of the potential for small wind to develop in Argentina and contribute to the country's sustainable energy mix. Argentina is an interesting case for a number of reasons, which are elaborated in detail in the following sections. The country has faced especially acute challenges in developing a wind industry – and yet has one of the highest wind resources of any country in the world. This paper will discuss these challenges and identify strategies for overcoming them.

Figure 1-1 depicts Argentina's wind resource compared on a global scale.

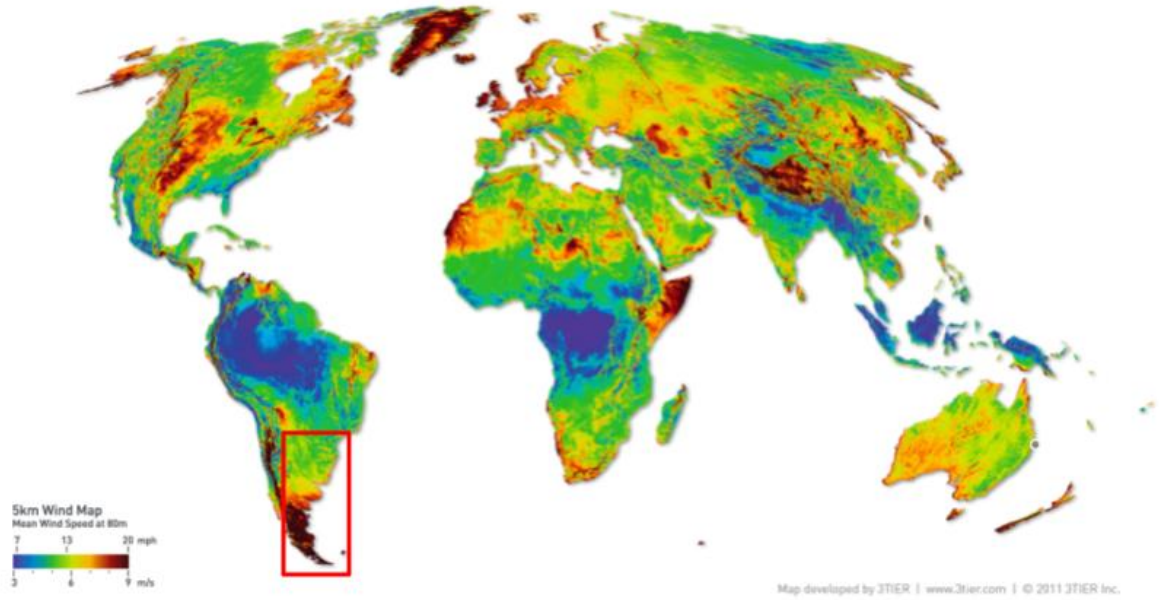

Figure 1-1 Global Wind Resource Map

Source: 3TIER

1.1 Objective and research questions

The objective of this study is to identify barriers to small wind energy in Argentina, and provide recommendations for Argentine stakeholders and policymakers for promoting the development of small wind in the country. The research aims to produce a document that unifies stakeholder viewpoints and information, addresses relevant areas of analysis, suggests applicable best practices and information sharing, and provides context-specific recommendations and conclusions.

This research is results-oriented in nature, aimed at providing recommendations that are as useful and applicable as possible to the Argentine case. As such there is heavy focus on analysis of barriers and policy and less focus on theory. Policy research tends to be descriptive, offering knowledge for action, rather than producing a deep understanding of causal processes. Hakim suggests that policy-oriented research will summarize current knowledge in a field and examine the knowledge and practice of relevant stakeholders, in order to discuss the background and consequences of policy. (Hakim 2000)

Following the objective of this study, after a literature view and initial research on the topic, the following research questions were developed to guide the research:

- What are the main barriers to wind energy and small wind in Argentina?
- How can Argentina best promote the development of its small wind industry?

1.2 Methodology

The research questions call for a qualitative analysis of complex issues in the Argentine context. The research relies on the following qualitative research strategies:

- Literature reviews on wind power and policy evaluations from other countries, as well as extensive literature review of wind energy and small wind in Argentina to identify key lessons and considerations
- Interviews in Argentina concerning barriers, strategies and proposed policy changes from key stakeholders identified in literature review and initial research on the subject.
- Participatory research and observations in Argentina including classes, workshops, and conferences on the subject
- Triangulation strategies that rely on a range of different types of evidence including reports, legislation, interviews, observations and experience in Argentina.

1.3 Data collection

Data collection for this analysis began with a literature review of energy challenges and issues in Argentina. Background information, including data and introductory conversations on the topic were performed. These included initial conversations with IIIEE professors and thesis advisor, as well as Argentina advisor and host university contacts. This phase also included an initial literature review, based mainly on news sources and journal articles. This process led to the initial topic decision and research question, and took place over a period of two months. Once a general topic was identified additional literature and information sources was gathered, as well as groups and stakeholders that could be used to inform the analysis. These literature sources were chosen to provide different perspectives on the topic.

The empirical stage followed, with a 15-week research period in Argentina. During this time appropriate contacts were determined through networking and conversations with academic, government and industry contacts working in wind energy. Data and conversations gathered during the empirical phase were also used to refine the research question and narrow the scope of the study. Contacts in Argentina, networking, and desktop research identified interview candidates amongst stakeholder groups.

1.3.1 Interviews

Interviews conducted were semi-structured, and a total of 11 interviews were performed. Semi-structured interviews were deemed appropriate for the research to allow flexibility and fluidity in the responses of interviewees. This allowed the interviewee to contribute a more non-biased viewpoint, rather than selecting from a stated list of barriers or policy strategies. If a specific strategy was mentioned, follow-up questions could obtain more detail and clarification. All interviews were recorded for later review and to ensure adequate translation. Follow-up interviews were performed if necessary for additional information, as well as clarification via email. Themes were identified based on literature review of similar research, as well as through discussion with advisor after the research question was chosen. A list of the interview questions, by stakeholder group, can be found in the appendix.

Initial conversations were held with local contacts, which helped narrow the research question and prepare the scope of the analysis. This process identified interesting research areas, namely barriers to small wind industry and strategies in overcoming those barriers. Literature review and conversation with advisor determined that viewpoints of different stakeholders, from industry, policy, academia, individuals, etc. would provide valuable empirical evidence for the research. Key interviewees within stakeholder groups were identified through networking and research in Argentina. Interview contacts were also generated from names of experts at conferences, reports, and wind industry literature within the country and through an evolving contact base.

Interview themes were identified during the literature review and initial introductory conversations with contacts in Argentina. After key stakeholders were identified a list of questions was developed for use with stakeholder interviews. 1-3 interviews were conducted with each stakeholder group. Interview groups were investors/private individuals, industry, policy, and NGO community. Interviews prioritized an industry and first-mover perspective as these were determined to be a key stakeholder group based on literature review and discussion with advisor. A full list of the interviewees and description of the interview structure can be found in the appendix.

1.4 Research Process

Figure 1-4 illustrates the research structure and general flow of the paper. Background to the topic is provided through a literature review focused on wind energy in Latin American countries, identifying strategies of first-movers and principal barriers. Further detail and discussion on small wind (in both developing and developed countries) follows. This includes financing strategies, key enabling factors, capacity building and technological strategies, and policy and regulation.

After the literature review and further background are provided, wind energy in Argentina is discussed, with an overview of wind energy in general and detail on the status of the small wind industry in Argentina. Following this section is empirical discussion and analysis, presenting the results of the interviews and identifying trends and key lessons. A discussion section follows which provides best practices and relevant the results of analysis. Finally, recommendations and conclusions will summarize key findings, answer research questions, and provide recommendations concerning development of small wind in Argentina.

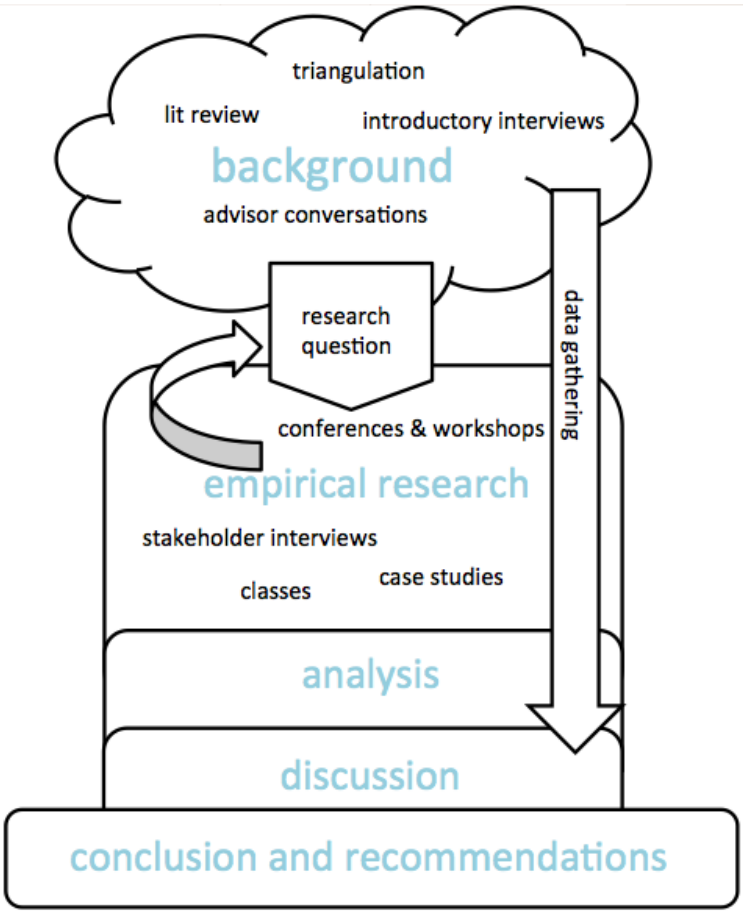

Figure 1-2 Structure of Research

1.5 Scope and limitations

The scope of the research provides an initial overview of wind energy in South American first-movers, to illustrate the general industry development and challenges in the region. Within Argentina, the focus of the analysis is small wind energy, generally focused on wind systems for household and community applications. These systems may be grid connected, but in general are not providing large-scale (i.e. wind farms) power to the grid.

The research provides a general overview of the small wind context in Argentina. The focus of the study is more regulatory and policy oriented. As capacity building and technical considerations are also discussed in the analysis, considerations of orgware will also be addressed. Orgware refers to institutional settings and rules for the generation of technological knowledge and for the use of technologies. The importance of the latter is often underestimated, particularly in developing countries where orgware is a major, if not the hardest, challenge. (Bazilian, et al. 2008)

An approach could have been taken for an analysis of wind in general in the country, but much of the work would be redundant. There was much more opportunity to contribute within the context of small wind because stakeholders suggested a research gap in initial conversation, especially concerning policy and regulation for small wind, and the topic was generally viewed as relevant and important.

As a US native with Spanish as a second language I face a language and cultural barrier. Entrance to industry, policy and academic circles can be difficult in any country, and some in

Argentina have especially strong views concerning North Americans. Language challenges may not allow me to communicate adequately in difficult situations (such as over the phone), understand context, and react and respond during complex interviews. These factors my influence both myself and the collaborators and interviewees of this study in Argentina.

Ideally this study would have included more interviews with stakeholders to obtain as much empirical data as possible, but there was limited time in Argentina and identifying and arranging appropriate contacts was a challenge.

1.5.1 Definition of Small and Distributed Wind

Small and distributed wind can be interpreted in a number of ways. This paper will refer to small wind interchangeably with other labels such as 'community' and 'distributed' wind. Small wind generally refers to household or business-scale small wind systems, ranging from a few hundred watts up to 100 kW. Definitions of small wind will vary by country, largely influenced by the country's wind industry and the type of regulatory framework in place. Small wind in Argentina is a system up to 5kW; in the US a wind system up to 100 kW is considered 'small'. This paper also discusses 'distributed' and 'community' wind systems, which can be much larger, sometimes even up to a MW scale. Often a community will pool investment (their aggregate electricity demand) and invest in a system that may be over a MW. While this system itself may not be considered small, the project is taking place on a distributed, relatively smaller scale (than say, large-scale wind farms) and therefore can be an important area to discuss when talking about small-scale wind projects.

This paper adopts the following definition, adapted from the US Distributed Wind Energy Association, for 'small' wind: small/community/distributed wind is the use of typically smaller wind turbines at homes, farms, businesses, and public facilities to off-set all or a portion of on-site energy consumption (Distributed Wind Energy Association 2012). Going forward this is the general definition of 'small wind', and will be used when referring to small, community, or distributed wind.

1.6 Intended audience

The intended audience for this study is academics, policymakers, and stakeholders in small wind in Argentina. These include industry and individuals that will benefit both directly and indirectly from a more sustainable energy system and the externalities of cleaner energy development.

1.7 Expected Outcome

It is expected that the analysis, conclusion and recommendations, and data gathered in this study be made available to stakeholders in Argentina's wind industry, to yield guidance for future work by these stakeholders (industry and policymakers for example). It is anticipated that this research will identify major barriers to small wind energy in Argentina, clarify and identify stakeholders within the industry, and provide analysis and discussion based on empirical evidence of those stakeholders that generates recommendations and conclusions for the small wind industry.

2 Wind energy in Latin America

This section explores the wind development strategies pursued by recent-adopter Latin American countries, to illustrate the experience and challenges of first-movers in wind energy amongst Latin American countries. Latin America is home to some of the world's best wind resources, as well as rapidly growing economies with increasing electricity demand. Wind energy is still in early stages of development, with the entire region's installed capacity only reaching 2,000 MW as of 2010 – less than 5% of the current installed capacity of China. Because investment conditions are volatile in Latin American, as a region characterized by unstable macroeconomic conditions, leaders in wind energy are countries that have driven growth through government investment (AWEA 2011). Several different strategies have been pursued thus far, with varying levels of success. This section will elucidate some of the main strategies Latin American countries have used to develop their wind industries, in order to identify key aspects of successful capacity development that may be applicable to the Argentinean case.

2.1 Brazil

Currently installed wind capacity in Brazil is 931 MW (GWEC 2011). Brazil's National Energy Plan projects an additional 4700 MW of installed wind capacity from 2005 to 2030. This projection is considered modest however; Brazil is easily capable of installing 12,000 MW by 2030, which is still low compared to leading growth rates in other countries (GWEC 2011). (LAWEA 2010) Brazil's overall potential is considered to be more than 350 GW.

Brazil's wind development strategy is driven by a national policy support mechanism, as well as large renewable energy auctions that set a competitive price for wind energy projects.

2.1.1 Strategy Overview

In 2003 Brazil adopted the first and largest support scheme of any grid-connected country in Latin America, called PROINFA, or Programa de Incentivo as Fonts Alternatives de Energia Electrica (Incentive Programme for Alternative Sources of Electrical Energy). PROINFA is a type of feed-in tariff, an artificial price-support mechanism designed to make renewable energies more competitive, with a cap on the amount of electricity that can be contracted. This scheme is based on the policies of European countries, such as those in Spain in Germany. PROINFA had to be adapted to the unstable macroeconomic condition of Brazil, meaning that the market incentives are adjusted frequently with the rate of inflation (Kissel and Krauter 2005).

