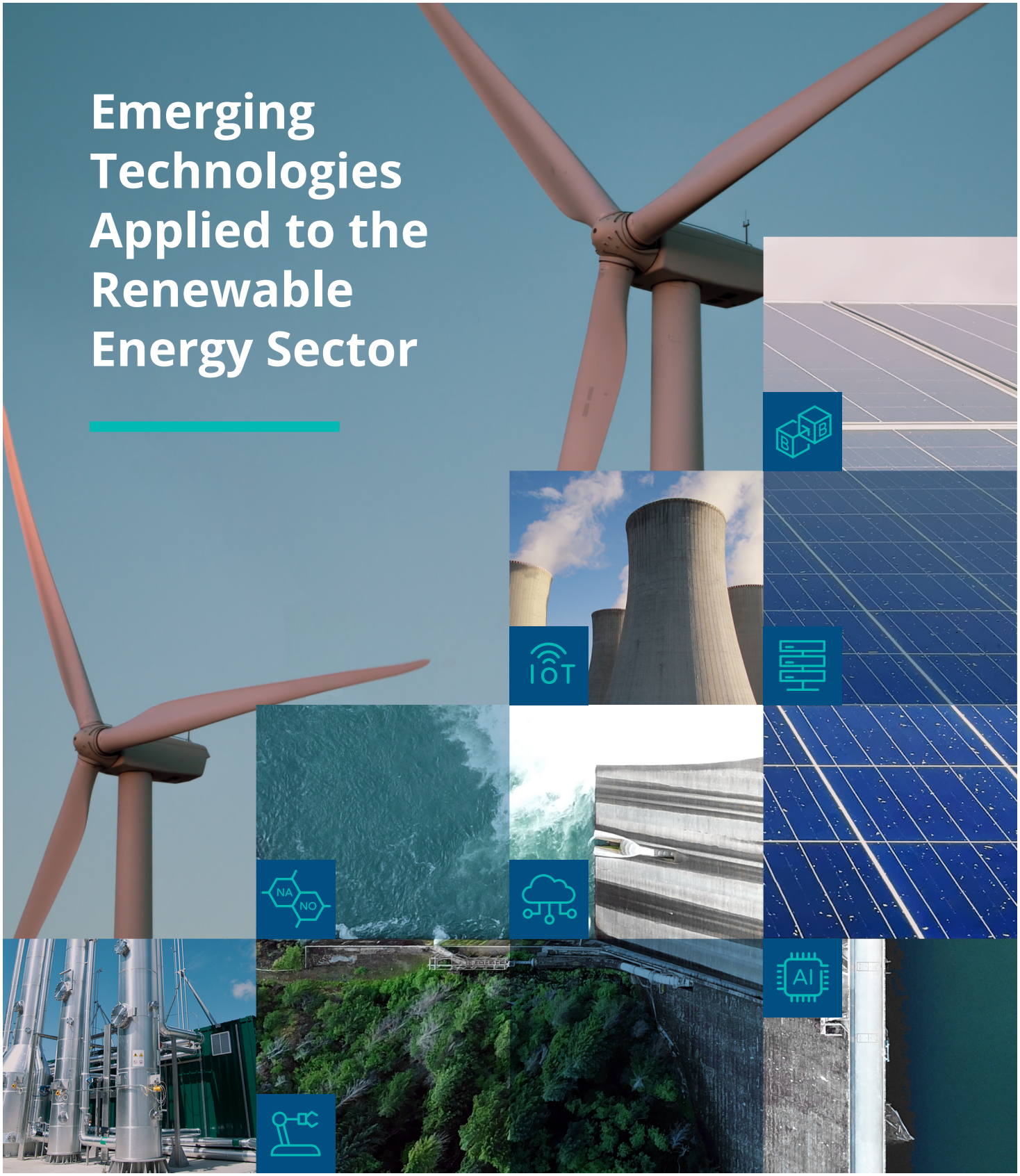
KONRAD ADENAUER STIFTUNG

Emerging Technologies Applied to the Renewable Energy Sector



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Foreword FGV IIU

Dear Readers,

Once again, FGV IIU and KAS EKLA join forces to identify the scope and uses of new technologies in the climate debate.

International intelligence, for us, includes the probing and investigation of the shape of approaches and solutions that may become relevant for tackling global problems.

Early awareness of those may prepare more adequately communities and specific groups, which can either benefit from or become actors of the prospective changes and developments.

This joint project, apparently simple, innovates in methodology and in its hands on way to tackle an indeed complex theme.

It is hoped that the present report, besides its own conclusions and impact, will stimulate similar pursuits, extremely needed to add a modern, or rather future dimension to the way we deal with the climate issue.

We thank the collaboration and efforts of all who gladly contributed to this final output, especially those who participated in the workshop and provided us with valuable inputs.

Renato G. Flôres Jr
Director of FGV IIU - International Intelligence Unit

Foreword EKLA-KAS

The Konrad-Adenauer-Stiftung (KAS) is a political foundation. In Germany, 16 regional offices and 2 convention centers offer a wide variety of civic education conferences and events. Our offices abroad are in charge of more than 200 projects in more than 120 countries. At home and abroad, our civic education programs aim to promote freedom, peace and justice. We focus on the consolidation of democracy, the unification of Europe and the strengthening of transatlantic relations, as well as development cooperation.

For KAS, energy security and climate change have become important pieces for the structure and maintenance of a democratic social order. In view of this, our Regional Program "Energy Security and Climate Change in Latin America" (EKLA) has been designed as a platform for dialogue, in order to give impetus to the political decision-making processes on these issues.

According to our values, the present study is the result of our Project "Emerging Technologies Applied to the Renewable Energy Sector", based on a workshop held in July 2019, in Rio de Janeiro, plus online research and interviews, developed in cooperation with the International Intelligence Unit of the Fundação Getulio Vargas (FGV IIU). The workshop gathered experts from the energy sector, development banks and start-ups as well as technology experts. During the workshop, we discussed developing solutions, challenges and benefits of emerging technologies, with a special focus on Blockchain technology applied to the renewable energy. Among these major techs, it is important to highlight some of the most popular emerging technologies as Blockchain; Artificial Intelligence & Internet of Things.

The collection of those initiatives is central for the development of the project methodology and with this publication, we aim to present a summary of our research and debate and offer policy proposals. Not at least, with the solutions that have been developed by the startups in this publication, we identify indicators that are able to measure the level of replicability and adaptability for other actors.

We hope this report meets its objective of strengthening the collaboration between local governments and entrepreneurs for better climate action. We would also like to thank everyone involved in this study and wish you all a pleasant reading.

Nicole Stopfer
Director of EKLA-KAS

Research members and collaborators gathered at the workshop

Emerging Technologies Applied to the Renewable Energy Sector

1 Introduction

Climate Change is considered one of the most important global threats of our time. In order to mitigate it from advancing and adapt to its impacts, both the international community and states have been engaging in a number of initiatives to limit the climate effects. A common criticism observed in this process is that, despite the wide reach of the Climate Change, the action is very much state centered. Other actors, so far, have only marginally committed. That happens for a myriad of reasons, and here we shall focus on small and medium municipalities.

Small and medium municipalities also are, generally, less committed to engage in climate action for several reasons, but we believe that two of them should be highlighted: Resources Constraints and Knowledge Gap.

Most small and medium municipalities have to live with budgetary restrictions. Even though many times they are heavily impacted by extreme climate events, such as droughts, desertification, floods, etc., they usually focus on adapting their infrastructure to resist such events. Due to their financial restrains, many times they have difficulty also to invest in mitigation initiatives.

The Knowledge Gap reason refers to the lack of information that decision makers, from those small and medium municipalities, have on the new solutions to address a given issue. For being distant from major centers, smaller municipalities are usually unaware of the disruptive advances - in our case here – provoked by dynamic startups working with emerging technologies.

In that sense, this project aimed to identify a number of initiatives on the renewable energy sector that use emerging technologies to enhance their efficiency and scalability. The mapped initiatives should have relative small or medium size, in order to allow themselves to be replicated or adapted in other contexts, especially small localities/cities.

Once the mapping was done, we realized that not every solution was very flexible or could be used in many different contexts. Therefore, the project tried to develop a methodology that would allow us to measure the level of "replicability" that a given initiative would have. By that, we mean how adaptable to other contexts such initiative is.

In the process of developing a methodology, our efforts have involved distinct activities, such as bibliographic reviews, interviews, a workshop, among others. The workshop was convened by Fundação Getulio Vargas' International Inteligence Unit in partnership with Konrad Adenauer Foundation through it's Regional Programme Energy Security and Climate Change in Latin America (KAS-EKLA) and it aimed to design the project's methodology through debates centered in challenges faced by energy startups and governments. It helped the research team to develope indicators, elements, criterias and other features explored by this work.

For having a disruptive nature, startups that try to operate in the energy sector often faces additional challenges, since the energy sector is considered to be very traditional and requires one a high level of knowledge to operate in it. In addition, amidst the industry particularities, there is a need of high upfront investments, which escalates even more with the introduction of clean cutting-edge technologies. As startups have very dynamic models and must react quickly to the market, the lack of considerable amounts of funding can be especially problematic to an innovative idea with great potential in the energy sector. Until now, it seems that the model adopted by most startup-oriented energy investment funds rarely follows the logic that would be most appropriate in this case.

There are only few specific calls for startups that develop services and/or products in the energy segment. Most research and development programs are implemented through governmental agencies.

Acceleration Programs Examples

The **Programa Centelha** funds innovative projects offering more than forty thousand reais per project. The Brazilian iniciative has national character, having representatives of the Ministry of Science, Technology, Innovations and Communications, Finep, CERTI Foundation, Confap, as well as representatives of various state funding institutions.

Start-Up Chile (SUP) is the leading accelerator in Latin America, developed by the Chilean government to upgrade high potential entrepreneurs to launch their startups. The **From Chile to the World** is the seed capital acceleration program aimed at companies with a functional product and an early validation of six months experience. Funds up to $50,000,000 CLP.

The Argentinian "Secretaria de Emprendedores y Pymes" manages the "**Fondo Aceleración**" to foster the development of high-impact technological, social and scientific enterprises. The program provides 'matching' funds for those startups that are accepted in the program of a group of ten accelerators selected by the Fondo Aceleración program. For the technological and/or social ventures, if the accelerator's investment surpasses US$ 25,000, the Fondo Aceleración will match the contributions, with a limit of up to US$ 50,000.

The Brazilian **Petrobras Conexões para Inovação** Program is mainly about enabling the insertion of small businesses and startups in the development of solutions to overcome technological challenges in the oil and gas area. In this first annoucement, which will be in January 2020, the forecast is that ten projects will be awarded with resources that vary, on average, between R$ 500 thousand and R$ 1.5 million.

This Report is divided in five sections. The first section introduces a number of elements that oriented the rationale used to develop this project, such as the centrality of the energy sector, the importance of the replicability character from mitigation initiatives and the role of the emerging technologies. The second section concentrates the startups world; here, we tried to introduce a number of elements necessary to understand what it is and how to evaluate it. The third section refers to the methodology designed by this project in order to help us to evaluate the level of robustness and replicability a given startup has. The fourth section presents the profile of several promising startups analyzed through the lens of our methodology. Those startups were selected from a comprehensive survey, conducted by the research team, with startups from Argentina, Brazil, Chile and Mexico. All information used to assess the startups profile was provided directly by them through an online form developed for those selected startups, conducted as a follow up step in the aforementioned survey. In the fifth and final section, we had presented some recommendations drawn from the research conclusions.

Photo by Pawel Nolbert on Unsplash

Energy as a Protagonist

The international flows of capital aimed to fund climate initiatives have recently gained a lot of attention and have been at the center of the climate change debate.

Related to this, is the massive volume of resources and its multiple financing channels, which have posed an enormous challenge in managing and guaranteeing the efficiency of the funding.

The levels of spending in climate finance have been steadily increasing in the last few years, although it was possible to identify a significant decrease from the 2015 to the 2016 levels. In 2015, a record high was achieved in terms of climate finance flows, reaching US$ 437 billion dollars. This surge was largely driven by private investments, according to the Global Landscape of Climate Finance 2017.

Mitigation efforts have been receiving the lion's share of the climate investment. In the 2015-2016 period, it accounted for nearly 93% of the total investment. From the volume directed to mitigation activities, the largest beneficiary was the renewable energy sector, having received 74% in the same period. This was a considerable increase, if compared to the last few years. This increase was propelled by heavy investments from United States, Japan and especially China, who was responsible for a surge in investment on its generational renewable capacity (Buchner, Oliver, Wang, Carswell, Meattle, Mazza, 2017).

Photo by Nasa on Unsplash

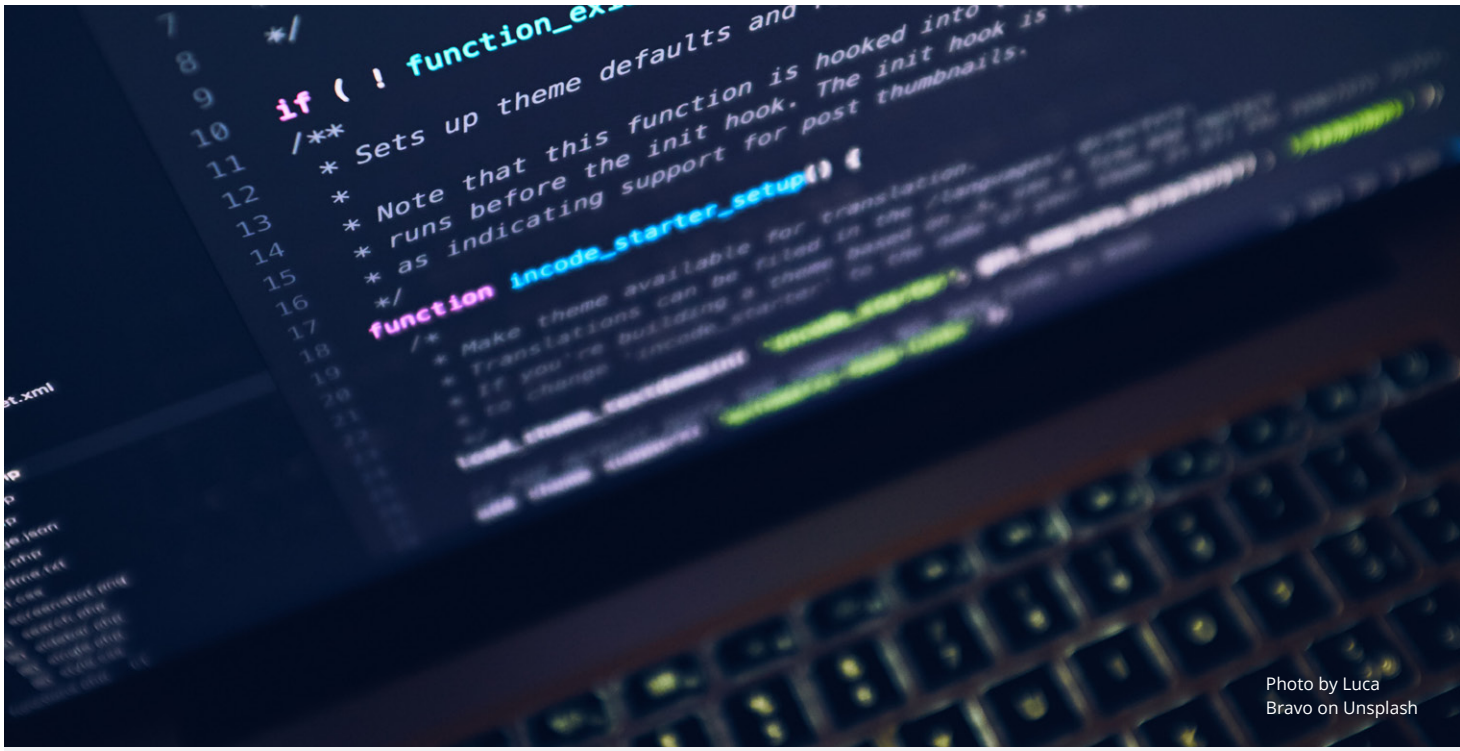
Replicability and Adaptability

Emerging technologies have been gaining ground as drivers of growth and progress. In this sense, development solutions have the potential to improve the competitiveness of the regions, reduce asymmetries between and within countries and help in tackling some protracted developmental challenges.

Within the development objectives to be achieved, the promotion of integration, understood in its broad sense (economic, institutional, functional and commercial integration), is instrumental and may happen by the consolidation of mutual assistance through cooperation and collaboration between countries and subnational actors.

The collective generation and transmission of knowledge through different instruments in the context of the South-South cooperation promotes innovation and the development of new collective solutions and dissemination of good practices and lessons. A large number of projects have the potential to replicate ideas from another country or municipality. In this way, the exchange of experiences within the framework of a given program is carried out through formal and informal channels that link the actors, developing good practices to potential recipients - hence the objective of our workshop, the exchange between participants with different backgrounds, fostering their cooperation.

Identifying and fostering replicable good practices constitute a powerful and flexible initiative that, through cooperation, different actors can obtain greater development benefits than if they operate on their own or produce these benefits at lower cost. This efficiency gain has been the emphasis of several programs from developmental banks such as the “Bienes Publicos Regionales” from the Inter-American Development Bank.



Emerging Technologies

While the bulk of the "startup economy" is drawing more attention, some areas have been growing more than the average. This is the case of the emerging technologies sector, which has outpacing the others.

To illustrate this point, currently nearly half (45%) of the new startups are from emerging technology-related sub-sectors. Their growth is remarkable not only in terms of volume but also speed, since this number corresponds to a 100% increase if compared to the year 2010 (Global Startup Ecosystem Report, 2019).

When we look at the emerging technologies sub-sector investment growth level, it is possible to identify the four best performing technologies, according to the 2019 Global Startup Ecosystem Report:

1. Advanced and Robotic Manufacturing (107.9%)

2. Blockchain (101.5%)

3. Agtech and New Foods (88.8%)

4. Artificial intelligence, Big Data and Analytics (64.5%)

In search for comparative gains in scale and efficiency, some of the emerging technologies have been changing the landscape of the energy sector, especially when it comes to renewable sources. Those technologies have enabled new approaches and solutions to old issues and constraints, which positioned them as real pivots in this scenario. In this sense, it is understood the importance of clean technologies, which consist of innovations capable of reducing the negative impacts on the environment through an increase in energy efficiency, productivity gains and costs and waste reduction in a sustainable performance. As CB Insights' The State of Tech Investment by the Fortune 500 (2017) report puts it, non-tech companies are losing market value to giant tech companies, while compared to startups with a strong technology base, the discussion gets even more complex.[1]

1. Lost of market value by non-tech companies to technology giants: example chart available at page 15 of the refered CB Insights' State of Tech Investment by The Fortune 500 (2017).

For the present report purposes, we highlighted some of the most popular technologies that have been powering solutions developed by tech startups:

Artificial Intelligence

Startups that develop and/or apply solutions that use cognitive computing on data and information in order to identify and process patterns, images, speech recognition, movements, languages, conversations, among others. In a broader concept, they are codifications that allow specific tasks to be completed in a "smart" way, or as a human brain would do it. A hot branch of A.I. is Machine Learning, that consists in the application of this technology to accomplish any kind of job (not only predetermined ones) as systems and devices can learn for themselves from nearly everything.

Big Data and Analytics

As its name implies, big data is a large set of data from different sources (and, therefore, non-standardized and with a wide variety of types) that are generated, collected and processed very rapidly. Usually, a term used to refer to this technology is "3Vs": Volume, Variety, and Velocity. Companies and startups in general commonly combine big data with Machine Learning projects, predictive modeling and other advanced analytics applications, in order to own and manage massive databases in a highly efficient and targeted manner. In this sense, such technology allows customizations and quick decisions that improve the service provided to each client.

Robotics

It consists of complex machines that can be used to perform a number of jobs. Many startups use this technology in activities that would be too dangerous, unhealthy, highly standardized or even boring for human workers. A common application in the renewable energy sector is the use of robotic equipment for solar plate cleaning at predetermined time intervals, so the dust and waste removed from the plate surface allows greater sunlight absorption and increases significantly its energy production capacity.

Blockchain

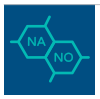
Platforms and solutions that develop and apply Blockchain as protocol technology for trust, security, certification and validation of transactions or process completion, as well as cryptocurrencies.

Cloud Computing

This technology enables easy access and storage of data on demand from computer system resources without the need of an active user management. Put simply, these are "spaces" with capacity to hold data, allowing applications and services to be accessed from anywhere (as long as there is internet), without the user having to know about this mechanism.

Internet of Things

Internet of Things can be understood as the technology capable of connecting electronic devices to each other and/or to the internet. Virtually everything that goes on and off can be included in the logic of IoT, such as refrigerators, cell phones, computers, cars, turbines, lighting and cooling systems, and more. The great innovation of this technology is that it allows devices with different settings and encodings - that is, that doesn't have a common language - to communicate effectively, at distance and wireless to each other. For example, some startups in the energy sector use sensors in an IoT system to prevent power waste.



Nanotechnology

Comprises the manipulation of matter at the nanoscale, that is, atomic and nuclear. It allows the construction of new liquid, solid and gas materials and components in a wide range of research areas, generally aimed at improving natural or existing structures.

It is important to note that technologies rarely act in isolation - their functionalities intersect and complement each other in many ways, allowing a wide range of combinations and possibilities of action.

Emerging Technologies Applied to the Renewable Energy Sector

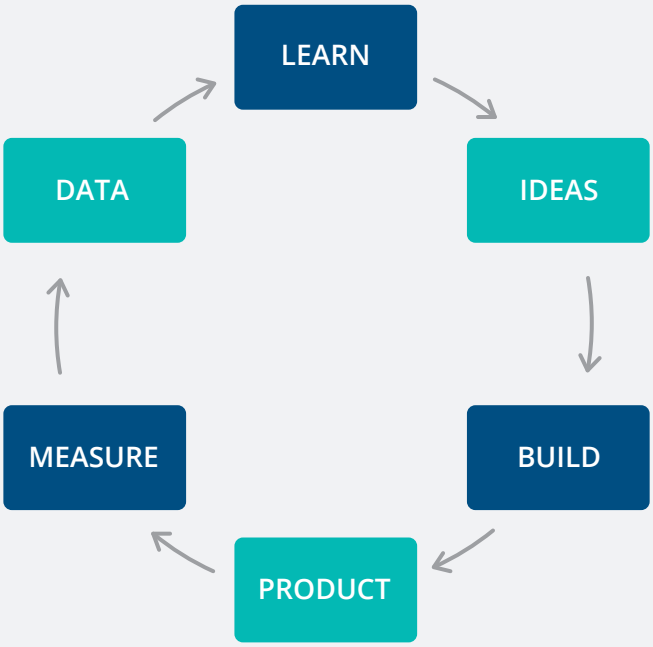
Startups Overview

When it comes to the modern business world, some recurring questions that emerge are about the concept and nature of startups. After all, what is a startup? What makes it different from a regular company? When does it no longer have this specific status?

Thinking about this matter, Steve Blank (2012), a Silicon Valley entrepreneur, concluded that a startup is an organization that aims to find a scalable business model, adopting a structured work process and being able to quickly test hypotheses in order to rapidly correct its routes when necessary. In this dynamic process, the startup turns its initial assumptions into facts, whether confirming or discarding these assumptions through the feedback received from customers during the earliest stages of development. A startup should always be based on solid data and its business model must have a high ability in adapting itself so that, when developed, it can be easily replicated and scalable (BLANK; DORF, 2012).