PROINFA adopted an initial cap of 1100 MW of installed wind capacity, which has now been updated to a total of 1423 MW (Brazilian Ministry of Energy 2011). A cap is a way to avoid oversaturation in case the incentive attracts too many investors, and also helps ensure that the government can sufficiently fund the program. PROINFA sets up a purchase power agreement (PPA) with the Brazilian Electricy Power Company (PETROBRAS), guaranteed over 20 years, with a policy structure adapted from the German model. In the German model, there is a basic compensation for wind power that is fixed per year, as well as a supplimentary initial compensation for onshore wind projects that is determined in 5 year periods. The duration of compensation depends on the yield of the particular power plant, so that the smaller the yeild, the longer the supplimentary compensation is paid. This is intended to guarentee the economic viabliity of power plants at less favorable locations. Grid operators are obliged to purchase the available wind power. If at the end of the year transmission-grid operators have purchased more than the average share of wind energy for the country, then they are entitled to sell the excess to other operators until everyone has purchased wind energy

equal to the average share. The means that each final consumer bears the same higher costs, because they are responisble for the costs of basic and initial compensations. (Kissel and Krauter 2005)

PROINFA has a similar design, but does not feature a basic compensation for wind energy. The compensation VE (valor económico/economic value) is based on the production capacity of the plant, so that less productive plants receive a higher compensation. The VE is paid by Electrobras, who transfers the expenditures to consumers in proportion to their electricity consumption, with the exception of those considered in a low-income class consuming less than 80kWh/month. A 220 MW cap per state was also implemented in order to avoid bottlenecks from overproduction in states with very favorable conditions. The VE suffers from devaluation due to inflation, which was an issue that PROINFA needed to address. Brazil's inflation rates have stabalized over the past decade, but over 20 years have been highly variable. Without a readjustment of the VE due to inflation the compensation would devalue considerably, so the VE is adjusted with the rate of inflation. The country's IGP-M (general market price index) is responsible for making the inflationary adjustments for the wind energy feed in tariffs.

In addition to PROINFA, the Brazilian Energy Regulator ANEEL has recently hosted a number of wind energy auctions that will bring a significant amount of wind capacity online in the coming years. In 2009, ANEEL contracted 71 projects for a total of 1800 MW at $65/MWh. In 2010 another auction was held that contracted 50 projects totaling 1519 MW, with 20 year PPAs. On the same day another auction was held that contracted 20 projects for a total of 528 MW at $73/MWh. Further auctions have been announced with similar capacity goals. (GWEC 2011)

2.1.2 Financing

The Brazilian Bank of Economic and Social Development (BNDES) is responsible for providing financial support for wind eneryg projects under PRIONFA, through the "Financial Support Programme for investments in alternative sources of electrical energy in the scope of PROINFA". This program offers loans with much smaller interest rates than otherwise available, and will provide loans that cover up to 80% of the investment costs. BNDES applies a long-term interest rate, recalculated every 3 months to be adjusted to the inflationary rate provided by the national monetary council's (CNM) consumer price index (IPCA). This is a major difference of PROINFA, because in PROINFA this inflation adjustment mechanism has the goal to stabilize the actual value of the compensation during the entire running time of the PPA. This is not of feature of, for example, the German model because inflation is so low. While this feature has been an important aspect of financing wind energy under PROINFA, having an initial compensation to cover the higher initial costs of investment, such as that under the German model, still seems to be just as important even in countries with high inflation. This would help to increase profitability and bring down the risk of Brazilian wind projects. (Kissel and Krauter 2005).

Some foreign companies have also become eligible for BNDES financing, based on commitements to manufacture wind turbine generators in Brazil within a short time frame. The initial goal is to reach a local content share of 60%. (GWEC 2011)

2.1.3 Institutional Capacity

Brazil's Wind Energy Association (ABEEólica) has been a very important player in the development of the country's wind industry, providing policy direction and market support.

The government has been the main driver for research, technological support, market development and investment.

2.2 Mexico

In 2010, Mexico installed 316 MW of new wind power capacity, bringing the total to 519 MW. Currently there are an additional 665 MW in process. In Mexico, collaboration between the World Bank, IFC and the Inter-American Development Bank has mobilized project financing for more than 300 MW of wind projects and helped to attract investment by commercial banks alongside the private sector (Global Wind Energy Council 2011). Mexico has an estimated wind potential of around 71 GW.

2.2.1 Strategy Overview

A generally supportive legal and regulatory framework, the availability of new transmission capacity in the Oaxaca region, where its largest wind resource is located, and access to financing for renewable energy projects drives Mexico's wind energy growth. 508 of 519MW of installed capacity are in the Oaxaca region, which means that the connection of transmission lines to this site has been essential to the growth of wind energy in the country. The estimated potential in Oaxaca alone is around 10 GW. (GWEC 2011) In Oaxaca the government is constructing a new 400 kV transmission line and strengthening the 2 existing lines for a total of 590 km circuit. They are also modernizing the existing lines in Oaxaca to aid with the integration of wind potential into the national grid.

In 2008 the Mexican government adopted an energy reform package, which included the Law for the Development of Renewable Energy, the Law for Effective Use of Renewable Sources (LAFRE) which set an 8% renewable (excluding hydro above 30MW) electricity generation target for 2012; and the Financing of the Energy Transition, which created a Renewable Energy Fund to promote the use of renewable sources and energy efficiency, endowed with $220 million annually from 2009-2011. This has been used mostly for energy efficiency projects, however. (GWEC 2011)

The 2007-2012 National Development Plan for Mexico contains plans for the development of the Mexican wind industry. By the end of 2012 the Federal Electricity Commission has the goal of installing 593 MW from wind energy. The project Temporada Abierta (Open Season) agreed to build and reinforce the necessary transmission infrastructure for 2473 MW of public and private wind projects from Oaxaca by the end of 2012. The project is mainly aimed to enhance transmission lines as large projects come online. This is a 60 billion-peso project that expects to result in the production of 4% of electricity demand through wind power. Additional 5 wind projects from the Federal Electricity commission will come online before the end of 2012. (Mexican Energy Secretary 2010) Most importantly is the Isthmus of Tehuantepec's wind energy project, which will contain the biggest wind energy project in Latin America, called Eurus. This will be developed by the Mexican Cement Company CEMEX and the Acciona Company, for the development of 167 wind turbines with a 250 MW capacity. In addition to this, the CFE has also contracted a number of additional projects in the region, with a total of 585MW from wind in the Isthmus of Tehuantepec by the end of 2012.

Until recently the private sector was denied participation in electricity generation, and all rights remained in the hands of the national monopoly Mexican Petroleum (PEMEX). Changes began in 1992 with a new regulation regarding the law of public service of electric energy. This allowed the participation of the private sector aiming at increasing the capacity installed under independent producers, among others, who are the players that recently have developed

renewable energy projects. (Cancino-Solórzano, Gutiérrez-Trashorras, and Xiberta-Bernat 2011)

Mexico's regulatory and policy framework for wind development still needs a great deal of clarification and strengthening. The regulatory framework is incomplete and often inconsistent, and rules for the renewable energy fund need to be more clearly defined and expanded for wind energy projects. Incentives for sites with lower capacity factors are non-existent. (GWEC 2011)

2.2.2 Financing

The Mexican Government, through a World Bank loan for Large-Scale Renewable Energy supported by the Global Environmental Fund (GEF), is incentivizing one of the wind largest projects La Venta III, by 1.1. cents per kWh delivered to the grid for up to 5 years, as well as the development of a national wind map that will keep up the expansion of wind energy in the country. (LAWEA 2010) (Mexican Energy Secretary 2010)

Aside from this, there are still very few dependable financial incentives for wind energy develop in Mexico, making development of any projects outside of the highest capacities very difficult. Those existing include a tax deduction for purchase of machinery and equipment for power generation from renewable sources within the first year of use, as long as they are in operation for a minimum 5 years after purchase. Also, with new interconnection contracts renewable electricity suppliers are given a so-called 'postage stamp' for transmission costs, making transmission costs more affordable (AMDEE 2011).

2.2.3 Institutional Capacity

Specific institutions have been created in Mexico to boost the development of renewable energies. These include the National Committee for the efficient use of Energy (CONUEE), the Institute of Electric Research (FIDE), which researches unconventional energy generation and tools to aid in development of these technologies, and the Trust of Shared Risk (FIRCO) which supports the integration of renewable technologies with rural development (agricultural and economic activities). Additionally, the Mexican Association of Wind Energy (AMDEE) is an important player.

In 2006 the Mexican Official Regulations were published for wind energy. They establish the technical specifications for the protection of the environment during the construction, operation and abandonment of wind energy facilities in agricultural, livestock and wasteland areas. (Cancino-Solórzano, Gutiérrez-Trashorras, and Xiberta-Bernat 2011)

Feasibility studies have been conducted jointly in cooperation with the Renewable Energy Laboratory of the US Department of Energy, Mexican Federal Electricity Board (CFE) and several other Mexican institutions. Also, the Institute of Electric Research together with the UN Program for Development has produced their "Action Plan for eliminating barriers for the development of wind electricity generation in Mexico". This plan has four goals: development of capacity, creating and demonstrating projects, analysis and proposal of improvements to the legal or institutional framework, the promotion of cooperation, and increasing links and effort. (Cancino-Solórzano, Gutiérrez-Trashorras, and Xiberta-Bernat 2011). This project built the Regional Center for Wind Technology, in Tuhuantepec, Oaxaca, and a center for research and technological development focused on wind energy. This plan also formed an agreement with the Netherlands Foundation for Research in Energy in order to be able to certify farms with the highest wind capacities – the first laboratory of its kind in Latin America for strong wind conditions. (Mexican Energy Secretary 2010)

2.3 Uruguay

Uruguay has positioned itself to be a regional leader in wind energy. Growth has been rapid since the first 6 MW wind farm was installed in 2007, and now 43 MW are installed today. The country aims to develop 500 MW of wind energy into its energy mix by the year 2015. The goal is to have non-conventional renewable energy, defined as wind and biomass, comprise 25% of electricity production by 2015. By 2013, Uruguay wants to wean itself completely off oil by transferring thermoelectric power plants to LNG and developing renewable energy resources.

2.3.1 Strategy Overview

Uruguay's legislative framework provides tax incentive for investments made in wind energy. Electrical Energy Transmission and Distribution are activities performed by UTE (Public Utility). Decree 455/2007 sets out a tax exemption between 50-100% for investment made in projects related to the use of clean technologies and research, development and innovation. Decree 354 in 2009 gives an income tax exemption for electricity generation from renewable sources and the manufacturing of the necessary machinery and equipment. The exemption is 90% from 2009-2017, 60% from 2017-2020, and 40% from 2021-2023. (PEEU 2011) The country also wants to promote renewable microgeneration connected to the grid, enabling net metering for consumers that want to install their renewable energy.

Additionally, two renewable energy auctions have taken place in 2010 and 2011 both for 150 MW of wind energy. In total there are 406 MW currently contracted, to be online by 2014. (di Chiara 2011)

2.3.2 Institutional Capacity

The wind energy program in Uruguay (PEEU) is a joint initiative of the Uruguayan government and the United Nations Program for Development. It is implemented through the Ministry of Industry, Energy and Mining (MEMBER) and funded by the Global Environmental Facility (GEF). This program takes a multidisciplinary approach towards developing a policy framework and regulations for wind energy in Uruguay. Activities include information development to facilitate wind power identified projects, local industry development, and removal of technological barriers through the installation of measurement equipment. (PEEU 2011)

2.4 Argentina

Argentina is a county with 42 million people, with the second largest landmass in South American and the 8th largest in the world. Argentina is roughly the size of India, with around a 3.5% of its population size (CIA 2012). The vast majority of Argentina's population is concentrated in the northeastern provinces of the country, and its largest city Buenos Aires with 13 million people. The country covers 2.8 million square kilometers and possesses a diverse geography endowed with natural resources. Rich plains of the Pampas dominate the northern half of the country, supporting a strong agricultural sector, flat rolling plateaus stretch across the South in Patagonia, and the rugged Andes mountain range stretches along the western border of the country. Argentina is a country with great technical capacity, demonstrated by its strong aviation industry. Although Argentina now has one of the strongest economies in Latin America, 30% of the country's population is living below the poverty line. (CIA 2012)

Argentina's energy sector is dominated by fossil fuels, especially natural gas. Figures 2-1 and 2-2 illustrate this dependence. The country produces around 40.1 billion cu m and consumes 43.46 billion of natural gas (as of 2010). Its natural gas reserves are around 378.8 billion cu m.

Despite its vast resource endowment Argentina still experiences energy shortages. Old gas fields have dried up and the economy has grown, leaving Argentina now using about 15% more hydrocarbons than it produces. (Economist 2012). According to the energy balance of the Secretary of Energy, 90% of the energy that Argentina produces and consumes is related to fossil fuels. Average demand growth for electricity is 4.2% between 1983 and 2011 (Marranghello 2011). Argentina faces a serious energy challenge with its high dependence on fossil fuels in the face of rising global prices and decreasing reserves, challenges in domestic production and expected rate of economic growth. (Marranghello 2011).