The whole process is fluid and should not be understood as linear, but in a circular logic instead, which could be better understood through the concept of Plan-Do-Check-Act (PDCA) that works under a continuous feedback loop. In this configuration, all planning generates an execution process, which in turn generates a measurement activity, and then it generates new initiatives that will once more be built and implemented, feeding the operation of this system. It is important to have in mind that every interaction with customers and suppliers provides qualitative and quantitative data that must be measured and incorporated into the learning process of the startup. These new ideas will define the construction of a new experiment to be carried out, which generates more data and learning, in a continuous cycle, as in the diagram below:

Figure 1. Build-Measure-Learn Feedback Loop



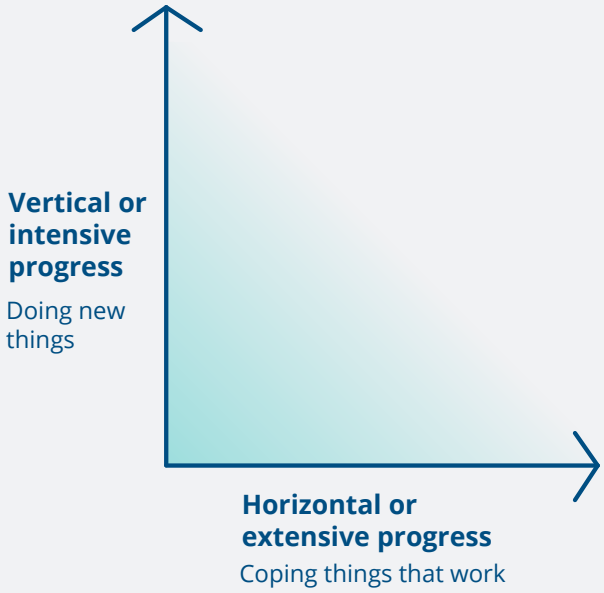
Source: RIES, 2011

Peter Thiel (2014), on the other hand, disregards the constant learning logic of a startup as proposed by Blank and Dorf, and focuses on another approach. For Thiel, the essential matter in a startup development is that innovation can be enough to create a monopoly. Thus, other factors are given more importance in a startup's development operation, like the idea that they should proceed, from the beginning, by a group of people with skills that allow them to create something new. However, it is worth noticing that this group should not be too large or have bureaucracies in its own hierarchical structure, since it is critical to be able to make quick decisions in this environment.

A startup development

In Thiel's book, "From Zero to One", he focuses on two different courses of action a given project should take aiming to pave the way for its business progress: the first is the Horizontal or Extensive Progress, which relies on the replication of existing ideas that already work. This process could be represented by the scale 1 to "n". On the other hand, there is the Vertical or Intensive Process, which relies on innovating and developing new ideas that could be represented by the scale 0 to 1. This latter strategy is particularly more challenging than the first one, since it works with the creation of original concepts, that is, that were never tested before.

Figure 2. Vertical and Horizontal Progress



Source: Thiel & Masters (2014)

As mentioned earlier, Thiel relates the success of startups to the creation of a monopoly, stating that a business has its success measured by its differentiation - by its ability to do something that others have not or cannot. Thus, we conclude that the possibility of creating a "monopoly" relies on unique solutions to unique problems, and this relationship is fundamental to the outcome of a successful business.

To a better understanding of what Thiel says about this process, we can look at companies like Tesla, Google, and Uber, as all these startups, in addition to creating value for the customer, have become synonymous with the services they provide. The fact here is that all of them have managed, at one point, to create semi-monopolies in the areas they operate.

The Customer Development Model

An important element observed by Blank is the application of the Customer Development Model by startups. This process has four steps that indicate all activities related to the customer and is divided in two sections: Search and Execution (BLANK; DORF, 2012):

i. The Costumer Discovery

Starts from the emergence of the initial business idea, going to the business model hypoteses formulation and the thinking of how these hypotheses can be tested by customers. The Customer Discovery can be divided into two phases: The first will test customer perception of the problem to be solved and the customer's need to solve it. The second phase happens when the product or service is a prototype or on a Minimum Viable Product (MVP) form and is first presented to the customer. This process of confirming the importance of the problem and the proposed customer solution marks the end of this step. (BLANK; DORF, 2012).

ii. Customer Validation

Testing and measurement of consumer reactions – consists on the actual confirming or discarding the formulated hypotheses. This step is characterized by business model testing: product, price and margins will be tested to check if it is validated by the customer, meaning that the model is replicable and scalable from the Customer Discovery step. In the case of validation, the business model should go on. If not, it must be reformulated (iterated).

It is noteworthy that Blank's stage model is very important when distinguishing a startup at a more advanced stage of development. Therefore, we can say that a startup begins to create value by reducing its uncertainties with its customers and suppliers. On the first two steps observed above, we went through the Search elements of the Customer Development Model: design the business, identify the customer, analyze the partner network and refine the product or service. Having the business idea validated, we move to the next two steps related to the Execution part of the Model:

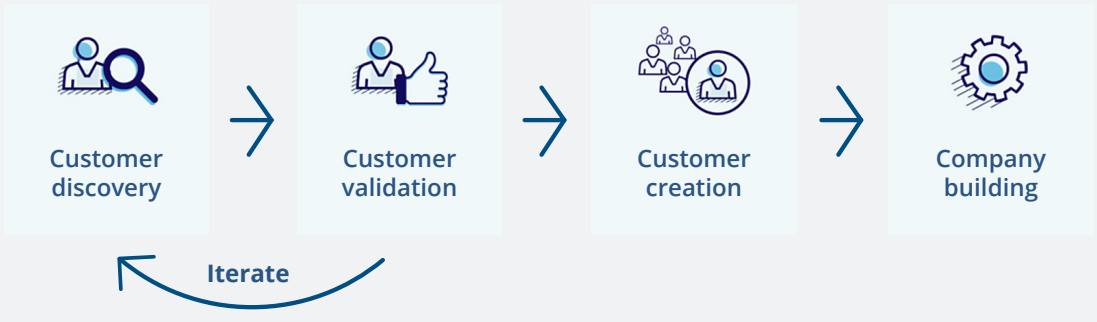
iii. Customer Definition

It is here that the startup will invest to create user demand and direct them to sales channels, which means greater investments in marketing and communication. The approach strategies will vary according to the nature of the market, whether it is well defined, whether it is a new demand created by the startup, or whether it is a specific niche between the two.

iv. Company-Building

At this stage, the business is already operating, with its model already tested and validated. During this period, the startup should begin to structure itself, creating its culture, training methods, product and process management, implementing KPIs and formalizing its operating standards. The IPO or purchase by a larger company usually occurs at this stage (BLANK; DORF, 2012).

Figure 3. The Customer Development Model



Source: https://producttribe.com/product-management/customer-development-guide; based on The Four Steps to the Epiphany, by Steven G. Blank

Startup investments

To better evaluate a startup and its conditions of prosperity, it is also necessary to understand how investments are or should be made. Within this framework, it is common for a successful startup to go through the following steps: angel investor, seed capital, venture capital funds, private equity funds and initial public offering (IPO).

Angel Investors are individuals who are interested in investing in young, high-risk companies, that is, generally without a product or service ready and geared toward initial product development and marketing efforts. They act individually or in small groups and most are experienced professionals. A striking feature is that they have a less complex investment strategy, often without very deep analysis of the business.

Seed Capital Investors set the first tier of investment above angel investors and typically their strategy is to set up funds with multiple sources of investment and apply them to a larger number of early-stage companies (already with product and customers defined) to increase their chances of return.

The Venture Capital Fund is usually a modality of private equity fund that usually focus on high risk investments and high return potential, such as startups. It is also common for these funds to be very active in the daily lives of these companies, putting experienced executives in various areas to advise entrepreneurs and sharing resources and contacts with them.

The Private Equity Fund is a kind of financial intermediary that raises cash to invest in a portfolio of companies seeking financing. These companies are usually privately held, or are publicly traded companies that have some restrictions on the sale of their shares, and provide a minority (or sometimes majority) equity interest in return for such investment. Note that these funds often have an influence on the business and operations of the company that received the investment.

An Initial Public Offering (IPO) is the first capital opening of a company, in which it will be distributing shares on a stock exchange, allowing shareholders to acquire significant shares of the company. This "opening" means giving up part of the property, privacy of information and even control over the company, in return for the possibility of absorbing large amounts of investment capable of financing a large expansion.

Classic Valuation Methods

Valuation methods are normally used and taken as references by investors who aim to acquire equity interests in mature companies, and they form the basis for startup valuation methods.

Measuring the value of an asset is always the 'search', in an objective manner, for the "real" value of something. However, it is essential to be clear that the views under which this measurement occurs is always endowed with subjectivity and biased at some level, which may alter the valuation in different directions, depending on the assumptions that underlie such analysis. To better illustrate this process, Damodaran (2015) developed a valuation approach as the following:

INTRINSIC: Assesses the cash flow generation capacity of an asset (discounted cash flow methods). This method is able to bring the present value of the company's ability to generate wealth in the future at a discount rate called Weighted Average Cost of Capital (WACC).

RELATIVE: This technique will always estimate the value of an asset by comparing it with similar ones, through a common variable such as net income, cash flow, EBITDA, revenue, among others. It is very useful due to it is capacity of presenting values close to the market value of similar companies. However, it may not be the closest value to what the business is really worth.

Emerging Technologies Applied to the Renewable Energy Sector

A New Startup Assessment Proposal

After understanding how a startup works, how it generates value and can be evaluated, we intend to propose a new startup classification methodology in order to assist both startups and decision makers in identifying fragilities and strengths of their solutions.

It was designed aiming to aid us to identify the level of replicability and resilience of startups and to help decision makers to develop their plans, strategies and decide whether or not rely on a given startup solution.

There are currently hundreds startups linked to the energy sector in the world and, by the nature of this market, they have a distinctly different profile when comparing to 'traditional' digital startups. Amidst the major energy startups particularities we highlight: i. they often have greater need of capital expenditure for investments in their early stages; ii. they usually require "patient and smart" money; iii. they need the possibility of rapid and constant expansion of their products and services to became viable; and iv. they operate in a highly regulated environment.

Due to the complexity of the sector, we seek to develop a methodology that can minimally analyze the replicability potential of a startup. Yet, beyond the capacity of measuring the replicability of a given startup in the energy segment, this methodology also intend to aid policy and decision makers to identify what they can do to help those startups to better operate and deliver their solutions in a reliable and efficient manner.

For instance, a municipality could use this methodology to classify a startup that presents an interesting solution for an important problem. If the startup ranks scores badly, the municipality decision makers will be able to identify where this startup failed to achieve a good rank and decide if they are able and/or willing to create better conditions to this startup to operate.

That means that, sometimes, it is possible that a startup might have a great solution and present a very good institutional, financial and business plan maturity, but it scores badly because there is a particular law that prohibit its operation and/or regulations that prevents it to apply to the procurement process. In that sense, the policy makers will be able to decide whether they should, or not, propose a change in the law and/or regulations to lift possible restrictions, allowing not only that potential startup to operate, but also enable other innovative business to thrive.

The methodology analysis presents multivariable data, and is represented in a Radar Diagram.

The goal is to provide a comparative portrait of a given startup and allow the comparison and analysis of multiple cases. The Methodology works with nine indicators: i. MVP Value; ii. Startup Stage; iii. Financial Maturity; iv. Business Plan; v. Regulatory Barrier; vi. Capital Requirement; vii. Technologies Adoption; viii. Financial Barrier; and ix. Entry Barriers.