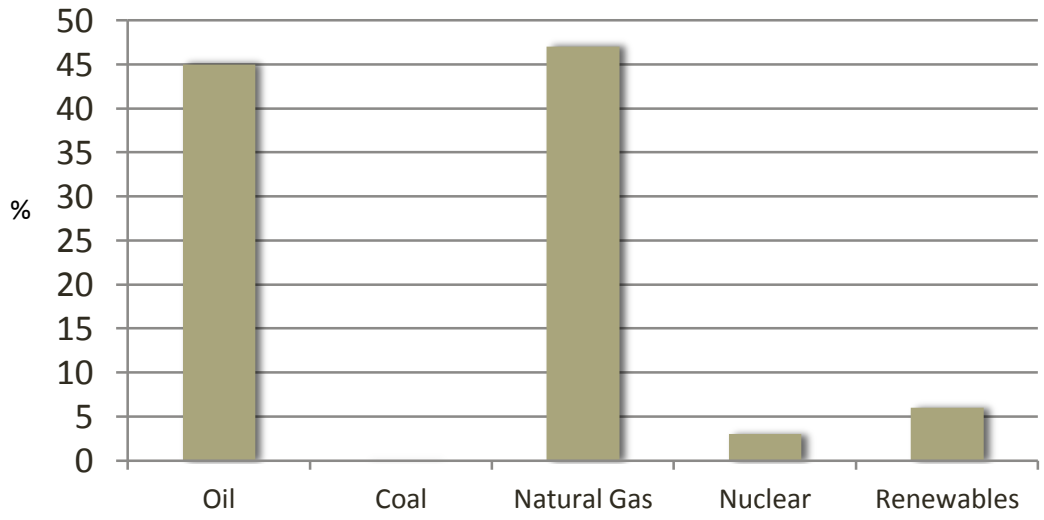

Figure 2-1 Primary Energy Sources in Argentina

Source: (EIA) (Marranghello 2011)

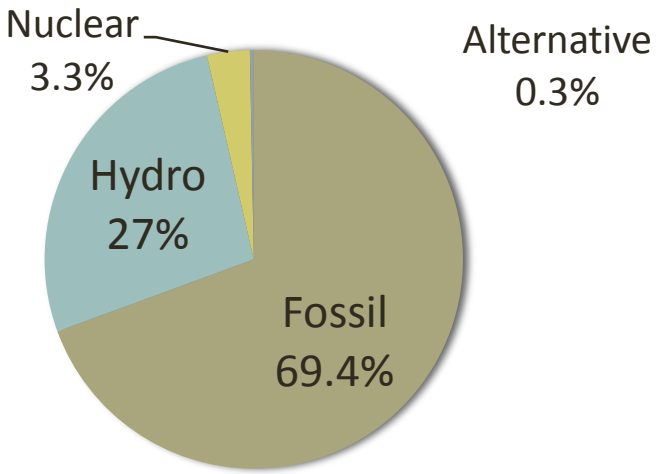

Figure 2-2 Gross Electricity Generation in Argentina

Source: (National Atomic Energy Commision of Argentina 2012)

Argentina has the strongest wind of any Latin American country, with over 70% of the country's territory suitable for wind energy generation (CADER 2009). Wind energy represents a great opportunity for Argentina to improve its energy security, and also a great challenge in overcoming path dependency as well as significant political, economic and technical barriers. Barriers to wind energy in Argentina include entrenched subsidies for fossil fuels, especially natural gas, heavily subsidized electricity prices, and a poor investment climate due to uncertain regulatory and macroeconomic conditions (LAWEA 2010) (CADER 2009) (Pardo 2012). Natural gas subsidies are an important barrier to alternative energies in Argentina. The government had frozen energy prices in the late 90s, and after the currency was sharply devalued the new government fixed prices in pesos has only slightly increased them. Because of this natural gas is 75-80% cheaper in Argentina than its neighbors, and electricity is 70% cheaper (Economist 2012). Presently natural gas, which is produced domestically and is the country's primary source of energy, is becoming increasingly insecure because of shortages due to insufficient upstream investment (IEA 2011), largely because of these leftover price ceilings, and the country is facing serious energy challenges. The country has mainly made up for shortages by importing costly fossil fuels, which are expected to reach a cost of $10 billion this year, coming out of what would have otherwise been a positive trade and fiscal surplus (Economist 2012). This is trend is depicted in Figure 2-3.

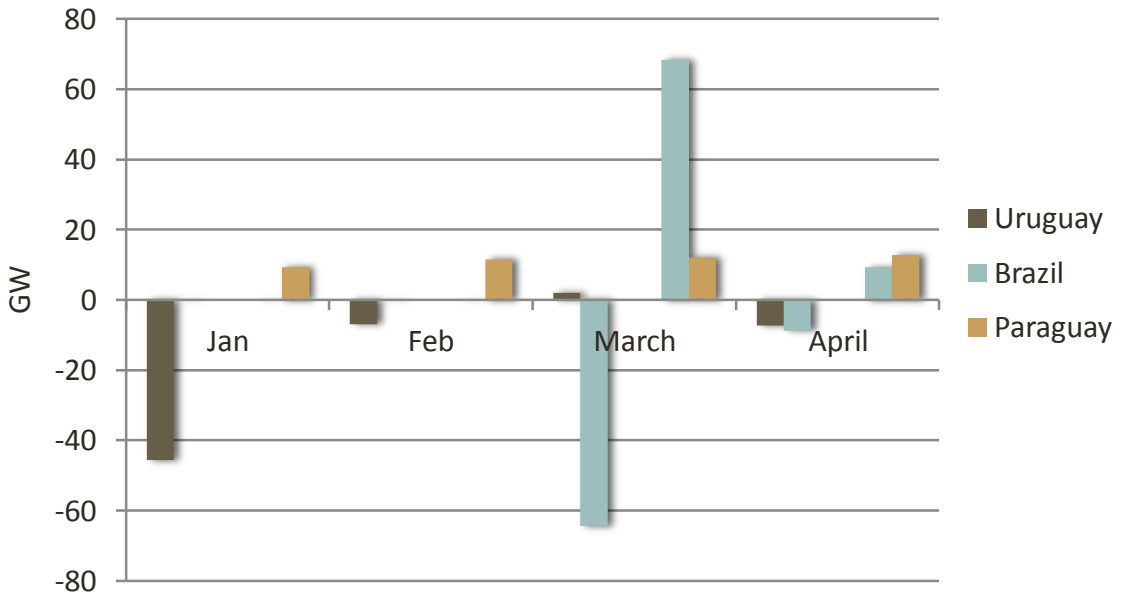

Figure 2-3 Imports/Exports of Energy in Argentina for 2012

Source: (National Atomic Energy Commision of Argentina 2012)

Argentina has begun to diversify its energy mix to address these challenges and is starting to incentivize alternative sources of generation. Argentina's wind industry has been growing in the last decade. The country's Camera of Industrial Engineering Projects and Capital Goods of the Republic of Argentina (CIPIBIC) has organized the Argentine wind industry into the Argentine Wind Cluster (Cluster Eólico Argentino). The goal is to create a sustainable growth within the national wind industry, to create a national industry that can supply the domestic market and reach a global level of competitiveness. The short-term objectives of the Wind

Cluster include collaborating with the government in developing energy policy and an adequate regulatory framework, achieving import substitution for wind power equipment, promote the exchange of experiences and information between businesses and professional associates, and increasing the overall competitiveness of the sector. By 2020, the Cluster aims to have created 10,000 jobs, 1000 MW of wind farms produced domestically, 500 MW installed annually in Argentina achieving the necessary scale to export 500 MW, 500 national suppliers and 4 national brands of wind turbine (this refers to large-scale turbines, as there are already more than four national brands of small wind generators) (CIPIBIC 2012).

2.4.1 Policy Landscape

Argentina has taken steps in recent years to incentivize investment in wind energy, and has had success in contracting a number of large wind projects. The country has passed a renewable energy portfolio requirement, law 26.190 (GENREN). The government expects a total electricity consumption of 61 GW by 2025, of which 8% is to be comprised of renewable sources (about 4.88 GW), which means an additional 32 GW in less than 14 years.

Contracts under GENREN are 15 years, with a guaranteed price in dollars. Contracts include a guarantee of a price incentive of 5% until 10% of future obligations are covered (Mattio, The importance of the GENREN auction in the development of renewable energies in Argentina 2011). The government held two renewable energy auctions, called GENREN I & II, which have contracted 954 MW of wind energy to come online by 2016 –a huge jump from the 60 MW of wind capacity installed in Argentina as of 2011 (Spinadel, Pasado, presente, y futuro de la energia eolica 2011). Despite this progress, bringing these projects online – producing electricity for the grid- has been a challenging and slow process, as contracted projects still face many barriers. Among these are technical, financial, geographic, infrastructural, siting, transmission, regulation, and social (Energy Secretary of Argentina 2008) (Pardo 2012). Recalde states that economic considerations and lack of effective policy instruments have been a major boundary to wind energy in Argentina (Recalde 2010, Recalde 2010). Many projects are unable to move forward simply due to lack of financing. Of the 754 MW of wind energy contracted in GENREN I, after a year and a half only 80 MW have thus far been completed. The final results of GENREN II remain unannounced, as investors await the progress of the GENREN I, which has so far been poor (Barragán 2012). As projects do come online, they face significant technical barriers related to grid connection. The first project to be completed for a GENREN auction was dedicated by the country's president - but not actually connected yet to the national grid. Table 2-4 summarizes the existing regulatory framework for wind energy in Argentina.

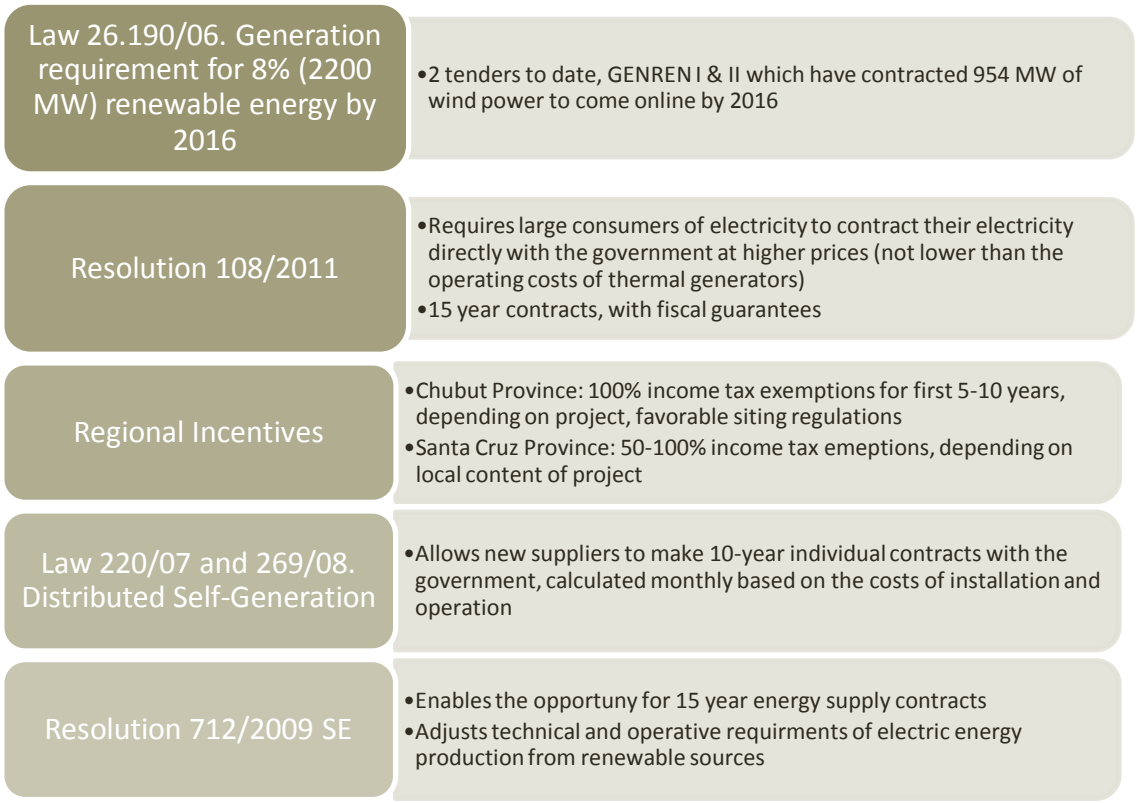

Figure 2-4 Regulatory Framework for Wind Energy in Argentina

Source: (Spinadel 2011) (Mathias 2011)

Electricity cooperatives in the 1990s were responsible for the development of the first wind projects in Argentina (LAWEA 2010) (Barragán 2012). Wind energy investment was more attractive at this time, when the peso was pegged to the dollar and energy prices were high. After the 2001 crisis and subsequent devaluation of the peso, electricity prices were fixed and these first wind investments were unable to compete. Most of the cooperatives were forced to shut down their turbines. Today, with the passage of Resolution 108, the cooperatives are now trying to renegotiate contracts directly with the ENARSA, the government owned electricity regulator (Barragán 2012). However, these types of projects face the same financial barriers, and have little bargaining power because of their smaller scale.

Because of these challenges, it is important for Argentina to encourage a diversified wind industry that will be more resilient to the country's tumultuous energy markets and myriad of barriers facing wind energy.

2.5 Summary of key lessons

The countries discussed in these case studies have pursued a range of different strategies for the development of their wind industries.

Brazil's strategy demonstrates the power of a well-designed policy support mechanism, tailored to unstable macroeconomic conditions. Brazil's renewable energy auctions have also been key drivers for attracting new investments in wind energy.

Mexico has received financial support from the World Bank's GEF to build out and strengthen transmission to its largest wind resource and incentivize two large wind projects. The country has not created a strong national regulatory and policy support framework, but

this investment in transmission infrastructure has enabled significant wind energy development. Wind capacity is so strong in Oaxaca that grid interconnection itself attracted substantial investments and yielded a large increase in Mexico's installed wind capacity.

Uruguay has a coherent and well-defined wind strategy, with intellectual, institutional, and some financial support from the UNDP. This program has made wind energy a priority for the country, situating Uruguay to be a regional leader in wind energy in the near term.

In Argentina, recent policy measures have encouraged the development of a large-scale wind industry, but progress has been slow due to remaining barriers such as finance and transmission challenges. Argentina faces serious near-term energy challenges, and needs to strengthen its strategy to overcome these challenges and move towards the development of a national wind industry. These considerations will be discussed further in the following sections.

3 Small Wind in Argentina

Small wind has been an important piece of a strong, resilient wind industry in many countries. Small wind in Argentina can complement large-scale wind energy development and help to alleviate some of the country's energy challenges while contributing to a more sustainable energy system, as well as producing economic and social benefits.

Wind energy has historically played a significant role in Argentina development. Argentina was one of the pioneers, together with the United States, in the diffusion of windmills starting around 1870. After the US, the country with the most windmills was Argentina. Windmills are a strong part of Argentine history and are widely used in the country, especially for pumping water in agricultural applications. The use of wind energy to generate electricity is much less widespread, but has existed since the 60s when the US company Windcharger began to sell small wind systems in the country, which were used as to charge batteries with a continuous current for low power utilization (Rusconi 2012).

Today in Argentina, there are two million people and more than 1000 rural schools without access to electricity (Spinadel, Micro-generación distribuída: Barreras y logros 2011). Generally, the strongest wind resources are found in rural areas, making a very strong case for the use of wind energy to produce electricity for the country's rural and isolated grids. Small wind often yields a more distributed energy development, which can be beneficial in countries with stressed electricity grids, such as Argentina. This type of production can also benefit urban grids. Individuals, private companies, academics and a few organizations have made investments towards in small wind energy production. These efforts however remain fragmented and lack support, especially an adequate regulatory framework (Spinadel, Micro-generación distribuída: Barreras y logros 2011) (Barragán 2012).

3.1 Definition, Technical and Financial Considerations

As discussed in the introduction, the term 'small wind' can be interpreted in a number of ways. In the Argentine context, the following data from the Argentine Wind Energy Association is applicable. A small wind system is generally sized to power a household, building, and a group of houses with larger systems. An average house has a power demand of around 1 to 5 kW, depending largely on the appliances that particular house has. See table 3-1.