Those indicators cover a wide array of features and possible contexts in which startups are involved. To try to have a comprehensive perspective, we combine endogenous elements, those that depend uniquely on the startups (such as the number of methodologies used to build the Business Plan) and exogenous elements, those that the startup does not control (such as legislation and regulations). Conscious that several variables will differ their impact on different contexts, we also adopted a mixed approach in including qualitative and quantitative variables to try to capture this rich and diverse scenario.

Each indicator have 5 levels. To determine the score of each indicator, one must refer to the levels described. That means, each level refers to a point, for example: an answer that refers to the level 1 equals to 1 point and the level 3 equals to 3 points. Once those points are inserted in the formula, the final score would help us to identify, not only the level of replicability of a given startup, but also assist us to better identify where startups could improve and municipalities may aid.

To reach a final score, we developed a formula that considers the score from all indicators. The formula was designed dividing the equation into three members. The first member refers to the financial related indicators, the second to the solution/product related indicators and the third member is related to the institutional indicators. Since the main focus of the project is to try to measure the degree of replicability of a given startup, each member has a "barrier indicator" that has a multiplier effect.

Formula

[(Financial Maturity + Capital Requirement) x Financial Barrier] + [(Technologies Adoption + MVP Value) x Entry Barrier] + [(Startup Stage + Business Plan) x Regulatory Barrier]

Simplified Formula

[(FM + CR) x FB] + [(TA+MVP) x EB] + [(SS+BP) x RB]

Once a final score is reached, we will be able to refer it to a "Reference Chart" that will help us to locate the general level of strength and replicability a given startup has. The final score of a given startup can range from 6 to 150. The "Reference Chart" is divided in five intervals and uses both a traditional metric to rank startups states of development and the level of replicability of the startup product. The Reference Chart does not have a linear progession. Rather, it focuses more on the startup ability on dealing with its barriers.

6 to 30	31 to 54	55 to 87	88 to 120	121 to 150
Discovery	**Validation**	**Consolidation**	**Efficiency**	**Scale**
Difficult Replicability	Eventual Replicability	Good Replicability	Very Good Replicability	High Replicability

To complement the analysis, this methodology also gives us the opportunity to do a Risk Assessment of the startups. From the indicators developed, some of them have a "negative character", in the sense that they try to measure barriers and obstacles to the startup solution. Those are: Regulatory Barrier; Capital Requirement; Financial Barrier; and Entry Barrier.

The Risk Assessment would then single out four "negative" indicators and create a second score only based in those indicators. The final score of the Risk Assessment will range from -1 to 0, where -0,8 refers to the higher risk possible and 0 to the lowest risk possible.

Risk Assessment Formula

[(Regulatory Barrier + Capital Requirement + Financial Barrier + Entry Barrier) / 20] -1

Simplified Risk Assessment Formula

[(RB + CR + FB + EB) / 20] - 1

* Further details on the methodology will be addressed in forthcomming article by Renato G. Flôres and Leonardo Paz Neves.

Indicators

1. Minimum Viable Product Value (MVP)

MVP is an important indicator commonly used to assess startups on their early stages. It aims to identify what is the minimum amount of resources needed to make viable a given product. This indicator could be used to evaluate the risks from new enterprises. It is also commonly used by startups to test and gather information from a less complete version of the product, since adding features also increase costs and risks in the event of the product fails. Startups with low MVP are more flexible and may conduct more tests to improve its final product.

2. Startup Stage (SS)

The level of maturity of the startup helps to mitigate the risks associated to the viability of its project. The earlier the stage a given startup is located, the bigger and more numerous are the obstacles that its solution face. In that sense, the later the stage a given startup is, the more tested and robust its solution should be, therefore it would probably have a more reliable solution.

3. Financial Maturity (FM)

The financial maturity of startups is directly linked to their "advancement" in terms of funding stages, which directly determine their ability to expand their business. With an adequate volume of resources, the startup will be able to expand not only in the sense of its market share but also toward further investments to enhance its products/solutions, acquiring technology and strengthen its team.

4. Business Plan (BP)

It is fairly common to have new startups beginning their business with nothing but a good idea. As we try to indicate in this report, there are a number of obstacles that requires a more professional approach to transform a good idea into a good business. Building a robust business plan is considered a pivotal condition not only to give the startup a "chart" to navigate more securely, but also to better communicate its project to investors and clients. There are several business model design methodologies, and we listed some of the most consolidated ones. Startups often evaluate their model based on more than one methodology, therefore here we correlate the number of methodologies used with the strength of the business model. The methodologies are: i. Customer Development; ii. Customer Discovery; iii. Business Model Canvas; iv. Target Market; v. MVP; or others.

LEVEL 1	1 Methodology
LEVEL 2	2 Methodologies
LEVEL 3	3 Methodologies
LEVEL 4	4 Methodologies
LEVEL 5	5 or more Methodologies

5. Regulatory Barriers (RB)

Regulatory barriers are a paramount obstacle to any enterprise, and this is particularly more acute in the case of startups for several reasons. First, because startups frequently are offering innovative solutions, solutions that were not foreseen by laws and regulations. Second, in the case of the startups segment that this research has mapped, those solutions rely on the use of emerging technologies, which also were not regulated and often are opposed by traditional business that are concerned with the impact those technologies might provoke in their business. Third, given their particularities (their dynamics of operations and need of rapid expansion), startups frequently are not able to compete in public procurement processes because of the traditional requirements of participation and the considerable length of the whole process. In that fashion, we measure here the conformity that a given solution has with laws and regulations to determine their ability to operate and the possible risks this solution might incur.

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5
The solution requires change in the legislation in one or more levels (municipal, state, federal)	The solution requires change in legislation in a municipal level	The solution requires change in non-legislative regulation	The solution is built upon the existing law, but requires governmental licenses to operate	Do not require any conformity with the law or non-legislative regulation

6. Capital Requirement (CR)

Capital Requirement is directly related with the amount of resources that a given startup needs to operate. This indicator aims to include the traditional Capital Expenditure (CAPEX), which tries to measure the amount of resources a startup would need to cover acquisition and investments, in its diverse forms. This particular indicator also includes a second traditional concept, the Operating Expenses (OPEX), which covers the everyday operational costs. Since many startups, especially in their early stages find it difficult to separate those two concepts, we believe it is useful to create a category that includes both, so we could have a better overview of the annual capital requirement a given startup demands.

* Values in thousand dollars

7. Technological Adoption (TA)

Based on the previous discussion on emerging technologies, this report works under the assumption that the adoption of disruptive technologies is an important aspect when we asses a startup. In one hand, startups working with emerging technologies are growing more and faster than the average, in the other hand they are gaining more attention and that performance have being "opening doors" to Venture Capitalists and other private funds and are leading to specific public programs designed to them. In that fashion, the report is considering that the number of emerging technologies adopted will not only (possibly) lead to more complex products, but also will attract more attention from supporters and clients. Since there are many different technologies and even more combinations, the report will adopt a quantitative approach to this indicator. Technologies: i. Artificial Intelligence; ii. Big Data; iii. Blockchain; iv. Cloud Computing; v. Internet of Things; vi. Nano Technology; vii. Robotics or others.

LEVEL 1	1 Technology
LEVEL 2	2 Technologies
LEVEL 3	3 Technologies
LEVEL 4	4 Technologies
LEVEL 5	5 or more Technologies

8. Financial Barriers (FB)

Financial barriers are a common obstacle for startups in general, since many of them are still seen with skepticism. This barrier is particularly challenging when it comes to startups that focus on the energy sector. Differently from most startups, the ones from the energy segment generally require a higher capital expenditure (CAPEX) to invest and acquire prototypes and equipments. The need of more resources to implement a given project generates more obstacles to capture external funds, especially because most public funds allocate only a moderate amount of resources in its programs, due to the risk generally associated with the startups business. Therefore, this indicator tries to measure the ability a given startup has to identify and capture the necessary resources to its projects (regardless of the amount).

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5
There is no available acceleration or incubator program (private or public) suitable for the proposed solution	The startup solution requires special financing programs	The solution requires financing for equipment and/ or prototypes (high CAPEX)	The startup manages to access both government programs and private financing	The startup is created with a secured major client

9. Entry Barriers (EB)

Entry barriers are one of the key elements that hinder or obstruct a startup's business development. It is possible to identify barriers from various natures. This indicator lists some of the most common barriers cited in the survey conducted by this research. Those are: i. public bureaucracy; ii. technical; iii. low public awareness of the technology(ies) involved in the solution; iv. high competition; v. access to skilled labor or others. It is important to highlight that those barriers could vary its intensity greatly from one context to another, thus against the difficulty to describe all the contexts and scenarios, we will measure the size of the obstacle a given startup has by summing up the number of barriers it may face.

LEVEL 1	5 or more Barriers
LEVEL 2	4 Barriers
LEVEL 3	3 Barriers
LEVEL 4	2 Barriers
LEVEL 5	1 Barrier

Emerging Technologies Applied to the Renewable Energy Sector

Startup Profiles

STARTUP 1:

Cubi

Introduction

Due to inherent characteristics of the energy, it is hard to have it well managed. Many people use tools such as energy bills and spreadsheet controls to monitor power consumption levels, but these tatics are not efficient in terms of time consuming and accuracy.

Presenting a response for this scenario, Cubi was born in São Paulo, Brazil, and has developed a complex solution focused in the service provision that aims to simplify energy management for the customer, making it more intuitive and pragmatic in applications, savings, planning and decision making in general.

More information at: **www.cubienergia.com**

Energies involved

It allows working with various types of clean energy, such as wind, solar, geothermal, hydraulic, biofuel, nuclear and electrical energy in a broader sense.

Startup solution involves

- INSTALLATION
- SERVICE
- MAINTENANCE
- SKILLED LABOR
- PRODUCT

Solution

PROCESS

First, the customer's energy infrastructure and connectivity points are evaluated. After that, the energy meters are installed in the equipment of interest, which can indicate when, where and how the energy costs in the production process occur. Subsequently, the vast amount of data stored in the cloud is finally processed by Cubi's algorithms, indicating opportunities for improvement and optimization, in a dynamic that feeds back this intelligent model so that it is increasingly efficient.

COMPLEXITY

The technical complexity involved in the project is low for the users. Despite the complexity in energy management, the possibility to adapt to the needs of each customer in the face of the same type of service (if the tools and methods vary), is key to simplify the customer experience. Thus, the maintenance fits in the knowledge of the teams themselves, so that any electrician can supply the functions. In other words, the solution is designed especially so that lay people could keep it after it is installed and enjoy their processed data and recommendations.

Cubi

Main techs involved

- ARTIFICIAL INTELLIGENCE
- BIG DATA
- BLOCKCHAIN
- CLOUD COMPUTING
- INTERNET OF THINGS
- NANO-TECHNOLOGY
- ROBOTICS

Acceleration/Awards

EDP Starter
(1st edition in Brazil)

Participation in Sebrae SP PRE-Acceleration Program

Participation in EDP Open Innovation

Braskem Labs Challenge Batch (Top 10 Best Pilot Projects)

Third place winners at the SECOP Challenge 2017 of Innovation (allowed the adoption of the Innovation Seal of ABEP (Brazilian Association of State Information and Communication Technology Entities)

Startup finalist at Inovativa Brasil - in 2017.2

Innovation of the solution

In addition to using hardware designed to maximize data security, connectivity (only wireless networks are used) and technical security, Cubi's main innovation can be understood in the intelligent processing phase. With a focus on delivering a service, the company can extract value from the data that is generated and present it clearly, already indicating the outputs that can be generated and also creating benchmarks of each segment, allowing internal comparison and in terms of the market. That is, transforming raw data into real and useful information for immediate decision making.

Target public

Managers and decision makers in the small, large and medium-sized industry. Some sectors that show greater natural interest in Cubi's solution because of its energy intensity are: plastics, food and metalworking sectors. In general terms, industries and buildings that can and may be interested in installing energy meters on specific machinery.