Table 3-1 Characteristics of Power Demand for a Household

Appliance	Power (Watts)	Average hourly use	Monthly energy consumed kWh
10 60 W incandescent bulbs	600	8	144
10 20 W fluorescent compact bulbs	200	8	48
Refrigerator w/freezer	200	24	64.8
Microwave oven	800	1	19.2
Washing machine	2500	1	26.25
Air conditioner	1350	2	60.75
Portable fan	90	2	5.4
Ceiling fan	60	6	10.8
Heating unit	2400	4	288
Vacuum cleaner	800	1	21.6

Coffee machine	900	1	21.6
Iron	1000	1	30
Personal computer	150	4	18
Printer	50	.5	.75
Laser printer	400	.5	6
Monitor	250	4	30
Television	100	4	12
Audio equipment	80	2	4.8

Source: (AAEE 2011)

In a summer month, a typical house might consume between 700-1000kwH, divided by the total hours in the month (720), and the power is 1-1.4 kW for average demand. Comparing this to large-scale wind generators, which produce between .6 and 3 MW, there is a great difference. For this study that small wind is typically talking about household and community applications, such as a hospital or school. A limit will intentionally not be placed on the system because there are some strategies that may allow small wind investors to jointly install larger grid scale systems. This may also be called community, cooperative, or distributed wind for example. The size of the wind system will ultimately depend on the average household consumption and the average wind speed of the area. Whether the system is grid connected or isolated, and regulation concerning sale of electricity to the grid, are other important factors.

The average output of a generator can be calculated using the design specifications of the turbine and the average wind velocity of the area. For an area with an average velocity of 6m/s, a 3kW generator will produce a yearly average of 1.5 kW. There are a number of different technologies of small wind turbines, but in general there will be a two or three blade turbine, the column/tower that supports the turbine, a generator, and tail (see figure 4-1) Turbines can be collapsible (in case of storm or high wind), or mounted. Rooftop mounting is not recommended for structural and noise considerations. It is recommend that a turbine is installed 9 meters about any physical barrier that would block the wind, such as a building, tree, etc.; and 90 meters distance away. The higher the turbine, the stronger the wind and less chance for turbulence – and the potential increases cubically with height with respect to wind velocity, so small increases in height will notably affect the electricity generated. Most small wind companies will recommend that turbines be installed at least 20 meters high, with optimal height between 24-43 meters – but the length of the cable is also a cost consideration to factor in.

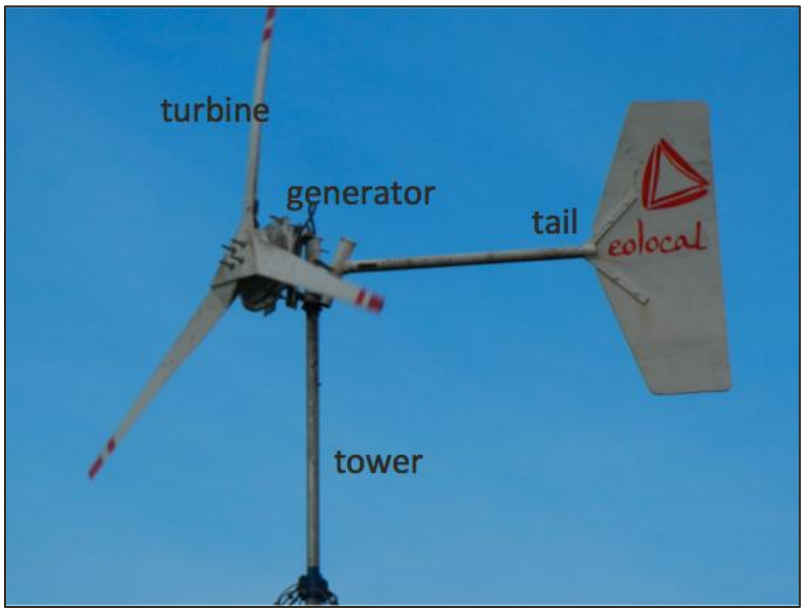

Figure 3-1 Components of a small wind turbine

Source: Author

Ideally wind speeds are measured using an anemometer or country/regional wind speed map, installed for at least a full year with the data processed by an independent site assessment specialist, allowing for accuracy within 5-15%. However this study will typically cost around US $7800, so is uncommon for installations less than around 20 kW (Sharman 2010). These resources may not always be available in developing countries, and the costs pose an even larger barrier. Alternatively a system called flagging can be used, which is especially effective on older trees, based on the deformation from wind. Essentially the deformation and angle of the tree corresponds to certain measured wind speeds, and therefore the wind speed can be fairly accurately deduced. Between these two options an installer can conduct a basic site assessment, which may be assisted by a short-duration anemometry (Sharman 2010).

Small wind can be categorized into systems that are grid connected, and isolated systems. Isolated systems aren't necessarily only found in rural areas, often times regulation does not allow for a system to be connected to the grid in an urban area with access to an electricity grid. Isolated systems are especially useful in areas that are a great distance from the electricity grid. They are usually accompanied with a bank of batteries to store excess electricity for later use. Typically, the cost of extending electricity lines is between $12,000-$18,000/km. Isolated systems can avoid the necessity of paying such high costs to build out electricity grids, and supplant or reduce the need to burn fossil fuels to power generators in isolated houses or communities.

When a system is connected to the grid, an inverter is used which allows the system to interact with the grid. Banks of batteries are not necessary, as the consumer can just take power from the grid when the wind is not generating sufficiently. There are different systems of regulation for these situations. Sometimes a user is able to provide a surplus that is either sold or credited to the grid. This is measured with the electricity meter. If the consumer generates more electricity than they consume they can earn a small profit or have a positive credit to be made up later.

Interconnection generates an incentive for reduced electricity consumption on behalf of the user. However when net metering is not allowed wind systems become less attractive economically, and will typically keep consumers from investing in a larger system that will produce excess electricity (and income).

Examples:

For a 1kW generator, installation cost is around $3000-$5000/kw. The life of such a system is around 20-40 years. The repayment period depends on the specifics of the system, availability and velocity of wind, and any existing regulatory/incentive conditions for example including the sale of electricity to the grid. Under such conditions the repayment will be less than 10 years.

For a 3 kW turbine up front costs are around $9000. Assuming an interconnection to the grid and a life of 30 years, with an average 7m/s wind speed, electricity cost of $0.34/kWh, average consumption of 700 kWh and average annual production of 1000 kWh. If the system covers 50% of total demand, then the repayment period is 30 years. If the system covers 100% of total demand, then repayment is 12 years.

For a 6 kW turbine, costs are around $18000, with a monthly production of 2250 kWh2; at an average wind speed of 7m/s. Energy excess is 1300 kWh monthly. This system can be profitable if sale of excess energy is allowed, depending on the incentive granted. If not there is little reason for a household/private owner to invest in a wind system of this size (AAEE 2011).

3.2 Small wind industry in Argentina

Small wind in Argentina is comprised of 14 small national manufacturers (INTI 2011). There are a few government programs that support the development of small wind for rural and isolated communities in Argentina. In total, small wind manufacturers have produced an installed capacity of 5 MW (INTI 2011). There are 67 people employed directly within the small wind industry. These companies currently fabricate 48 different types of small wind turbines, with a power range from 150W-10kW. Differences in design are due to the wind variance of geographic and wind conditions that characterize Argentina. All models are horizontal axis. Small wind in Argentina is classified up to 10 kW, above which is considered 'intermediate' or 'medium' power. Approximated cost is between $1500-$6000 kW (INTI 2011).

Banfi, one of Argentina's first small wind manufacturers, began in 1980 and produces the first turbines to use magnets. (Spinadel, Micro-generación distribuída: Barreras y logros 2011). Table 4-2 provides a list of small wind manufacturers in Argentina.

Table 3-2 Argentine Small Wind Manufacturers

Name of company	Location	Products
Agroluz	Buenos Aires	2 kW
Electromecánica Bottino Hnos. S	S. Martín, Mendoza	1.1 kW
Eólica Argentina SRL	Concordia, Entre Rios	500/750/1500/3000 W
Eólica Salez	Rojas, Buenos Aires Province	400 W
Giacobone/Eolux	Rio Cuarto, Córdoba	800/1000/1200 W
Giafa SRL	Córdoba capital	800 W/ 2 kW

Grupo ALP	Buenos Aires	1.1 kW
Invap	Neuquén capital	4.5 kW
Makiargentina	C. de Areco, Buenos Aires Province	500-6000 W
Pablo Alvarez	Neuquén capital	1.8 kW/10kW
Pampaco SA	La Plata, Buenos Aires Province	No data
ST Charger	San Luis Capital	150 W/600 W
Tecnotrol SRL	Cdro. Rivadavia, Chubut	400 W/800 W/1.5 kW
Windearth	La Plata, Buenos Aires Province	800 W
Windywest SA	Necochea, Buenos Aires Province	150 W/900 W
IMPSA (large scale)	Mendoza	1.5 MW/2.1 MW
NRG Patagona (large scale)	Cdro. Rivadavia, Chubut	1.5 MW

Source: (INTI 2011)

3.2.1 Industry Spotlight: INVAP

In Neuquén, INVAP is advancing the installation of 4.5 kW small wind generators for rural areas. (Secretaria de Energia de Argentina 2009). INVAP's technology is especially designed to support the extreme wind conditions experienced in Patagonia. INVAP is operating currently in some of the windiest provinces including Neuquén, Río Negro, Chubut, Santa Cruz, Buenos Aires, and Córdoba. INVAP is working on a medium potential system that is designed for small isolated communities of up to 500 people. One of the largest benefits of these, according to one of the company's chief engineers Hugo Brendstrup, is that 'for Argentina and the Latin American region, distributed electricity generation enables the supply of the low-power grid, avoiding load transmission lines. So when there is wind the surplus can be delivered to the grid, and calm it would take power from the grid.' (TELAM 2012)

3.3 Testing and Certification of Products

Certification and testing of small wind products is an important aspect of the industry that allows small wind manufacturers to gain credibility and fortify their products. There are a number of ways that small wind manufacturers in Argentina certify (or self-certify) their products. These are summarized in table 4-3.

Table 3-3 Certification of Small Wind in Argentina

Method	Description	Number of Companies
Power Curve	Electricity output is measured as a function of wind speed	1
Power Curve (CREE certification)	Same method, with certification of all productions by the regional center for wind energy (CREE	4
Vehicle Power Curve	Electricity output as a function of wind speed, which are varied during the test using a vehicle to power the generator	1
Motor Generator Test	Electricity output as a function of wind speed, which are varied during the test using a motor generator	7

Wind Tunnel	Electricity output as a function of wind speed, tests conducted inside a wind tunnel	1

Source: Style 'Caption' (INTI 2011)

3.4 Industry Barriers

Argentina's National Institute of Industrial Technology (INTI) performed a study, based on interviews with small wind manufacturers, on perceived barriers to market entry. The results of the study are summarized in figure 4-2.

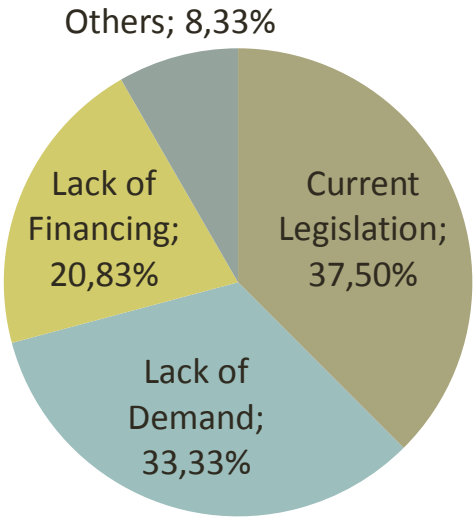

Figure 3-2 Industry Responses on Barriers to Small Wind in Argentina

Source: Adapted from (INTI 2011)

Industry representatives identified current legislation as a principal barrier to entry. This barrier specifically refers to a lack of regulation that enables the possibility for connection of generation systems to existing electricity networks. Lack of demand was the second most commonly stated barrier, specifically that small wind systems are not yet considered an alternative energy supply in isolated areas, and there is a need for dissemination of the technology. Lack of financing was another important barrier, referring specifically to lack of financing for development of new products, manufacturing existing designs, and financing on the client's side for purchase of the products. Other barriers mentioned were high manufacturing costs associated with lack of standardization for equipment and lack of education or awareness concerning the importance of renewable energies.

Interviews also asked manufacturers to suggest interventions and strategies to remove these barriers. Responses were to form a camera (association) of small wind turbine manufacturers, develop a common request and negotiation platform with the support of INTI, tax imported small wind systems, and assist with the dissemination of technology with technical seminars, demonstration projects, university partnerships, etc. (INTI 2011)

3.5 SWOT for Small Wind in Argentina

INTI also recently performed a SWOT analysis based on interviews with small wind manufacturers in Argentina. Responses are summarized below in figure 4-2.

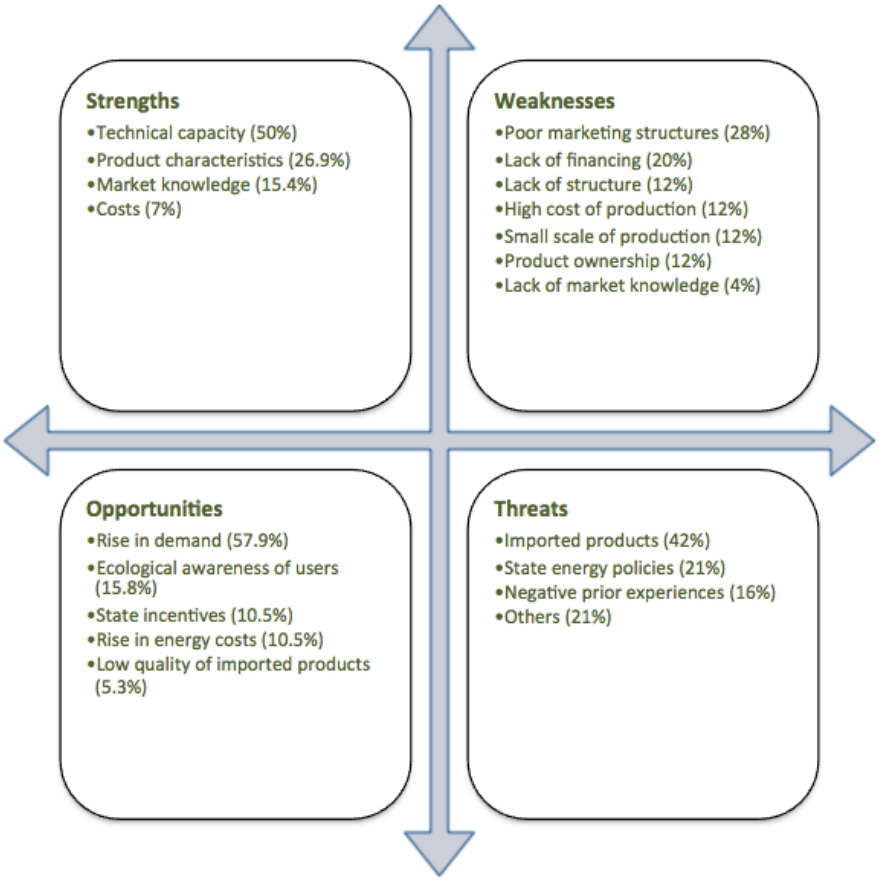

Figure 3-3 SWOT Analysis for Small Wind Producers in Argentina

Source: Adapted from (INTI 2011)

A principal strength mentioned was strong technical capacity amongst national manufacturers, which is especially tailored for the specific conditions of Argentina. For opportunities, there was a general consensus of a perceived rise in demand for renewables, both nationally and internationally. Respondents especially mentioned possibility for very significant growth if legislation that permits grid connection (through two-way metering) was enacted. Weaknesses mentioned related to a lack of marketing structures to promote, sell and distribute small wind products. Lack of financing was also mentioned. Imported products were identified as an important threat, especially products of Chinese origin (only for their lower costs, product performance was widely as inferior in Argentine conditions). State energy policy, especially subsidies for electric energy consumption and continued prohibition of owners of small wind systems to inject energy into the grid, were also mentioned as important threats. (INTI 2011, Spinadel, Micro-generación distribuída: Barreras y logros 2011)

3.5.1 Wind Platform INTI

INTI is working to bring together Argentina's small wind industry to strengthen the sector and create a platform for communication and the advancement of collective interests. INTI has developed a number of proposals based on its research and the results of the 1st Meeting of Small Wind Manufacturers, on the areas of importance for strengthening the sector

identified by small wind manufacturers through the study. The recommendations relate to the sale of wind generation systems, demand, and addressing principal weaknesses and barriers (identified by manufacturers). Key recommendations and strategies based on each barrier/weakness follow below.

Concerning the sale of wind systems

- Develop a standard list of technical specifications that is specific to each product; to define a common recommendations to include in a user manual for small wind systems
- Define a common certification procedure for all small wind systems tested using INTI's Wind Platform.
- INTI proposes to gather information on the ability of manufacturers to provide equipment for direct grid connection, provide a communication and networking platform for the industry and develop a trademark.

Addressing demand

- Advancing a process of certification (headed by INTI) for small wind generators is a priority.
- Development of joint technology demonstration projects together with industry, conducted regionally with INTI's support, as well as projects that are aligned with community needs.
- Develop partnership with universities and technical schools, as well as INET (National Institute of Technological Education), in order to incorporate programs, lectures and seminars into curriculums.
- Other areas of focus include working with industry to encourage rural expositions, and providing marketing tools to strengthen the sector.

Concerning industry weaknesses

- To improve poor marketing structures, INTI aims to provide networks for improving productivity, and marketing tools.
- Create an industry newsletter to improve market knowledge, disseminated to manufacturers and associations such as AAEE and E-Renova.
- To improve products it is INTI proposes research partnerships to connect manufacturers with research centers to identify concrete solutions.
- To help address high production costs INTI will conduct initial surveys for the status of each manufacturer and provide case specific support to strengthen productivity.

Regarding financing, lack or production capital and credit lines for potential users was a widespread point of interest for manufacturers.

- INTI, together with manufacturers, planned to make an approach to the National Bank of Argentina to open credit lines to finance small wind projects.
- INTI's platform also aims to strengthen and provide support to exist finance organizations, such as Sepyme, to strengthen their ability to offer specific support to small wind investors.
- INTI also aims to conduct meetings with Sepyme, the Ministry of Labor, and other government agencies to make available existing credit lines, and share information and

experiences with manufacturers about existing credit lines from the public and private sector. (INTI 2011)

With regard to legislation for the small wind industry

- INTI proposes to develop capacity and joint action focused on a number of areas. A first effort is focused on reviewing and advancing state and national standards as a basis for a proposed national legislation. This effort will be aimed at identifying the reach and objectives of new legislation in close collaboration with the industry.
- Work jointly with industry and government to enact a national law that enables the grid interconnection of small wind systems.
- Obtain a report from ENRE (Argentina's National Regulatory Authority for Electricity) on the regulations for injection of electricity to the grid from small and medium wind power systems.
- Organize meetings with manufacturers and the Department of Energy to present industry viewpoints and discuss initiatives.
- Develop a Complete Legal package- made up of a group of manufacturers working with the support of INTI. The aim is to work with lawmakers to bring forward a bill concerning electricity production for the grid by small and medium wind systems, which specifies the amount of price support. (INTI 2011)

3.6 Government Programs

3.6.1 PERMER

PERMER (Project for Renewable Energies in Rural Markets) has contracted and installed 1,500 small wind generators for isolated populations in the province of Chubut alone. PERMER's principal objective is to supply electricity to a significant number of the rural Argentine households with no electricity (about 30% of the rural population), and 6000 public services of all kinds (schools, hospitals, etc.) that don't have access to the electricity grid, with the participation of the private sector and in a sustainable way. PERMER is funded with a loan from the World Bank of $30 million, a donation from the Global Environmental Fund ($10 million), as well as some federal funding from the Minster of Education (for electrification of rural schools) and provincial funding primarily from the National Energy Fund. The remaining $10 million is funded by private investment from dealers and users. Total project investment is $58.2 million US dollars. PERMER subsidizes the installation of equipment, as a form of incentivizing the users and making private investment possible by absorbing most of the costs of the initial investment. PERMER is currently active in 12 provinces, and implementation agreements have been signed in 6 more (PERMER 2012). PERMER is the largest project of its kind in the world.

The objectives of PERMER are to assist provinces technically and economically with the provision of electric services in rural areas in a sustainable form, to fortify capacity of provincial regulatory entities with matter of generation and utilization of renewable energies, and determine technical-economic feasibility of rural electrification with alternative generation sources. They also aim to establish an energy market for the private sector (cooperatives or companies) that ensures the sustainable of the service, and to develop an institutional framework for off-grid rural electrification (PERMER 2012).

3.6.2 INTI

INTI, who's efforts have been mentioned above, is a leading the 'Test Platform for Small Wind Turbines' in the windy province of Neuquén in the central western part of Argentina,

involving 14 Argentinean small wind companies. The idea is to measure the performance of these companies' products in the harsh winds, and work together with the companies to make things easier on users of small wind. INTI has classified these companies by the power size of their products. 59% offer up to 2 kW, 29% between 2 and 10 kW, and 12% higher than 12 kW (INTI 2011). Companies have been eager to get involved with the project because it gives them visibility, and allows them to demonstrate that their products function exceptionally in these especially windy conditions.

INTI is trying to empower small wind companies to network and form partnerships between producers of wind systems for distributed generation. INTI views an increase in demand for small wind as a driver for distributed power generation and development of more decentralized production networks, with a consequent impact on industrial development and fairer distribution of wealth. Another motivation is to strengthen the Argentine small wind industry against outside competitors, from China for example. One of the main advantages of these national companies is their ability to manufacture turbines that are able to withstand the exceptionally windy conditions seen in many parts of Argentina. (INTI 2011) Additionally INTI is assisting the small wind industry by investigating gaps in the value chain, providing methodological studies of the technological landscape, tracking and making contact with the actors-producers, and other related capacity building activities (INTI 2011).

3.6.3 PRONGED

PROINGED (Provincial Program of Incentives for the Generation of Distributed Energy) came out of Law 12603 and Decree 2158/02, which stated a declaration of provincial interest for the generation of electric energy through renewable sources. The law provides 10-year tax exemption and a compensation of $10/MWh, and promotes scientific investigation and program elaboration. PROINGED aims to promote the conception of distributed energy as a complement to the existing transmission installations, improve the supply of energy, and increase the penetration of renewable energies. The program provides financing to projects, based on five conditions of eligibility: technical capability, cost competitiveness, local participation, environmental impact, and benefits to the electricity system of the province (Callegari 2011). (MORE details on wind projects and funding)

3.6.4 CREE

The Regional Center for Wind Energy (CREE) began in 1985 in the Province of Chubut, Argentina. The center was created originally through an agreement between the Province of Chubut, the National University of Patagonia, and the Energy Secretary of the Nation. Since 1990 is has been funded exclusively by Chubut and now works as national and international advisory body (CREE 2012). Objectives are the develop knowledge on wind energy, provide technical advise and exchange of information to with technical and scientific professionals. CREE is involved in project management, technical studies, economic and financial studies, siting and approvals, operation and maintenance, certification, design of small, medium and large scale wind power plants, software development for wind mapping and siting, organization of national and international courses, professional training and internships, wind resource assessment, and electrification of isolated rural populations and schools. (CREE 2012)

3.6.5 FONTAR

Argentina's Technical Fund (FONTAR) provides assistance for the implementation of innovation technological projects. FONTAR advises and provides technical assistance to stakeholders, and finances projects that pass evaluations. They also provide funding and performance evaluation for funded projects. (FONTAR 2012) FONTAR has made possible a

number of feasibility and assessment studies for wind energy in Argentina, as well as funds for design and manufacturing of new small and medium technologies.

3.6.6 Lineas de Sepyme

Lineas de Sepyme is a credit line through the National Bank of Argentina specifically focused on micro, small and medium scale enterprises, with a credit line of about US $112 million. It makes 5-year loans covering up to 80% of project capital (up to about US $180,000), with low fixed interest rates. Some small wind projects and investors have been able to secure Sepyme funding (Sepyme n.d.).

3.7 Provincial leadership

Regionally, a number of Argentina provinces have incentivized small wind with favorable land use rights as well as some tax incentives and outreach programs. Some have even started developing small wind legislation in conjunction with provincial policymakers. A few of these efforts are discussed below.

Law 12.603 grants a 10-year extension on provincial taxes for installing wind turbines, as well as activities related to the development of technology for the production of wind energy. This law creates a small FIT of $10/MWh for wind, and makes available special long term, low rate credit from the Banco Provincial (Mathias 2011)

Mediante Decreto 1837/09 in Neuquén, declaring as public interest wind energy generation on provincial public lands. This includes the technical assistance in identifying areas with high wind potential and other capacity assistance, certification according to high international standards, and some small tax incentives. (Riavitz 2011)

3.7.1 Province of Córdoba

Giacobone is taking a very active role in helping policymakers in the province of Córdoba, where the company is located, design effective regulation. The company, in collaboration with other industry stakeholders, has submitted a draft proposal to the legislature for comments that outlines a system of net metering for implementation on the provincial level. The legislation proposes that consumers are allowed to produce their own energy up to their estimated yearly household consumption. When they are producing excess it is injected to the grid and metered, and they take electricity when production is low. Every 6 months out of the year, a balance is made. If the user has an oversupply, the balance is credited, and they are paid the equivalent market price of electricity. Right now there is a 100kW maximum for production, to test the program first, in the future a cap of 500kW may be considered (Giacobone 2012).

3.7.2 Province of Chubut

Chubut has the conditions to be a leader, and one of Argentina's key provinces in wind development. Law 17 N 95, promotes sustainable growth in the province, and declares provincial interest of the development, commercialization and use of renewable energies. The law also includes some fiscal incentives for technical development, production/manufacturing, use and transport related to renewable energies. These include tax exemptions during development and research phases, income tax exemptions on commercial operation, favorable loan guarantees. The law also created a provincial agency for the promotion of renewable energies, and a provincial fund for renewable energies. (Mattio, New Law of Renewable Energy in Chubut. Benefits for the Development of Wind Energy 2011)

3.8 NGOs

There are a number of NGOs operating in Argentina in the area of small wind energy, providing anything from financial assistance to technological capacity.

500 rpm, a small NGO, holds courses on the construction of small wind turbines for rural schools and households. They use a design that enables the turbine to be constructed by hand, from very basic materials that can be locally sourced. They use an open design that is low cost and easily replicable worldwide, originally created by the Scottish engineer Hugh Piggott. Course participants are able to learn how to build a wind turbine, and then end result is then installed, at a lower cost for the user. Typically the turbines are built for schools without access to electricity. The turbines provide 700 W of power and can supply a small house, rural school or health center, providing light and possibilities for refrigeration, communication equipment such as computers.

Aside from INTI's efforts, and programs such as PERMER for small wind in rural off grid areas, little has been done on the part of the government concerning a regulatory framework or legislation that incentivizes small wind in any significant way. The Argentine private and nongovernmental sectors have been very energetic and active in pushing small wind forward, but complementary support and encouragement from the government has been lacking. The following empirical analysis provides a detailed discussion of barriers facing small wind in Argentina from the point of view of different stakeholders, followed by a discussion based on stakeholder interviews concerning what is wanted and needed to help accelerate small wind in Argentina.

4 Analysis

Analysis in this section is based on empirical data gathered while in Argentina through interviews, observations and participatory research. This section also includes data gathered from stakeholder groups in Argentina, including reports, conferences and legislation and other primary resources. A list of the interview questions, by stakeholder group, can be found in the appendix.

4.1 Stakeholder groups

4.1.1 Industry

Interviews from this stakeholder group were chosen amongst small wind companies and manufacturers in Argentina. Three different perspectives were attained in order to gain a strong understanding of the viewpoints concerning issues facing the sector and pathways forward. As first-movers in the Argentine small wind industry, this group's experiences and insights are especially important to consider for this analysis.

Owners of the companies Giacobone, Agroluz and Enersol were spoken to for the analysis. Giacobone and Agroluz are two of the most established small wind manufacturers in Argentina, and Enersol is a company specializing in small wind and other renewables. Other manufacturers, such as INVAP, contributed data through email interaction.

4.1.1.1 Barriers

One of the largest themes that came out of stakeholder interviews was a lack of adequate government support of their industry. Frustration was evident concerning the *inconsistency of government support for wind in Argentina that fluctuated with political cycles and made projection and planning difficult*. Government programs would at times support projects and demonstrations, but responses suggested that there was little follow-up and no continuity, and no effort to raise awareness on a national level.

Another important theme was the *lack of an adequate regulatory framework that specifically addressed the small wind industry*. There was acknowledgement that some steps had been taken by the government, but a general agreement that for small wind there was little substance behind the measures, meaning that policies were largely empty statements. Some policy steps had been taken, but these were not backed up with funding and incentives, such as investment or tax incentives. Viewpoints reflected a need for government action to be backed up by concrete incentives, such as tax breaks and other incentives for installation.

'The government supports [small wind] activity to some extent, but its always the same. I started in the year 1981, and its always the same, we're always equal or worse off. New people enter the market, and get tired because they can't sell, and leave the business. I don't leave it because I've been here half my life, and its no longer a question of losing money- its something genetic at this point…. unfortunately, this is a country where there is always change. There are four years of policy- or political economy- that goes to one side and then stops. And people get tired.' -Agroluz

Finances were another important barrier mentioned in interviews with industry stakeholders. This refers to both the *difficulty of financing projects* within Argentina as well as the industry's susceptibility to macroeconomic conditions abroad. Financing within Argentina suffers especially from *lack of access to capital*. In areas where the product may be useful, such as isolated rural areas with strong wind resources, there is often little capital available. If capital was

available it may be used to support alternative activities, such as diesel generators, or other economic activity.

One company pointed to the industry's susceptibility to outside conditions, such as financial conditions in the Europe or United States. This company depended heavily on capital from international companies, because the price of their system was too high for most Argentine investors. When foreign crises hit, often international funding for small wind, or other similar projects, is the first area cut by companies, which can deal heavy and sudden blows to the industry.