Cubi

Major obstacles

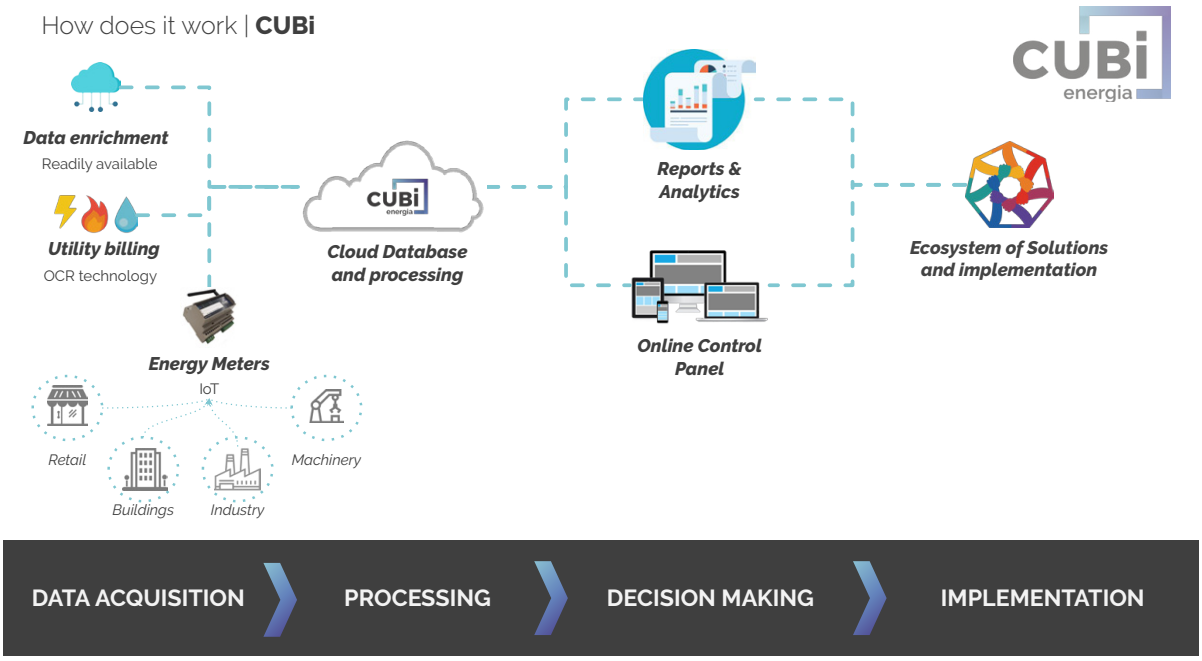
Greater accessibility and better values for IoT connectivity: The low amount of connection options make them very expensive, and this is directly linked to poor infrastructure, with many poor sites with low levels of coverage. In addition, there are also few companies / tools that manage mobile chips on the type of equipment needed. Two other challenges are the development of a hardware product in Brazil, where access to prototyping is costly and difficult and the lack of market knowledge about the benefits that this type of solution can generate.

Operation investment/ROI

Focused on an Operational Expenditure (OPEX) solution, customers are usually not charged for an initial investment, but monthly fees are required for full power management.

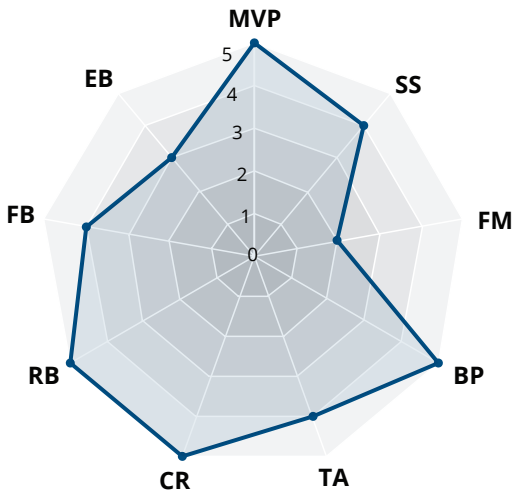
Because each model is tailored to the particular needs of each customer, there is no specific model on return on investment. What can be said in this sense is that the increase in the contracted time brings more impacts to the negotiation than the increase in the volume of solutions regarding price reduction.

Graphic scheme



Cubi

Diagram



Cubi stands out by combining relative low costs for its operations (MVP and Capital Requirement), strong business (tested business model and a solution supported by several technologies) and manages to not get very impacted by the barriers indicators. From the methodology perspective, once the startup manages to access more resources and cope with several of its entry barriers, it will have a high potential to gain scale.

INDICATOR	LEVEL	SCORE
Minimum Viable Product Value **(MVP)**	Less than 100	**5**
Startup Stage **(SS)**	Traction	**4**
Financial Maturity **(FM)**	Seed Capital	**2**
Business Plan **(BP)**	5 Methodologies	**5**
Technological Adoption **(TA)**	4 Technologies	**4**
Capital Requirement **(CR)**	Less than 500	**5**
Regulatory Barriers **(RB)**	Do not require any conformity with the law or non-legislative regulation	**5**
Financial Barriers **(FB)**	The startup manages to access both government programs and private financing	**4**
Entry Barriers **(EB)**	3 Barriers	**3**
RISK ASSESSMENT		**-0,15**
FINAL SCORE		**100**

STARTUP 2:

Fohat

Introduction

Starting from the concept of "Energy Intelligence ", Fohat comes from Curitiba, Brazil, and works with disruptive technologies such as Blockchain, Artificial Intelligence, Big Data and Tokenomics. This sofisticated combination allows them to solve problems in the energy industry with regards to the integration, control, management and dispatch of distributed generation assets, as well as digitalization of energy trading with the financial sector.

More information at: **fohat.co**

Energies involved

It allows working with various types of clean energy, such as wind, solar, geothermal, hydraulic, biofuel, nuclear and others.

Startup solution involves

Solution

PROCESS

Fohat operates in three major segments: **1.** Integration, control, management and dispatch of distributed generation assets in arrangements such as Microgrids and Virtual Power Plants (VPP). In this sense, the products offered are i. I-Grid2You (Microgrid Solutions) and ii. I-Grid2Corp (Microgrid Solutions, Virtual Power Plants and Demand Response Program fulfillment); **2.** Digitalization of trading to over-the-counter (OTC) and stock markets, promoting the free trading market. The products of this segment are i. Raptor Home Broker (Energy Trading Home Broker Solution), ii. Raptor Unorganized Balcony (Energy Trading Balancing Solution for Unorganized Markets), iii. Raptor Organized Balcony (Energy Trading Solution for Organized Markets), iv. Turing Clearing House (central counterparty solution for custody and settlement in organized OTC markets and v. Raptor + Turing Trading Exchange (Distributed Market Energy Trading Solution); **3.** Automation and market places for trading certificates of Origin and Distributed Generation Lots. Products: i. I-Grid Certificates of Origin (Issuance, Trading, Consumption and Retirement of Certificates of Origin [I-RECs]) and ii. Autonomous Assets (Distributed Generation Allotment and Commercialization Solution).

COMPLEXITY

As different product and service models apply (in Generation Line, Commercialization and Automation), complexity varies by customer's purpose. In terms of skilled labor, the level of complexity can be understood as high: are required software developers in Blockchain, Java, Javascript, React, Angular, Django, Python, Graphql, Apollo, Jenkins, Spring boot, multi agents systems, deep learning, Machinne Learning, Docker, MongoDB and PostgreSQL and people with specific knowledge in the energy market and financial sector.

Fohat

Main techs involved

- ARTIFICIAL INTELLIGENCE
- BIG DATA
- BLOCKCHAIN
- CLOUD COMPUTING
- INTERNET OF THINGS
- NANO-TECHNOLOGY
- ROBOTICS

Acceleration/Awards

Founder Institute (2018)

Recognized as Top 6 Energy by 100 Open Startups

Startupbootcamp Energy Australia (2019)

Innovation of the solution

In addition to being the first company to reconcile Blockchain technology and the energy sector in Latin America, Fohat has the distinction of integrating solutions and platforms, creating end-to-end solutions from generation through accumulation, distribution, transmission and commercialization, until finally energy consumption. Thus, innovation lies in the articulation of sophisticated technologies capable of promoting high levels of effectiveness, flexibility, decentralization, reliability and scale around sustainable solutions.

Target public

All players in the Generation, Distribution, Transmission, Trading and Consumption segments are potential target audiences. That is, generators, distributors, transmitters, traders, self-producers, special consumers, free consumers, exporters, importers or independent producers may enter here.

Fohat

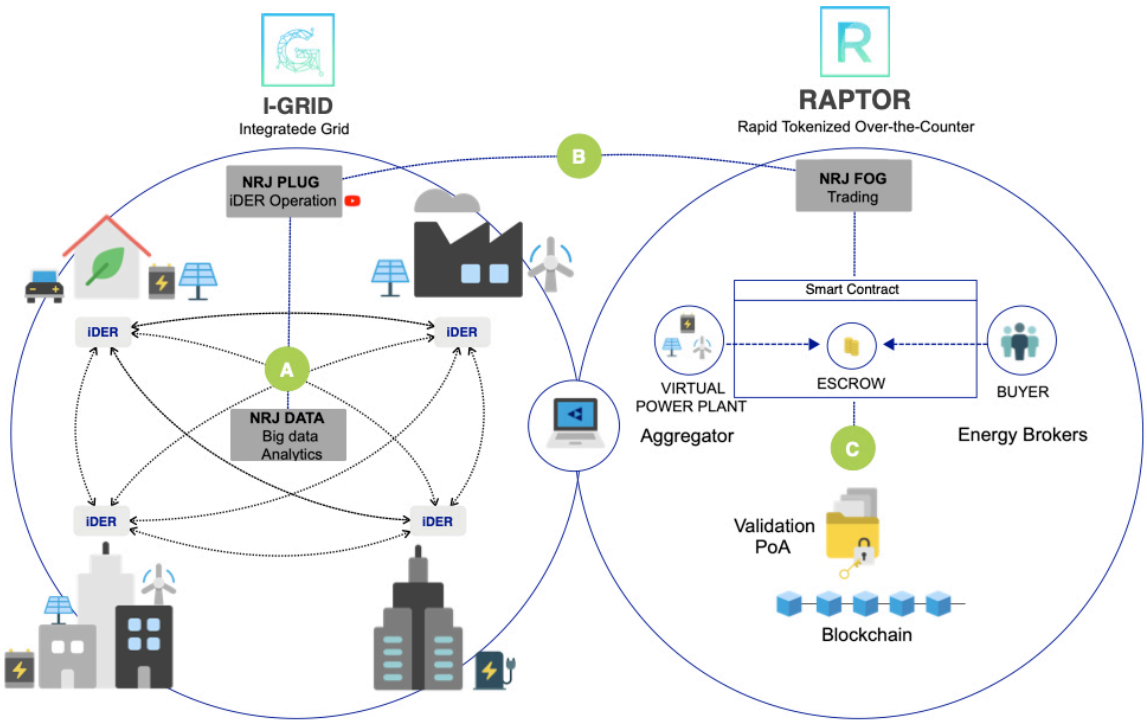
Major Obstacles

In general terms, the challenges are: financing for solution development, skilled labor and market liquidity. In terms of barriers: there is the modernization of the electricity sector for organized over-the-counter model, market opening, availability / creation of a stable token. Specifically, existing constraints in this sense are the Regulatory Impact Analysis (AIR, in portuguese) of the revision of Normative Resolution 482/2012, which deals with the rules of Distributed Generation, and also the need of modernization and opening of the free market discussed in Public Consultation 33/2017 and 77/19.