'In the countryside, there isn't money left over from herding, or large profits from soy, to make extra investments. The distances are very large, and while there could be application for rural communities often they are not interested or cannot make that investment. My system is $20,000 USD to install, so it is a little too expensive for this application. So the only [customers] left are the telephone companies. They need stability for their systems, and they have outside capital to put up.' -Agroluz

Subsidies of fossil fuels/electricity were also repeatedly mentioned as a significant barrier to small wind. These subsidies create an artificial price for fossil fuels within Argentina that makes investment in other sources of even more economically uncompetitive. These subsidies make fossil fuel sources in Argentina much lower than their international value, distorting the price of electricity and creating an unnecessary barrier to small wind (and other renewable) generation in Argentina.

Other considerations related to *lack of adequate testing programs* in the past, in which poor equipment from abroad, that could not take Argentine wind conditions, was tested and performed poorly, which discouraged industry stakeholders. One company also mentioned that even when they made demonstration projects in rural schools they received no support from the government and were left abandoned. Another barrier mentioned was that the government made *little attempt to raise awareness* concerning the industry and test projects. *Large geographic distances* in Argentina were also mentioned as a barrier. This makes it difficult to transport and install systems, as well as provide maintenance or other technical support if necessary.

4.1.1.2 Proposed Policies and Initiatives

Regarding strategies for the overcoming of these barriers and accelerating the developing of small wind energy in Argentina, a common theme that emerged from interviews was to *pass a law concerning grid connection, in which the user could interact and exchange energy with the grid*. Specifically referred to in two interviews was a system of net-metering, in which the user interconnects their system with the grid and produces their own electricity, taking electricity from the grid when production is low and supplying energy to the grid when there is excess production. This was generally viewed as a way to create a positive consumption and demand boost for the industry, because it would enable investors to gain a faster return on their investment, and potentially an income if certain regulations were enacted (permitting the sale of excess generation). Some of the interviewees specifically pointed to the types of legislation and regulation found in countries such as the United States or in Europe. Specifically mentioned was legislation such as Spain's Decreto Real 1699/11 for distributed wind generation, providing specific regulation for small wind with adequate incentives.

It was also stated that electricity costs should be calculated taking contamination and other externalities into account, which would make clean energy sources such as wind immediately more competitive.

'What we propose, is that for those who want to generate their own electricity, they can make an exchange by the quantity of kW. It's an exchange of energy. I inject my energy into the grid, and I take it when I need it. And every six months out of the year, a balance is made. A system of net-metering.' –Giacobone

Another important area of discussion was some type of *incentive for the user to cover up-front investment costs and strengthen access to capital*. There was a general view that areas with the most need had some of the least access to capital. Mentioned here was the possibility of applying a *system of credits to help cover up-front investment costs*. This would provide a subvention for the users of small wind systems. The credit would be bankable, allowing the user to pay for the investment with a credit and pay it off with a monthly fixed rate (Rusconi 2012). Stakeholders acknowledged that this could at least be made available to a target group, so that the state is providing at least partial subsidies to populations with the most need, such as rural, dispersed communities (Brendstrup 2012).

4.1.2 Government

Government perspective was obtained through two interviews with contacts from the Argentine Secretary of Energy and of the government technological development program INTA. Follow-up communication and clarification was also solicited through email.

4.1.2.1 Barriers

Interviewees pointed to issues with an *adequate regulatory framework*. One point was that electricity regulation was designed for generation from conventional sources rather than for renewable and distributed generation. *Existing regulation also does not consider the possibility that the consumer could also produce energy and sell excess to the grid*, such as the net-metering schemes seen in other countries. The regulation of energy markets in Argentina fundamentally excludes this possibility, requiring that electricity distributers supply all the demand in their concession areas. The government has a tendency to extend the distribution system over the possibility of local renewable generation, leading to larger installation costs and reduced dependency in power supply. (Alvarez Cruz 2012)

Finance was also an important barrier. The *difficulty of small projects to achieve financing and reach true economies of scale* was mentioned (Alvarez Cruz 2012). This relates to issue with the supply chain, availability of nationally produced product components and lack of demand. Also mentioned was the importance of extending and linking existing credit lines to consumers for small wind investments, from sources such as Sepyme and FONTAR. A *lack of technical capacity on the part of the final user* was mentioned, specifically insufficient resource knowledge and technological capability (Alvarez Cruz 2012). Final users often do not have the experience or awareness to successfully acquire and install a small wind system.

Other considerations were a shortage of adoption of onsite technical solutions on the part of the providers, and high maintenance requirements of the technology. The availability of other options for supply that are more competitive, such as GLP, Diesel, etc. when externalities are not considered (noise, smoke, transport, etc.), and theft and vandalism against installations were additional barriers mentioned.

4.1.2.2 Proposed Policies and Initiatives

Strategies mentioned included *strengthening and extending the reach of existing successful programs working with small wind energy*, such as PERMER, which awards installation and maintenance to private suppliers that respond for the provision and performance of the equipment in the areas of the country where the state has identified development opportunities for these

technologies and applications of rural electrification. Also mentioned was the importance of facilitating *certification and testing platforms for the industry*, to strengthen visibility and consumer trust.

Legislative and regulatory strategies were also mentioned, specifically concerning the *grid interconnection* of the systems. A need was mentioned to study the actual potential of possible schemes of microgeneration for interconnected systems and propose regulatory changes that open the possibility that under certain circumstances the final user can exchange energy with the grid (Alvarez Cruz 2012). It was mentioned that efforts should also be made on a provincial level, not only tailored to available energy sources but also the social and cultural considerations of the region. Provincial policies were viewed to be more able to account for this social side of energy, and how small wind and renewable projects can be tied into community life to improve standards of living (Cardozo 2012). INTA is working with renewable energies for rural households and farmers, including small wind systems, with this strategy in mind. Each technology that they use is adapted to the local conditions and cultures. If a community has access to wood they promote the adoption of efficient and clean wood burning stoves. If a there is strong wind, small wind systems are prioritized. If the community has a great solar resource and little wood they will promote solar ovens (Cardozo 2012).

4.1.3 Individual investor

A case study was obtained with an individual farmer, in a rural off-grid area close to Las Toninas, Argentina. The individual invested in a system to power his small house. His stated motivation for the project was a need for electricity, for light, and the fact that he was very far away from the electricity grid, about 4 kilometers from the closest transmission line. He would have had to pay a charge of around US $4,500/kilometer to have a new transmission line installed, a great deal of money. He had purchased a gas generator, but this was very loud and expensive to continuously purchase fuel. Through a friend he found out about an NGO-led course that built generators for of grid rural applications, and signed up to take the course and purchase the generator to supply electricity for his house.

4.1.3.1 Barriers

The *initial investment costs* were stated as the principal barrier. The total system cost was around US $7,800. The individual's investment was subsidized heavily by the NGO, which only charged for the batteries and equipment. This brought the total down to around US $3,100, a much more affordable investment.

The farmer also mentioned a *lack of demand* as an important consideration. This was due to a to a few reasons. First, installing a small wind system on a rural farm may not even fall to the individuals or families that could use it the most. Each farm has an owner, who would make the investment decisions on the farm, and they are not likely to pay US $7,800 so the gaucho can have electricity. The gauchos and their families don't really have a say in this matter. The gaucho, or the farm worker, has lived all their lives without electricity. So they know how to live without electricity. He might have a small turbine or generator, but doesn't use it. So as people live, there isn't interest in installing a turbine. In the rural farms in the north and south, there isn't water, any hospitals, etc., so electricity isn't the largest priority. There aren't trains, buses, so these things would be higher on the list of demands for people living in these areas (Quiroga 2012)

4.1.3.2 Proposed Policies and Initiatives

When asked what assistance or help may have been desirable, the famer's response was: 'Just help to cover the initial cost.' (Quiroga 2012)

4.1.4 NGO

An NGO perspective was gained from interaction, interviews, and participatory observation through workshop attendance of the NGO 500rpm. Interviews were conducted with one of the workshop organizers as well as attendees.

4.1.4.1 Barriers

Barriers mentioned related to land ownership, enormous distances, which cause high maintenance costs, lack of legislation (such as the law of microgeneration in Uruguay), and lack of providers of some of the basic components of renewables at reasonable prices, such as batteries, regulators, inverters). (van Dam 2012)

An important barrier mentioned relates to *land ownership*. Most of the land in Argentina is owned by 'big fish' -individuals who own huge plots of land not actually live there, so they don't know or care about the living conditions of the gauchos that live and work on the farms. These gauchos have a very poor standard of living with no electricity. This contributes to a slow but continuous de-population of rural areas, and exacerbates overpopulation in big cities, especially Buenos Aires. NGOs especially are trying to make these big fish understand this problem, because it is in their interest that the people working for them are comfortable (van Dam 2012)

Another barrier mentioned was political, stating a *historical distrust with the government* and external viewpoints concerning the Argentine government and economy. It was pointed out that there was low faith in the government due to prior history of default and economic instability, making it difficult today to attract the resources and finances for wind energy that are costly investments. (Spayorosa 2012)

Subsidies on energy prices were also viewed as important barriers. There was a view that these subsidies created an artificial demand for natural gas. Gas is imported at a cost far higher than the production costs in Argentina, but subsidized to keep electricity prices cheap. If the tariffs are put instead on the cost of aggregate demand, then alternative energies, which were not competitive, start to get within the rank of traditional energy sources.

Geographic and demand considerations were also mentioned as important barriers. In Argentina we have almost all our population is in one area, so small wind energy has to compete with a very centralized grid'. Salvador Lurbé, engineer, student of 500rpm workshop (Lurbé 2012)

4.1.4.2 Proposed Policies and Initiatives

Strategies mentioned were related to an *adequate regulatory framework* and need for further *capacity building* efforts. Specifically for capacity building, partnerships with universities were viewed as important, so that students and the professors are dedicated to the calculation, projection, and technical consideration related to the small wind industry. Economic considerations were also mentioned, and a need to solicit external funding from other parts of the world (Chiapini 2012).

Pricing energy for the real costs, including externalities and importation costs, was stressed as a key to stimulating demand for renewables. If real imported costs were reflected in prices, interest in alternatives would rise. There was acknowledgement that current pricing hides a strong interest in small wind, which exists much more today in Argentina than is manifested.

4.2 Summary of Stakeholder Perspectives

Interviews identified a range of barriers and proposed policies, incentives, initiatives and common strategies. Overall, there was a significant amount of overlap within stakeholder groups, as well as common themes that emerged throughout the entire interview process.

Most of the interviewees pointed to policy as a major barrier, and a need for policy/regulatory leadership with small wind backed by some sort of financial incentive to help users/investors cover the up front costs. Specifically mentioned was policy concerning an adequate regulatory framework for grid interconnection. A change in energy tariffs to better reflect the real cost of energy was also repeatedly mentioned, which also refers to federal policy.

Other areas of discussion pointed to a need for further strengthening of existing and effective government capacity building programs, as well as improved financing opportunities and support for university partnerships. There was mention of geographic and demographic (spatial location of electricity demand) considerations, as well as external conditions affecting Argentine markets.

Table 4-1 attempts to identify and summarize common themes derived from stakeholder interviews.

Table 4-1 Summary of Stakeholder Viewpoints

Interviewee	Strategy or Incentive				
	Federal policy	Provincial policy	Market incentive	Government program (capacity building, outreach/education)	Other
Industry					
Ing Giacobone (Giacobone)	X (remove electricity subsidies)	X	X (net-metering, credits of oversupply)		
Ing. Milanesi (Agroluz)	X (continued support, awareness raising)		X (incentives for installation, tax incentives)	X	X (external investment)
Ing. Sergio Rusconi (Enersol)	X	X	X (grid connection, system of credits for investor to cover costs)	X	
Ing. Hugo Brendstrup (INVAP)	X (removal of fossil fuel subsidies, need for adequate distributed energy regulation)		X (incentives, credit, subsidies to cover investment in rural areas)		
Government					
Ing. Pablo Alvarez Cruz (Secretary of	X (consideration of distributed	X	X (net-metering with sale of oversupply)	X	

Energy)	energy)				
Francisco Cardozo (INTA)	X	`			
Individual Investor					
Federico Quiroga (Farmer)			X (to cover initial investment)	X	X (NGOs, outreach to farm owners)
NGO					
Salvador Lurbe	X (actual valuation of fossil fuels, removal of tariffs)		X (removal of subsidies for fossil fuels)	X	
Pedro Spayorosa	X			X	
Hector Hugo Chiapini				X	X (university partnerships, external resources and finance)
Esteban Van dam	X		X (interconnection regulation)	X	

Source: Interview data

As table 4-1 suggests, there was strong consensus on the need for a market incentive to boost demand, specifically regarding interconnection and exchange with the grid by small wind users, which was mentioned explicitly by all groups except individual investor. Stakeholders within both industry and government mentioned net metering as a specific tool. Some type of incentive, or credit, was mentioned repeatedly within industry to cover costs, and also in government (for certain cases) and individual investor stakeholder groups. Based on these results it can be suggested that there may be substantial support for a market incentive that allows interconnection and exchange of energy with the grid by small wind users, which is also backed by a subsidy or other price incentive.

Energy subsidies and the valuation of electricity in Argentina were repeatedly mentioned throughout stakeholder interviews as an important consideration for the advancement of small wind. It was generally viewed that the removal of energy subsidies would create a positive boost for wind and other renewable energies. There was nearly unanimous sentiment that the federal government's energy policies were an important barrier to small wind and that changes needed to occur to remove barriers and create a stable regulatory and investment environment.

Another notable response related to capacity building and strengthening of existing programs, as well as outreach and education. There was agreement across all stakeholder groups that existing programs related capacity building (technical support, availability of credit, project demonstrations, etc.) and outreach and education (from government, universities, NGOs) were effective and needed to be strengthened.

4.3 Comparison of Interview Findings with Literature

In order to frame this analysis with existing perspectives on the small wind in Argentina, this section will compare empirical findings with data from previous literature. The main sources of previous analysis from literature come from INTI's study with wind manufacturers, and other sources from news articles, conferences, and other secondary sources from Argentina. Main barriers are summarized and compared in table x and compared to literature. Strategies, policies, and initiatives mentioned are summarized in table x and compared to literature. A discussion follows that identifies the most commonly mentioned responses for each.

In the tables, a 'Yes' is placed if a stakeholder group stated the barrier/strategy. To account for the four different stakeholder groups in the interview data, the table will divide 'Yes' responses with an accompanied 'one' (if a single stakeholder group stated the barrier strategy), 'various' (if 2-3 stakeholder groups stated the barrier/strategy) and 'all' (if all 4 stated the barrier/strategy). If a data source (covered in this study) does not mention a certain barrier/strategy, the table states 'Not mentioned'. Barriers that are mentioned in all 3 sources are highlighted.

Table 4-2 Comparison of Barriers between Interview Data and Literature.