Operation investment/ROI

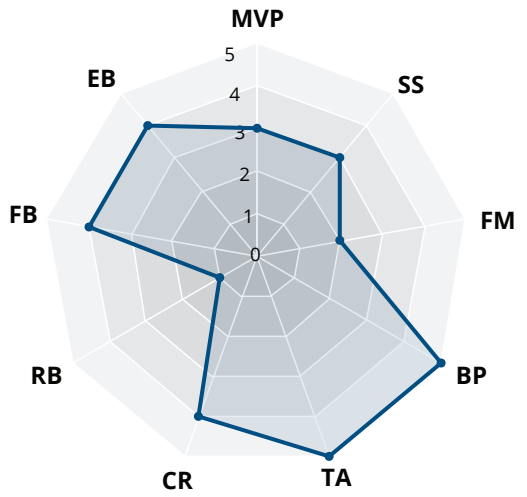
Considering Fohat's integrative model, in which different types of solutions are offered, each product and service has a defined acquisition, use and compensation model. Therefore, the Return on Investment depends on the purpose of using products and services, and it is possible to apply software such as service, subscription, pay per use or success rate model so that the way of updating, support and maintenance is changed for each case.

Graphic scheme



Fohat

Diagram



Fohat is a case point of a startup operating in the energy sector which, for having a solution that involves equipment, has considerably higher costs of operation. Nonetheless, its solution and business model seems very robust, for having the business model tested by many methodologies and applying numerous technologies to its solution. Fohat case is important for this analysis because it presents a situation in which the main barrier posed to the startup is of an exogenous nature, which means, in the event of positive changes promoted by the public power, its business will probably make a big leap in scale and reduce considerably its risks.

INDICATOR	LEVEL	SCORE
Minimum Viable Product Value **(MVP)**	200 -500	**3**
Startup Stage **(SS)**	Operation	**4**
Financial Maturity **(FM)**	Seed Capital	**2**
Business Plan **(BP)**	5 Methodologies	**5**
Technological Adoption **(TA)**	5 Technologies	**5**
Capital Requirement **(CR)**	500-1000	**4**
Regulatory Barriers **(RB)**	The solution requires change in the legislation in one or more levels	**1**
Financial Barriers **(FB)**	The startup manages to access both government programs and private financing	**4**
Entry Barriers **(EB)**	2 Barriers	**4**
RISK ASSESSMENT		-0,3
FINAL SCORE		**64**

STARTUP 3:

Infra Solar

Introduction

Considering the chaotic distribution of electric modes spread over large cities and the consequent difficulty of charging the batteries and their full utilization by users. Originated in São Paulo, Brazil, Infra Solar's sustainable energy recharging and parking space in strategic locations of cities represent a solution aligned with the legislation and capable of solving problems that tend to increasingly escalate.

More information at: **infrasolar.com.br**

Energies involved

Solar energy

Startup solution involves

- INSTALLATION *(NOT FOR EACH CUSTUMER)*
- SERVICE
- MAINTENANCE
- SKILLED LABOR
- PRODUCT

Solution

PROCESS

Infra Solar operates in the battery market for electric vehicles, offering sustainable solutions through the use of new technologies such as Big Data, Cloud Computing, Internet of Things and Artificial Intelligence. Its solutions cover energy recharging - through solar panels - and parking for light electric vehicles increasingly common in large cities (such as scooters and bicycles) and intelligent data management operation and maintenance services. Its performance is in the midst of a nascent but exponentially escalating activity (the size of the world market for electric vehicle batteries is $ 84 billion), which has been finding solutions and problems on a daily basis, which means that Infra Solar can also monitor regulatory issues and contribute to the best use of this type of transport.

COMPLEXITY

Medium complexity for data collection and analysis during operation - requiring specialized operators, and low complexity for maintaining the physical recharge points - with no need for great technical knowledge.

Infra Solar

Main techs involved

ARTIFICIAL INTELLIGENCE | BIG DATA | BLOCKCHAIN | CLOUD COMPUTING | INTERNET OF THINGS | NANO-TECHNOLOGY | ROBOTICS

Acceleration/Awards

Braskem LABS

Acceleration - Braskem Labs Scale 2019

Mentoria - Eduardo Mayer Fagundes

Major obstacles

In terms of scaling the project from the pilot, the major obstacles are the recruitment and retention of professionals specialized in artificial intelligence and communications tools and sufficient service provision contracts to make the operation profitable. In addition: the untimely changes in legislation, finding financial support, adhesion of electric vehicle companies and the technology development in the country.

Target public

Infra Solar offers gains in energy efficiency and clean energy solutions for electric transport modes and O&M maintenance services) with intelligent data management. Thus, its target public can be described as the suppliers of micro mobility and shared electric vehicles.

Innovation of the solution

The use of renewable energy and emerging technologies for the development of a SaaS (Software as a Service) so that it works as a mediator software in a Cloud Computing environment. This allows to implement a mathematical model of mediation and suggestions, based on Artificial Intelligence, of charging and parking points using a NoSQL (nonrelational) database capable of receiving real-time data from remote devices with Internet of Things (IoT) technology over a mobile network data communication.

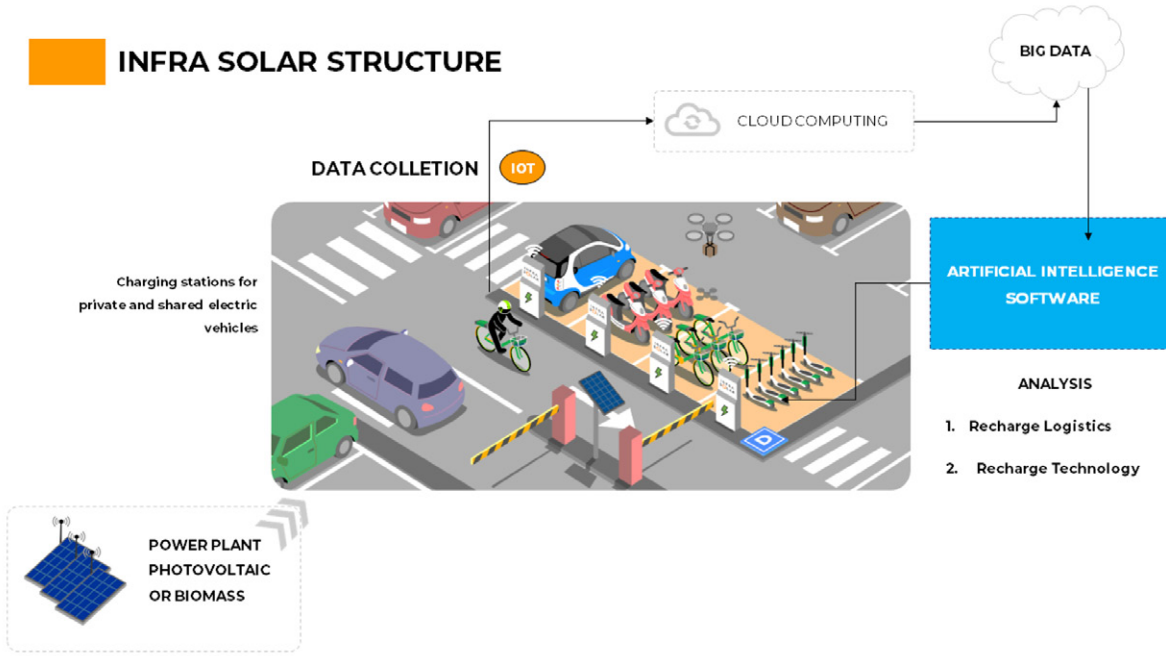
Operation investment/ROI

The design of monitoring and control systems is highly scalable: there are only costs of storage and installing a computational microsystem. The physical recharge point project has only labor costs after the final investment in Capital Expenditure, with an average return on investment of eighteen months since installation and the beginning of the service.

Another type of return on investment that lies in Infra Solar is its alignment with the legislation in a new (and sometimes chaotic) market, making the brand a reference in this kind of solution for scooters, bicycles and any electric modes.

Infra Solar

Graphic scheme



INFRA SOLAR

Process Chart Diagram

CLIENTS

Sustainable recharge point in B2B subscription form for:

- Shared electric scooters startups;
- Light electric vehicles;
- Commercial establishments;
- Companies, universities, and others.

PRODUCTION & INSTALLATION

Production steps

- Recharge points design;
- 100% plastic refill points production;
- Data collection materials installation.

Installation

- Specialized electrical technicians install recharging points in proper locations.

OPERATION

User engagement

- Light electric vehicle users use recharging points and will be properly motivated to do so.

Maintenance

- The subscription paid by the companies will maintain the recharge points made by technicians specialized in electrical.

DATA COLLETION & ANALYSIS

Data Colletion

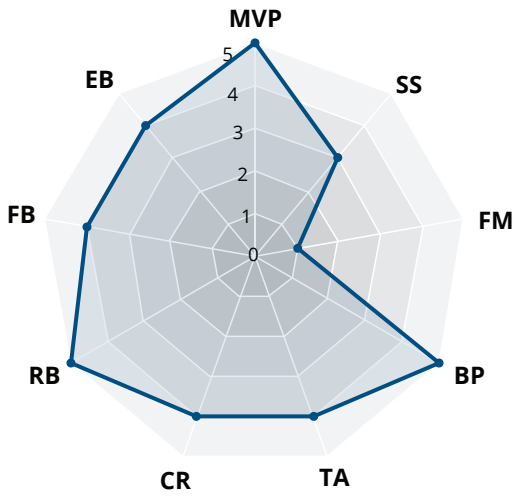
- Recharge points collect through IoT technology relevant data such as energy usage, battery level and others.

Analysis

- Data routed to Infra Solar Artificial Intelligence software is transformed into efficient routes and other benefits.

Infra Solar

Diagram



Infra Solar is another case of a startup in its early stages that has developed a strong business model with an interesting solution that lies in a considerable number of technologies and that manages to keep its operation at relative low costs. It is also notable that their solutions do not face a high resistance from the barrier indicators. Once it manages to access more funds and move in the Financial Maturity indicator, its operation could gain traction and scale considerably.

INDICATOR	LEVEL	SCORE
Minimum Viable Product Value **(MVP)**	Less than 100	**5**
Startup Stage **(SS)**	Operation	**3**
Financial Maturity **(FM)**	Angel Investment	**1**
Business Plan **(BP)**	5 Methodologies	**5**
Technological Adoption **(TA)**	4 Technologies	**4**
Capital Requirement **(CR)**	500 - 1000	**4**
Regulatory Barriers **(RB)**	Do not require any conformity with the law or non-legislative regulation	**5**
Financial Barriers **(FB)**	The startup manages to access both government programs and private financing	**4**
Entry Barriers **(EB)**	2 Barriers	**4**
RISK ASSESSMENT		-0,15
FINAL SCORE		**96**

STARTUP 4:

SolarLatam

Introduction

With an office in Buenos Aires, Argentina (among others), SolarLatam aims to make it easy for everyone in Latin America to adopt sustainable energy sources, by creating a platform that enables anyone to design, quote, finance and purchase their solar system 100% online. Their innovative strategy makes it possible for different sectors to purchase Solar Systems where access to this technology is not easy. Additionally, a social program developed by SolarLatam together with Engineers Without Borders, have trained and certified more than a hundred professionals in Argentina so they could learn how solar technology works, is installed and operated.

More information at: **solarlatam.com**

Energies involved

Solar Energy

Startup solution involves

- INSTALLATION
- SERVICE
- MAINTENANCE
- SKILLED LABOR
- PRODUCT

Solution

PROCESS

SolarLatam offers an integrated solution for the installation, financing, operation and maintenance of self-consumption solar power plants. Solar plant sales can be made directly or by financing programs. Installation includes products, permits, projection, engineering, execution, maintenance and corresponding financing. Operation consists on a detailed monitoring system per panel in real time. Finally, maintenance is done by the team of engineers on a regular basis throughout the contract.