Barrier	Data Source		
	Interviews	INTI Study	Other Literature/Data
Lack of Legislation for Small Wind	YES (various)	YES	YES
Lack of Demand	YES (various)	YES	YES
Lack of Financing	YES (all)	YES	YES
Electricity/Energy subsidies	YES (various)	YES	YES
Macroeconomic considerations	YES (various)	YES	YES
High manufacturing costs (lack of affordable materials)	YES (one)	YES	YES
Land ownership issues ('big fish' landowners do not care about gaucho living standards)	YES (various)	Not Mentioned	YES
Small scale of production	Not mentioned	YES	Not mentioned
Poor past experience	YES (one)	YES	Not mentioned
Large geographic distances	YES (various)	Not Mentioned	YES
Poor Marketing Structures/lack of market knowledge	Not mentioned	YES	Not mentioned

Lack of awareness of the importance of renewables	Not mentioned	YES	YES
Existence of competing or imported products/alternatives	YES (various)	YES	YES
Technical capacity on part of user	YES (one)	Not mentioned	Not mentioned
Theft and Vandalism	YES (one)	YES	Not mentioned

Source: Interview Data, Literature Review

Table 4-3 Policies, Initiatives and Strategies

Policy/Initiative/Strategy	Data Source		
	Interviews	INTI Study	Other Literature/Data
Legislation: enact small wind legislation that enables grid interconnection and exchange of electricity	YES (various)	YES	YES
Legislation: Employ market instruments to help cover investment costs (credits, incentives)	YES (various)	Not mentioned	YES
Strengthen access to finance and existing government credit lines	YES (various)	YES	YES
Conduct studies on legislation and market/industry	YES (one)	YES	Not mentioned
Create university and technical partnerships	YES (one)	YES	YES
Create joint demonstration projects, especially in rural areas	YES (various)	YES	YES
Reform electricity/energy subsidies	YES (various)	YES	YES

Create an industry association/platform	Not mentioned	YES	Not mentioned
Improve marketing through networking and communication strategies	Not mentioned	YES	Not mentioned
Develop common certification	YES (one)	YES	YES
Strengthen existing government programs and testing projects	YES (various)	YES	YES
Impose tariffs on imported products	Not mentioned	YES	Not mentioned

Source: Interview Data, Literature Review

These tables highlight quite a few common barriers and strategies between data sources. Based on this data, principal barriers to small wind in Argentina are:

- Lack of legislation for small wind
- Lack of demand
- Lack of financing
- Electricity/energy subsidies
- Macroeconomic considerations
- High manufacturing costs (lack of affordable materials)
- Existence of competing or imported products/alternatives

Interview data and literature from this research also suggest that land ownership challenges are an important barrier. Those who would benefit the most from small wind systems, such as guachos and their families, have no agency to invest in them. The 'big fish' landowners, who often own vast holdings, do not live on and have no concern for the living conditions on the farms that they own. Large geographic distances and negative prior experience with testing and demonstrations are also mentionable barriers. Others that did not come up in empirical date from this research include lack of awareness of the importance of renewables and poor marketing structures.

To overcome these barriers, the most favored policies, strategies and initiatives are:

- Enact small wind legislation that enables grid interconnection and exchange of electricity
- Strengthen access to finance and existing government credit lines
- Create joint demonstration projects, especially in rural areas
- Create university and technical partnerships
- Reform electricity/energy subsidies
- Develop common certification
- Strengthen existing government programs and testing projects

Interview data and literature from this research also suggests to utilize market instruments such as credits or tax incentives to help cover investment costs. Market and policy studies to support the industry are also a mentionable strategy. Other important strategies that did not come up in empirical data from this research include the creation of an industry association/platform and improving marketing through networking and communication strategies.

5 Potential for Policy Lessons: International Experiences and Best Practice

Throughout this study, data derived from literature reviews, industry study, and empirical data has illuminated findings concerning the research questions. Regarding barriers, these relate principally to considerations of:

- Policy and regulation
- Finance
- Product demand and certification
- Energy subsidies and macroeconomic considerations.

Concerning development strategies and initiatives, findings relate to:

- Policy and market incentives
- Sources of finance
- Marketing and communication
- Energy policy reform
- Certification,
- Strengthening outreach programs, partnerships and technical support.

It is clear that these general areas are very important for the Argentine case. This section will discuss case studies and best practices from other countries, to provide additional information and insight into effective strategies for overcoming barriers and accelerating the development of small wind. Through this process it is hoped that lessons can be derived that are applicable to Argentina.

5.1 Regulatory Models and Best Practices for Small Wind

States and countries utilize an array of different policy tools to incentivize small wind systems. These may be grouped in three primary categories: financial incentives, mandates, and education and outreach (Wiener and Koontz 2010). Financial incentives are designed to help technologies overcome initial financial barriers, and include tax credits or exemptions, grants, and low-interest loans. These include net metering, decoupling, and specific policies for independent, joint and cooperative/community electricity production.

Mandates, often called renewable portfolio standards, are also common tools used to support renewable energies. These set a requirement for a certain percentage of utilities' electricity generation to come from qualified renewable energies by a certain date. Small wind systems may not be specifically required, but included amongst other eligible technologies.

Promotion and outreach is a final major category, which provide and encourage greater awareness and technological capability. This may include for example government programs to test equipment and provide mapping and wind speed metering technology. (Wiener and Koontz 2010)

The following cases provide an overview of regulatory models and strategies for the development of small wind in other countries that are either considered best practices, or are of specific interest to the Argentine case due to similar political and economic considerations. While barriers may be especially acute in some cases for Argentina, small wind generally faces

similar barriers within each of the chosen countries, or the country or region can be considered a best practice that may be of interest to Argentine stakeholders and policymakers.

5.1.1 United States

The US case is interesting for Argentina because a number there are a number of shared barriers, especially finance, and some political similarities such as a lack of a favorable federal energy policy and a provincial/state based governmental system. The US is also considered a best practice country for small wind regulation.

The US small wind market has developed rapidly in recent years and is expected to grow 16 percent until 2015, accumulating over 51 MW of total installed capacity. Small wind challenges the century-old system in the US of centralized generation, historically owned and operated by utilities. There are a wide variety of regulatory models for grid interconnection of small-wind in the United States. States utilize net metering, renewable portfolio standards, grants, tax incentives for investors and manufacturers, loans, education and outreach, and anemometer loan programs (Wiener and Koontz 2010). Small wind in the US refers to wind turbines up to 100kW. The majority of small wind turbines sold are 10kW or less. (Asmus 2011)

The primary drivers for small wind in the US are federal, state and utility financial assistance programs: rebates, tax credits, grants and other incentives. Small wind in the US can benefit from federal and state incentives. While California and a handful of other states have offered rebates for small wind systems for well over a decade, the federal government first approved a federal Investment Tax Credit (ITC) as part of the Emergency Economic Stabilization Act of 2008, available for homeowners who purchase a small wind system. The initial 30% ITC for small wind was capped at $4,000. In February 2009, the American Recovery and Reinvestment Act removed the $4,000 cap on the ITC and created the 1603 program instead of just creating another ITC for businesses, and businesses can receive a 30% reimbursement through the American Recovery and Reinvestment Act. (AWEA 2010)

Concerning policy, most US states opt for some form of net metering to incentive small wind and other renewables. With net metering, electricity producers are allowed to offset their electricity payments with the electricity they produce. Utilities are required to compensate customers for the power they generate. So, if the producers are generating some, all, or a surplus of electricity onsite, they pay only the balance of what they require from the grid. This allows a small financial return for the electricity produced, and in some cases regulatory models will enable economic opportunity by allowing these onsite producers to generate power for the grid.

As of 2010, 43 states and the District of Colombia have adopted net metering. A lack of consistency with state standards is a significant challenge for the US context, and the federal government has taken steps to unify standards, such as the FERC's small generator interconnection standards (Interstate Renewable Energy Council 2009). The US DOE has created a policy comparison software that ranks states based on paybacks for small wind turbines. Analysis considers factors such availability of financial incentives in rural areas that feature the strongest wind resources, availability of net metering and state rebates, renewable energy credits and other forms of financial support (Asmus 2011)

Most variety amongst states in interconnection policies is amongst eligible technologies, the types of generators, the treatment of excess production, the total system capacity or cap, and the type of utilities or electricity providers regulated (investor-owned, municipal, cooperatives, etc.). Studies (Wiener and Koontz 2010) have identified a number of different factors that may determine a state's adoption of small wind policies. These may correlate to a range of different

factors, level of economic development and extent of pro-environmental policy adoption, political ideology, strength of interest groups, and political and bureaucratic capability (measured with factors such as legislative professionalism, with professional legislatures mote likely to support pro-environmental policies). Historic commitments to environmental protection and severity of pollution problems in the state are also important. Electricity prices in the state are also important to consider in adopting renewable energy policies, states with higher electricity prices are more likely to adopt renewable energy as a means to lower future retail electricity prices for citizens. Perception of renewable energy to job creating is another factor. Physical and geographic characteristics, especially the state's wind resources, can be an important determinant of a state's support for small wind energy, however studies have shown that the strength of an area's resource is not a key determinant. (Wiener and Koontz 2010).

Regional policy diffusion research has identified two main variables that are believed to facilitate the diffusion process: interstate competition and regional policy networks. Competition may relate to jobs or perception of a state as an environmental or energy leader. Policy networks can be formal and informal and have been found to play a key role in regional policy diffusion (Wiener and Koontz 2010). Of these, the independent variables most closely associated with state small wind policies are commitment to environmental protection and policy innovation, as well the political ideology of the state.

Specific features of regulatory models concerning grid interconnection differ in a number of different important areas. Caps for the amount of energy generation allowed from small wind, and size of onsite electricity produced vary by state. Some will have specific caps based on a particular electricity provider. Caps have advantages and disadvantages. Caps can represent a protectionist measure for electricity providers, but can also unnecessarily limit private investment in wind energy generation (Interstate Renewable Energy Council 2009). Also, if a cap placed is too small, it limits the ability of onsite generators to pool their resources and invest in a high quality, professionally installed system.

Another important area of interconnection policy relates to excess generation. Most common approaches amongst states allow the electricity provider to retain the excess generation for free, or provide a payment back to the generator. Some models will allow the excess generation to continually rollover, and the annual generation is then channeled into another social service (Interstate Renewable Energy Council 2009).

The interstate renewable energy council, which acts as a watchdog for state net-metering and interconnection policies, identifies a number of key lessons from the US experience.

- A system should be sized to meet a customer's on on-site demand.
- Limits can be restrictive for the market
- All utilities/electricity providers should be included
- Third party ownership should be allowed
- Multiple/aggregate meter billing: allows groups of customers or single customers with multiple meters at different locations to share a single system to offset load at these dispersed locations. This allows a broader range of customers to invest in renewable systems, even if they don't have ideal sites themselves. Shared system net-metering is even broader, allowing groups of electric customers to jointly invest in a renewable energy system and use that shared system to offset energy consumption at their individual households.
- Treatment of excess: to avoid bureaucracy and administrative overhead, excess should be calculated by year if applicable.
- Main barriers generators faced in grid connection: technical, business practice,

regulatory. Many of the barriers have little to do with the strength of wind resources in a region.

The following sections will discuss a few best practice regulatory models of US States. New Jersey and Colorado are widely recognized for having the best net-metering policies of any US state. California is also a leader in incentives for small wind, distributed energy, and grid interconnection for small renewables, so is discussed as well.

5.1.1.1 New Jersey

New Jersey first implemented net metering in 1999, with the passage of NJ State Law 84: 3-87, and then NJAC 14:8-4.1 in 2004. There is no capacity limit specified, but the system must be sized so that energy production does not exceed onsite energy consumption. There is no limit for the aggregate system limit; state board of public utilities (BPU) may require a limit of 2.5% of peak demand. Individual generators have several compensations options for excess generation. They can receive a month-to-month credit for net excess generation, at the avoided cost, a real-time compensation, or may enter into a bilateral agreement for with their electricity supplier or service provider to the sale and purchase of net-excess generation (NEG). SB 2698 of January 2008 also expanded eligible producers to industrial and large commercial customers and allowed utilities to recover costs of new/upgraded meters through rates or customers. A separate rule in 2009 also allowed generators to choose their month to begin the annualized period – which is important for more seasonal renewables such as solar, where the excess will be more useful in the following winter. Customers are the owners of any renewable energy credits.

5.1.1.2 Colorado

Colorado's net metering places a system capacity of 120% of the customer's average annual consumption. Municipality and co-ops have a 25 kW for non-residential, and 10 kW for residential cap. Net excess energy generation is credited to the customer's next bill at retail electric rate. After a 12-month cycle, investor owned utility (IOU) customers may elect to roll over credit indefinitely of to receive payment at average hourly incremental cost. Municipality and co-ops provide annual reconciliation at a rate they deem appropriate. IOU customers can aggregate multiple meters, customers own RECs.

5.1.1.3 California

Most distributed and small wind systems in California range from one to 25 kW. The California Energy Commission supports grid-connected small wind systems of 10 kW or less through the renewable rebate program. (California Energy Commission 2011). California has been supporting small wind since 1996 when it began offering rebates that covered roughly half the costs of grid-connected small wind systems.

Today California has a net-metering scheme for small wind and intermediate wind up to 1 MW. There is no aggregate limit on the amount of capacity that can be installed under this program. Any net excess generation is credited to the consumer's next bill at the retail electricity rate. A tenant with multiple production sites is not allowed to aggregate meters. The customer in this scheme owns any renewable energy credits. (Interstate renewable energy council 2012) California recently saw a surge in rebate applications, with 85% of the requests totaling amounts close to or equal to the systems total installed costs. The California Electricity Commission called for an investigating, and discovered that a single company was responsible for these questionable rebate requests. Lessons learned from this issue are that basing the incentive levels on certified power performance ratings, and setting a cap on the portion of system costs that rebates offset, can avoid these problems. The Small Wind Certification Council is working with governments to incorporate certification requirements

into small wind funding programs (Asmus 2011). Another current issue with net metering in California relates to overall system caps. Legislation was unclear regarding these areas, creating a fierce debate on whether net-metering policies should continue. Opponents challenge net metering as a subsidy for renewables, proponents called it the 'civil rights legislation' for renewables. Legislatures acted to continue policies and clearly affirmed system caps to avoid future disputes (Trabish 2012).

5.1.2 Uruguay

Uruguay was chosen for its geographic location, as a neighbor and energy trade partner with Argentina, and with similar wind resources and a shared language.

Uruguay has recently passed the Law of Microgeneration, which incentives small and micro wind systems. Uruguay's Rule of Distribution of Electric Energy (Decree 277/002) (Uruguay Minister of Industry, Energy and Mining 2010) authorizes subscribers connected to the grid to install renewable generation from wind, solar, biomass, or minihydro. Decree 173/10 specifies the regulation for power generation at homes and businesses. The maximum current allowed cannot be greater than 16 amps, with the exception of monophase suppliers connected to a ground return, which have a maximum current of 25 amps (Uruguay Minister of Industry, Energy and Mining 2010). Overall maximum power of the system is limited to 11 kW (UTE 2010). The peak potential of the system should be less or equal to the contracted power of the subscriber. Subscribers interested in surpassing these limits must obtain prior expressed agreement from the UTE. The UTE is required to buy all electricity produced from subscribers for 10 years. The energy sold to the grid by the subscriber will be remunerated at the same price as the current charge of electricity from UTE. The micro generator will not pay charges for the use of the grid. The price of equipment for interconnection and any new metering equipment necessary all falls at the expense of each micro generator. The costs associated with interconnection of this type of energy will result in a connection fee that UTE must propose to the Executive Power for approval. (Uruguay Minister of Industry, Energy and Mining 2010)

Uruguay also puts forth strong tax inceptives for renewable energy projects, as well as research and development activities. Uruguay's program is lead by an innovative partnership between the Uruguayan government and the UNDP with funding from the GEF (PEEU 2011). More detail on Uruguay's wind energy strategy can be found in section 2.

5.1.3 Thailand

Thailand was chosen as an interesting case study because it is a developing country that faces serious energy challenges related to a lack of investment in natural gas, similar to Argentina. A team of international experts collaborated with policymakers in the country to produce an innovative program and supporting legislation that supports small wind and other renewables.

Thailand enacted a net-metering policy in 2002, allowing for grid connection of systems up to 1 MW. Excess production is compensated at average cost of generation, around 80% of retail rate. Thailand's national grid reached over 99% of all Thai villages, but community acceptance of large-scale plants have been a barrier for new generating to reach rising demand. The country relies on natural gas for 69% of electricity production, but domestic reserves are expected to be depleted within three decades, and Thailand has been severely affected by the volatility of gas and oil prices in recent years. Notable features of the regulation are that renewable energy generators are allowed to export up to 1 MW of electricity. This allows systems larger than 1 MW to connect as long as the customer is consuming enough electricity on-site. The system also allows aggregate metering, which enables an entire community to connect combine their aggregate consumption, and jointly invest in a larger generating system.

This is only allowed for new customers. Time of use metering is also utilized, which allows for the possibility of increased revenues with electricity generated during peak demand. Remaining challenges include lack of awareness, high quality equipment and financing. (Greacen, Greacen and Plevin 2003)

5.1.4 Spain

Spain was chosen as a case study because it is also considered a best practice country for small wind policy. Spain's regulatory framework and incentives for small wind were specifically referred to in empirical research and discussions in Argentina. Common language is also an important consideration.

Spain passed Real Decreto 1699/2011 in November 2011, concerning the regulation of grid interconnection for installations of small-scale electric energy production. Spain states that distributed generation can allow reduction in losses for the grid, the reduction of the need for investments in new transmission infrastructure; Spain's framework governs the interconnection of systems up to 100kW, connected to interior grids. These installations cannot be higher than the available capacity at the point of connection to the distribution network, nor the subscribed power of the supplier. There is no payment for net excess generation, but oversupply can be credited to future bills. The law also regulates larger installations for distributed energy, up to 1 MW, connected to the national grid. The decree specifies between interconnection with the national grid, and with interior networks, which are electric installations with the necessary infrastructure to serve an installation receptor that doesn't belong to the distribution network. The connected generators should not exceed 2.5% of the nominal tension of the low/medium grid. Remote, multiple-site metering is allowed, as well as aggregate supply.

5.2 Summary of Regulatory Models and Best Practices

Countries and regions with strong small wind industries share a number of common characteristics. Countries typically employ a net metering program that is backed by a range of incentives (such as an RPS or tax incentives), loan programs, outreach initiatives, and technical support. These are summarized in tables 5-2 and 5-3.

Table 5-1 Comparison of Net-Metering Incentives in Best Practice Countries

Country/Region/ State	Limit on System Capacity	Limit on Aggregate Capacity	Net Excess Generation
California	1 MW	5% of utilities peak demand. No limit for LADWP	Credited to consumer's next bill at retail rate
Colorado	120% of customer's average annual consumption for IOU; Municipality and co-op customers 25 kW for non-residential, 10kW for residential	No	Credited to consumer's next bill at retail rate
New Jersey	Energy production does not exceed customer's annual on-site energy consumption	No	Generally credited to customer's next bill at retail rate; excess reconciled annually at avoided-cost rate

Spain	100kW for interior grid, 1 MW for national	No	No payment for oversupply, credited to next bill
Thailand	1 MW (of exported electricity)	Only for new customers (not already served by utility)	Compensated at average cost of generation, around 80% of retail rate
Uruguay	11 kW Peak energy production less than or equal to contracted power of subscriber (unless agreement obtained with utility)	Yes (11kW) - special permission can be obtained with utility	Compensated at current utility energy price

Source: Literature Review

Table 5-2 Incentives and strategies for small wind in Best Practice Countries

Country/State	Net Metering	RPS	Tax Incentives	Loans	Education/Outreach	Technological Capacity (i.e. anemometer loan, testing program)
California	X	X	X	X	X	X
Colorado	X	X	X	X	X	X
New Jersey	X	X	X	X	X	X
Spain	X	X	X	X	X	X
Thailand	X			X		X
Uruguay	X		X	X	X	X

Source: Literature Review

5.3 Considerations for Argentina

While best practices are useful for policy transfers and replication of successful programs, not all of the policies and strategies discussed in this section may be feasible for Argentina. Funding a wide range of programs and initiatives is costly and challenging for a country like Argentina in where access to capital is very limited. Implementing tax rebates, grant programs and other financial incentives may be very difficult. Based on findings from the literature review and country data on Argentina in previous sections, policies, initiatives and strategies implemented in the Argentine case would likely be characterized by:

- Minimum administrative and operational overhead
- Low financial obligation
- Strong social or economic benefit

Some of these policies and programs do not require large amounts of capital and could be likely be effectively implemented. Net metering, if designed without payment for oversupply, can be easily implemented with low financial and administrative overhead. Argentina already has an RPS program in place (GENREN, which requires 8% renewables by 2016).

Access to capital in general is very difficult in Argentina, so expanding access to low-interest loans is challenging. Existing loan programs may be difficult to extend further for small wind but could be strengthened and targeted for specific groups with the most need, such as rural

farmers without access to electricity. Expanding outreach programs and funding new efforts may be possible if benefits of small wind are communicated effectively and aligned with social and economic development goals. Strengthening existing technical support is feasible and needed in Argentina, especially related to certification and testing, but continued program funding for expansion of programs may prove to be challenging.

In sum, many of the lessons and best practices discussed in this section are applicable to the Argentine case. Policies, programs, and initiatives may need to be adapted to a more difficult funding environment, but can still be very effective tools for promoting the development of small wind in Argentina.

6 Conclusion and Recommendations

Based on the lessons summarized from stakeholder interviews, and data gathered concerning Argentina's small wind industry through studies such as INTI's Wind Platform, a number of important barriers to the small wind industry can be identified. Analysis and data in this study has also identified key policies, strategies, and other incentives to help to promote the development of small wind in Argentina.

6.1 Research Questions Revisited

This research set out to answer the following questions:

- What are the main barriers to wind energy and small wind in Argentina?
- How can Argentina best promote the development of its small wind industry?

These questions have been addressed through a wide range of academic sources including literature review and data gathering, empirical evidence from Argentina, and information from country data, industry reports, and legislation concerning small wind. Analysis in this study has developed conclusions that are summarized in the following two sections.

6.1.1 Barriers to Small Wind in Argentina

Barriers to small wind in Argentina have been identified through extensive review of INTI's barriers/SWOT analysis for the industry, primary data based on stakeholder interviews, as well as other primary and secondary sources. Principal barriers to small wind energy in Argentina are:

1. Current legislation
    a. Lack of an adequate regulatory framework that enables the possibility for connection of generation systems to existing electricity networks.
    b. Lack of net metering
2. Lack of demand
    a. Small wind systems are not yet considered an alternative energy supply in isolated areas
    b. Rural communities may not have agency to make decisions for small wind investments, and 'Big Fish' landowners who can make these decisions have little interest in spending money to improve the living conditions of workers on their farms
    c. Communities/households may be accustomed to living without electricity, with little interest in a small wind system
    d. Other alternatives readily available and economically more competitive
3. Financing
    a. Lack of financing for development of new products, as well as manufacturing of existing designs
    b. Lack of sources of capital on the client's side for purchase of the products.
    c. Difficulty of small projects to achieve economies of scale
4. Federal energy policy
    a. Federal subsides for electricity
    b. Federal subsidies for fossil fuels
5. High manufacturing costs
    a. Associated with lack of standardization for equipment
    b. Lack of providers of basic components at reasonable prices
6. Lack of institutional and technical support

   a. Need for standardized certification, testing programs
   b. Lack of adequate wind resource assessment resources
7. Lack of education or awareness
   a. Little government attempt for education and outreach
   b. Poor marketing structures
8. Geographic distances and considerations
   a. Large distances create challenges for maintenance and technical support
   b. Electricity demand is highly concentrated in a single area
9. Prior experience
   a. Poor past experiences with demonstration of products and testing of bad equipment
   b. Historical distrust with the government due to prior history of default and economic instability
10. Others
   a. Theft, vandalism

6.1.2 Promoting Small Wind in Argentina

Strategies for promoting small and distributed wind in Argentina were derived through analysis of stakeholder interviews, secondary sources such as INTI's summary of recommendations from industry, and additional information from literature review and discussion of best practices countries. Conclusions were analyzed and compared across multiple data sources. Key lessons were identified, which were then discussed and further based on feasibility and applicability in Argentina.

Through this process, key policies, strategies and initiatives have been identified. Argentina should take the following actions to promote its small wind industry:

1. Small wind legislation
   a. Work jointly with industry and government to enact a national net metering program that enables the grid interconnection of small wind systems.
      i. Develop policies on the provincial level concurrently, specifically tailored to regional conditions
   b. Investigate the possibility of a price support for small wind, and other tax/financial incentives
   c. Facilitate meetings with manufacturers and the Department of Energy to present industry viewpoints and discuss initiatives.
2. Strengthen access to finance
   a. Provide sources of capital to help investors cover up front costs
   b. Work with Argentina National Bank to open new lines of credit and strengthen existing programs
   c. Disseminate information regarding available finance to industry, investors and other stakeholders
   d. Solicit external sources of funding
3. Form an industry platform/camera
   a. Unify industry interests and create a communication platform to lobby government and strengthen industry visibility
   b. Develop a lobbying body, such as INTI's 'Complete Legal' package- made up of a group of manufacturers working with the support of INTI.
   c. Improve marketing through networking and communication strategies
   d. Create an industry newsletter/market update

    e. Develop an industry trademark/identity
4. Create university and technical partnerships
    a. Develop joint technology demonstration projects, especially in rural areas, together with industry and government institutions such as INET
    b. Hold more seminars, technical fairs, conferences
    c. Align projects with community development needs
5. Reform and gradually remove energy subsidies
    a. Continue to subsidize the electricity prices of the poorest households that would be most affected
    b. Set energy prices that consider contamination and actual costs of externalities
6. Develop common certification and facilitate regional testing in coordination with industry
7. Strengthen existing programs
    a. Strengthen and extend the reach of existing successful programs such as PERMER and INTI's Wind Platform
8. Investigate the possibility of tariffs on imported wind systems

6.2 Recommendations

Small and distributed wind can help Argentina alleviate some of its energy challenges and develop a more secure and sustainable electricity system. It can enable distributed sources of generation that relieve stress on the grid, create economic opportunity in rural areas, and help provide electricity to isolated communities. Argentina should develop its small wind industry through the following key strategies.

First, Argentina needs to address policy barriers. The government should work with industry and other stakeholders to create a regulatory framework for small wind and other renewables that allows for the interconnection and exchange of energy with the grid. One of the largest challenges is the consideration of orgware: putting into place institutional settings and rules for the generation of technological knowledge and for the use of technologies.

Regulation should be designed that views consumers of electricity as potential solutions to Argentina's energy challenges. A system of net metering, which has strong support from stakeholders within Argentina, should be enacted. Best practices and lessons from international models suggest that Argentina should create a program of net-metering without a cap on aggregate installed capacity, which limits installed systems to size of household consumption but allows for aggregated metering – meaning that consumers can pool their collective electricity demand and invest in larger, more professionally installed systems. Instead of just a household or business, a community can come together to pool investment and reach economies of scale. Ideally excess generation would be purchased at fair market (or higher) prices but simply crediting oversupply to the next billing cycle and making a yearly account is the strategy that requires the lowest cost and administrative overhead. Other financial incentives, such as tax credits on purchase of equipment or a system of bankable credits for renewables, should also accompany net-metering regulation to help producers/consumers cover investment costs. These may be more difficult to implement but can be justified if aligned with economic development goals. Energy subsidies for fossil fuels should be gradually removed so renewables can have a chance to become competitive, subsidizing the electricity prices of the poorest households that would be most affected.

Argentina's small wind industry should organize itself into an association, potentially the Argentina Small Wind Energy Association (AAEEBP), backed by the support of INTI and

regional associations such as the CADER and AAEE. This would allow for more effective lobbying, communication, visibility, and exchange of information and best practices within the industry. This would also allow industry to align common goals and prioritize areas for capacity building, as well as technical and legislative activities. The association should create a newsletter to provide market updates, share best practices, and strengthen intra-industry cohesion.

The Argentine government should work to standardize certification for small wind, and strengthen testing programs such as INTI's wind platform. Partnerships should be formed with industry, which allows industry opportunity for visibility and market exposure, and also helps keep program costs down. The government should also strengthen existing wind assessments at regional and local levels, and facilitate programs to lend wind assessment equipment such as anemometers to enable small wind projects, which will help lower capital investment costs for technology. Technological information should be disseminated through publicly available sources. Successful existing programs, such as INTI and PERMER, should be strengthened on the grounds that they promote industrial development and rural economic development. Social development programs and government/NGO outreach should focus attention on large rural landowners to raise awareness of the social and economic implications of poor living standards on their farms. Small wind projects, where feasible, can be aligned with development goals and play a part in improving rural living conditions.

The government should also strengthen access to financing for small wind projects, and provide capital/low interest loans for individual investors to cover up front costs. Project goals should be aligned with community needs and larger social and economic development goals in order to help justify funding. The Argentine National Bank should open new lines of credit and strengthen existing programs, and attempt to solicit additional external funding from international energy and environmental funds. Efforts should also be made to disseminate information to industry, investors, and other stakeholders about available sources of credit and existing incentives for small wind projects.

University and technical programs and partnerships for small wind, involving industry as much as possible, should be strengthened and expanded. Industry and government should place more effort on outreach within universities and the general public, to educate about the benefits of small wind and other renewables. Technical support should also be provided to enable users and potential users to become more familiar with small wind systems and related technological and maintenance considerations.

Argentina is a country blessed with natural resources, an innovative and technically capable population, and a strong sense of independence and nationalism. Development of a small wind industry in Argentina allows the country to put all of these qualities to use and move towards a more sustainable future.

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Appendix

Interview Questions

For individual investors:

Why do/did you want to invest in a small wind system?

(Potential follow-up questions: was the motivation environmental, economic, or other?)

What are/were the biggest challenges to your project?

(Potential follow-up questions: was the largest challenge technical, administrative, financial, geographic, time?)

What is/would have been required to speed up your small-wind project?

What, if any, assistance would you have liked/do you need with the project?

[If the project has already been installed]

Are you happy with your investment? Are the benefits as you expected? Are there remaining challenges?

For industry, Gov., NGO viewpoints:

What are the biggest barriers to small wind in Argentina?

What do you think is needed to accelerate or promote small wind energy in Argentina?