COMPLEXITY

In terms of complexity, SolarLatam's operations can be understood as medium level. The process needs qualified installers to apply the systems, perform periodic maintenance to keep pace with regulatory changes and provide overall operations and maintenance (O&M) services.

In this sense, its integrated model ranges from searching for the best product type, passing through customer´s follow-up and maintenance, to clean energy service provision. Therefore, it is also a model that simplifies the customer experience, bringing together a series of processes in one place.

SolarLatam

Main techs involved

- ARTIFICIAL INTELLIGENCE
- BIG DATA
- BLOCKCHAIN
- CLOUD COMPUTING
- INTERNET OF THINGS
- NANO-TECHNOLOGY
- ROBOTICS

Acceleration/Awards

Draper Cygnus Pitch Competition in Buenos Aires, Argentina

Endeavor Conecta Inversor in Buenos Aires, Argentina

Raizen Impulse, In Buenos Aires, Argentina

Innovation of the solution

Real Time Tracking of consumption using Internet of Things that connects sensors to information devices. Through a monitoring system, it allows the tracking of the generation of the panels in real time, permeating an increase in efficiency with the reduction of maintenance costs and effective detection if there is a problem of production in any of the elements of the system remotely. The system is available online in its Apps and web platforms for the user verification. While traditional solutions use normally fossil energy connected to the grid, this scheme enables users to become empowered and decides what energy sources to use, how much they are willing to pay and act independently and sustainably in microgeneration.

Major obstacles

Regulatory bottlenecks are still being overcome (Argentina is the last country to adopt distributed energy bills that enable distributed energy to become a reality to its users, which characterizes a market that still needs maturation), and also the lack of government support can be seen as a barrier. In addition, common Knowledge on the offered technology and fundraising by a smart investor are also important challenges.

Target public

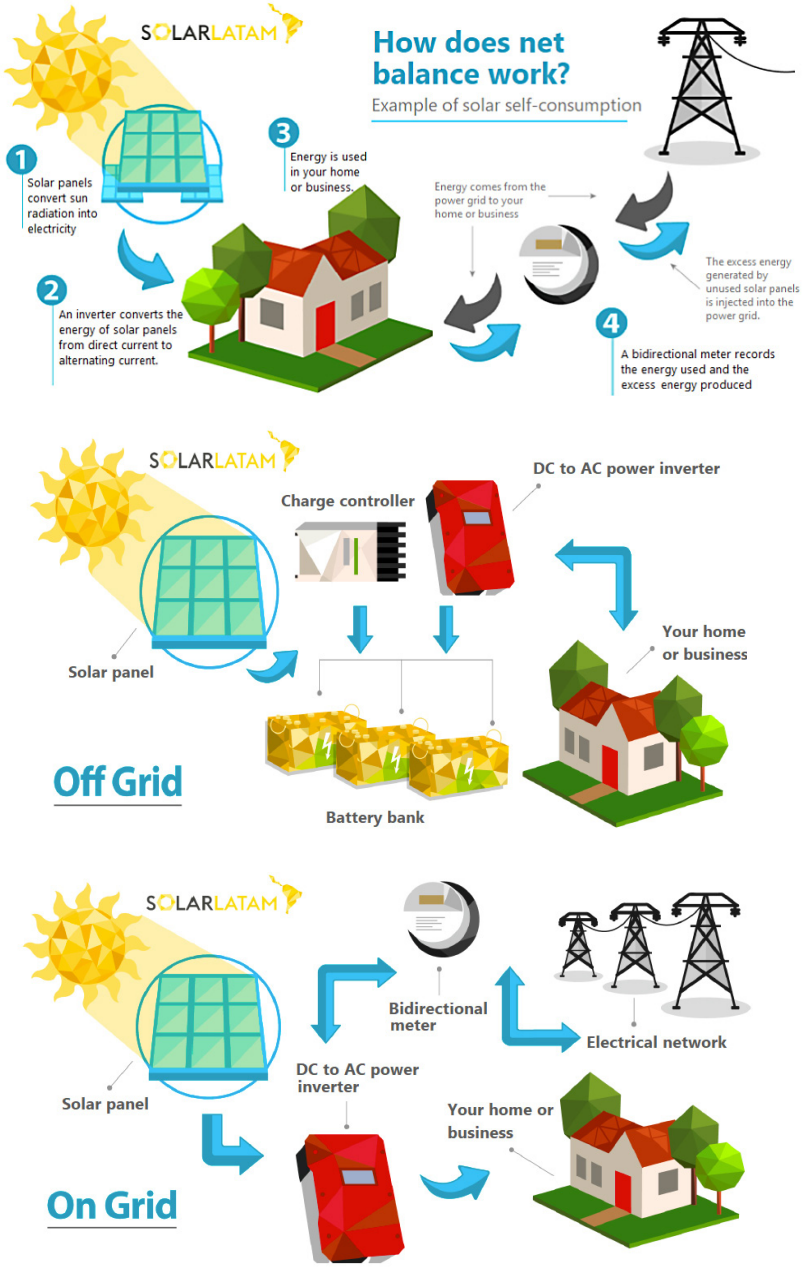
The residential, commercial and industrial sector. The market of SolarLatam is made by Business-to-Consumers (Residential: Houses that aim to become more eco-friendly, independent and efficient) and Business-to-Business, which are commercial, industrial and Agro SMBs and large businesses that aims savings and sustainability.

SolarLatam

Operation investment/ROI

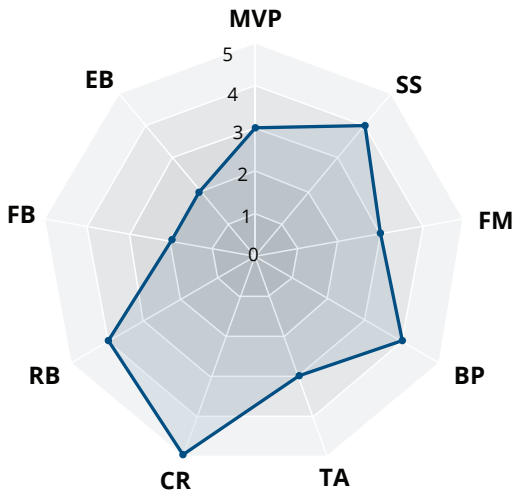
The return of investment is based on scalability. SolarLatam's strategy is to centralize in one platform for all markets a unique solution that fits on each country. The platform was built with that goal, and because of this, the cost of implementation declines abruptly per country/market addressed. Also, as they gain volume, their negotiation position with providers improve, allowing them to become more efficient.

Graphic scheme



SolarLatam

Diagram



INDICATOR	LEVEL	SCORE
Minimum Viable Product Value **(MVP)**	200 - 500	**3**
Startup Stage **(SS)**	Traction	**4**
Financial Maturity **(FM)**	Venture capital	**3**
Business Plan **(BP)**	4 Methodologies	**4**
Technological Adoption **(TA)**	3 Technologies	**3**
Capital Requirement **(CR)**	Less than 500	**5**
Regulatory Barriers **(RB)**	The solution is built upon the existing law, but requires govern-mental licenses to operate	**4**
Financial Barriers **(FB)**	The startup solution requires special financing programs	**2**
Entry Barriers **(EB)**	4 Barriers	**2**
RISK ASSESSMENT		-0,35
FINAL SCORE		**60**

SolarLatam is the case of a startup that is quite advanced in regard of its business. For being already in the Traction Stage and being able to access resources from venture capital funds, it demonstrates the strength of its business model, which is well tested. Conversely, from the perspective of this methodology, it faces several challenges from the barriers indicators. The need of especial financing programs in general is an important obstacle for early stages startups – in this case, this indicator could help us to explain its advanced position in the Financial Maturity indicator. The entry barriers is also another important issue that could constrain its ability to rapid gain scale, so coping with those issues could help to propel their business (for instance by reducting the public bureaucracy and greater adoption of solar panels and wind turbines).

STARTUP 5:

Suncast

Introduction

Suncast is a Chilean startup, more specifically from Santiago, specialized in Data Science, which offers digital services to maximize energy production in solar and wind power plants. With the mission of contributing to the growth of clean energies and sustainable development in all energy markets in the world, their services are packaged in a single web service called Smart O&M (Organization and Methods) that is delivered to the customer.

More information at: **suncast.cl**

Energies involved

Wind and Solar energy

Startup solution involves


INSTALLATION


SERVICE


MAINTENANCE


SKILLED LABOR


PRODUCT

Solution

PROCESS

As an online forecasting system for solar and wind power generation, Suncast provides accurate predictions of electric power generation by crossing the historical information from the solar plants with real-time monitoring of its weather conditions, through hi-res satellite imagery.

Using Big Data Analytics, Machine Learning, Artificial Intelligence, Electrical Engineering and Research, the company is capable of offering different types of services in an integrated solution: i. generation prediction (Meteologica and Solargis), ii. consultancy in studies on forecasting energy sales prices, iii. rain forecasts (in models like Accuweather, Windy, among others), iv. spot studies by consultants in optimization of cleanliness and maintenance plan and v. some control systems that integrate standard solution platforms for O&M.

COMPLEXITY

In terms of complexity, it is necessary to have an information system that would allow access to the data of the centrals (for real generation and sensors of meteorological stations). But, on the other hand, once the project is in place, it does not require specialized labor.

Suncast

Main techs involved

- ARTIFICIAL INTELLIGENCE
- BIG DATA
- BLOCKCHAIN
- CLOUD COMPUTING
- INTERNET OF THINGS
- NANO-TECHNOLOGY
- ROBOTICS

Acceleration/Awards

CHILE GLOBAL VENTURES FCH

Acceleration of ChileGlobal Ventures with monthly monitoring and access to the "Red de mentores", where they have two of their mentors supporting strategic planning.

Target public

Energy companies (multinationals of energy that build, operate and finance renewable energy plants in solar and wind) and individuals who own power generating plants.

Operation investment/ROI

The initial cost of the project is approximately U$ 20,000, then a periodic subscription to the web service is also required, and project implementation takes two to three months. In addition, as the project grows in scale, its cost declines, and its maintenance cost is around U$ 10,000.

Innovation of the solution

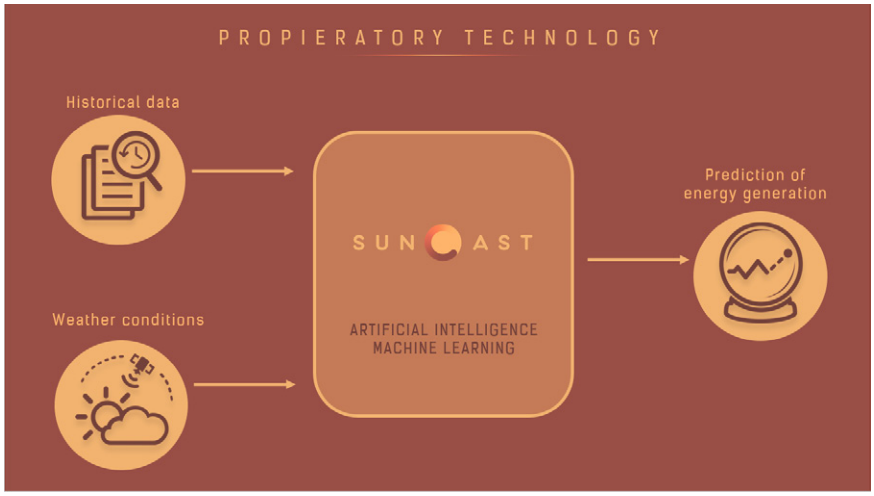
Whereas the traditional solutions correspond to consultancies that make models in Excel and deliver a report with the solution for the time they ran the models, Suncast innovates in taking advantage of the large amount of data that can be obtained from the generation plants and weather conditions. In addition, by providing cloud services, they can be constantly updated, while artificial intelligence models are improving over time as they are retrained. The use of big data for large processing capabilities coupled with the use of artificial intelligence enables a number of innovative dynamics such as: Hourly generation predictions, forecasts of energy sales prices, rain and cloud predictions, cleaning and maintenance plan optimization and direct bidding of cleaning services of photovoltaic panels with local suppliers. In addition, all these data are delivered to the customer in real time, which allows it to reduce uncertainty in energy production, improve the operation of the plant through advance information and automate the sending of reports of forecasts to the National Electric Coordinator.

Suncast

Major obstacles

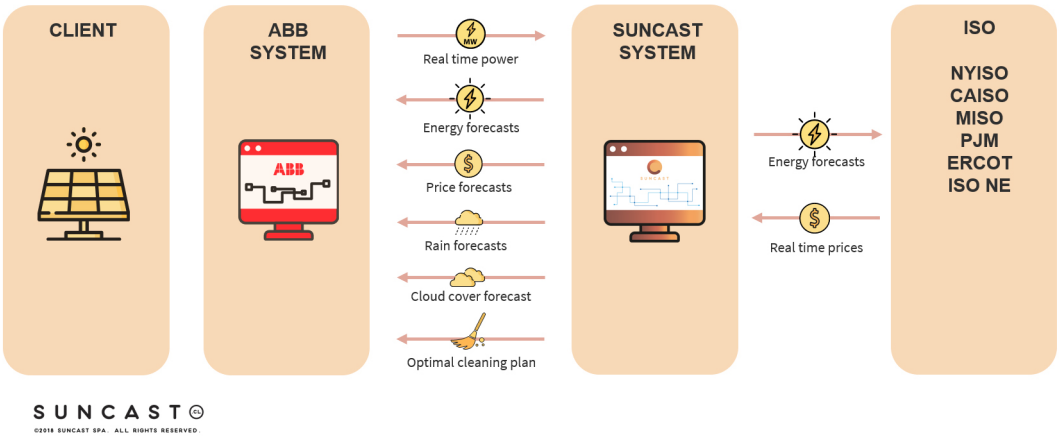
There are three main obstacles to growth and consolidation: i. accessing private capital, ii. little experience in business development and iii. long sales cycles. In addition, in countries where the prediction service is more valuable than in others, depending on the legislation, there are fines proportional to the percentage of error. Also, lack of market knowledge and of the technology employed in this type of solution are challenges.

Graphic scheme



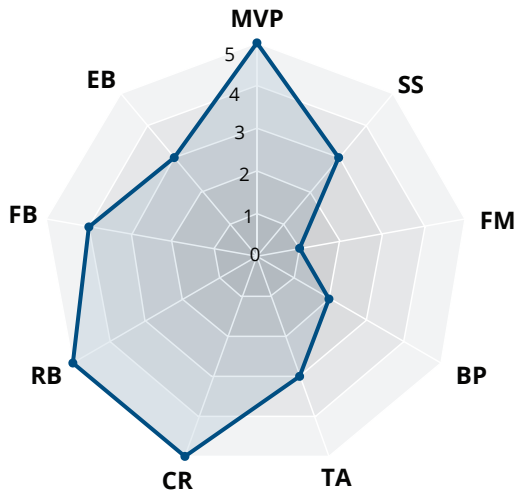
SMART O&M (PARTNERSHIP WITH ABB)

Innovative solution to maximize the output of solar farms.



Suncast

Diagram



Suncast is a very interesting case, because unlike most startups in this segment, it major product is a service, therefore it manages to keep its MVP and Capital Requirement considerable low. Another important element is the fact that it is not highly impacted by the barriers indicators, which combined with the relative low cost for operations, reduces the startup risk. In terms of operation, it needs to broaden the analysis of the business model, as well as seek investors of public programs to increase the size of its business.

INDICATOR	LEVEL	SCORE
Minimum Viable Product Value **(MVP)**	Less than 100	**5**
Startup Stage **(SS)**	Operation	**3**
Financial Maturity **(FM)**	Angel Investment	**1**
Business Plan **(BP)**	2 Methodologies	**2**
Technological Adoption **(TA)**	3 Technologies	**3**
Capital Requirement **(CR)**	Less than 500	**5**
Regulatory Barriers **(RB)**	Do not require any conformity with the law or non-legislative regulation	**5**
Financial Barriers **(FB)**	The startup manages to access both government programs and private financing	**4**
Entry Barriers **(EB)**	3 Barriers	**3**
RISK ASSESSMENT		-0,15
FINAL SCORE		**73**

Emerging Technologies Applied to the Renewable Energy Sector

Recommendations

As we have seen, the creation, development and expansion of energy focused startups are linked to their ability to increase their level of maturity and to cope with the key barriers highlighted.

Taking as an example the startups analyzed in this report and despite the barriers faced by each one, they all look very promising, for the robustness of their Business Plan and sophistication of their solutions highlighted by the number of emerging technologies they adopt. All of them are still in their early stages, which it is a barrier by itself.

Nonetheless, high-impact startups tend to increase their chances of success when inserted into an entrepreneurial ecosystem that enable their conditions and foster the exchange of experiences with other startups. Thus, cities have a vital role in supporting this entrepreneurial movement by developing an enabling environment that ranges from adapting law and regulations, reducing burdensome bureaucracies, facilitating access to resources and the consumer market (where the city could be one of the major beneficiaries), investing in education, etc.

In our view, cities could benefit greatly in creating those enabling conditions, since the expansion of those energy startups will not only serve for the cities themselves assisting them to overcome their energy challenges, but also they would promote efficient and environmental friendly solutions to its population. With that objective, this report lists a number of recommendations, divided in Tiers, determining the level of priority identified by the research team, that should serve more as ideas than actual guidelines, since we recognize that the particular context of each city varies greatly and we do not believe it is possible to provide an "one size fit all approach".

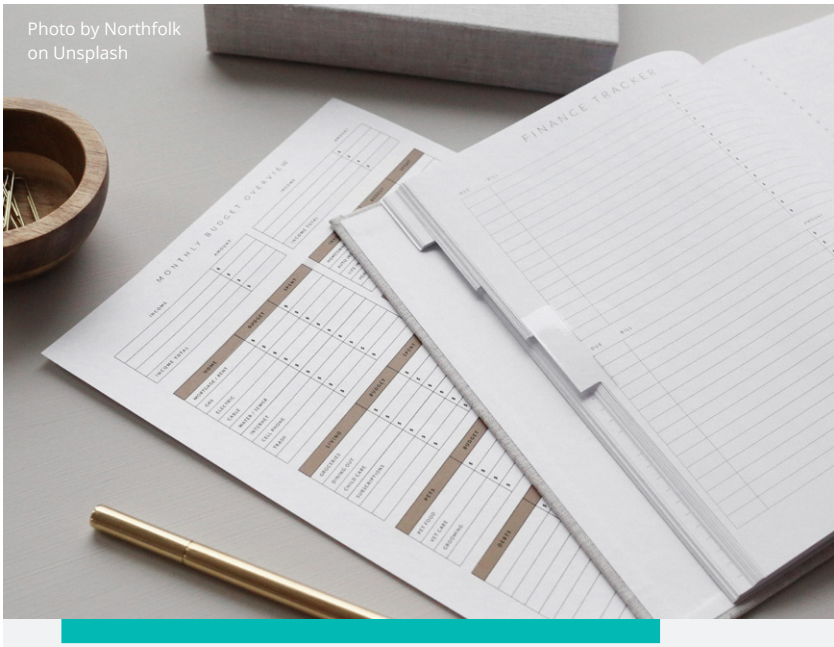


Photo by Northfolk on Unsplash

Tier 1 Recommendations

Regulation:

Frequently, the cities' legislation cannot keep up with the dynamic sector of startups and technological innovations. Even because of their disruptive nature, startups often come across laws and regulations that hinder the development of their solutions. Developing more modern legislation and even sandbox-style mechanisms can streamline internal processes and foster new solutions and services for cities.

Financial support:

Provide resources for idea and product development, loans, guarantees, venture capital provision, tax exemptions, discounts or new business contributions. Programs directed to startups in the energy sector should consist in providing access to "patient and smart money", given the particularities of this segment.

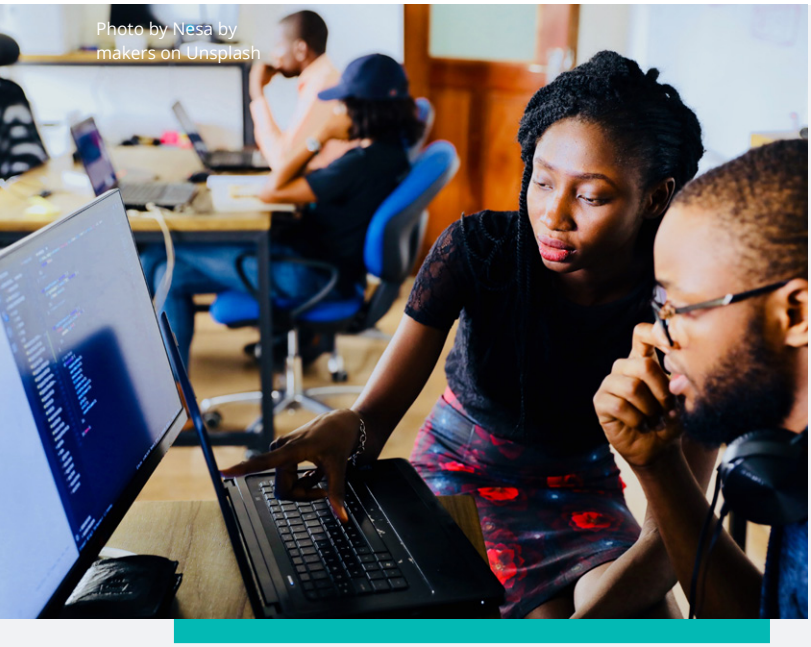


Photo by Nesa by makers on Unsplash

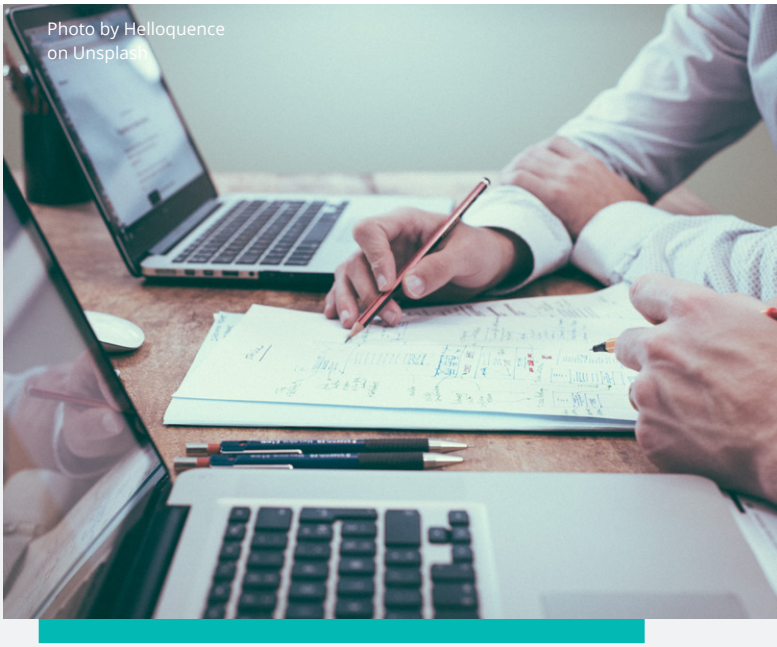


Photo by Helloquence on Unsplash

Tier 2 Recommendations

Training:

Create incubators, accelerators and science parks, especially at schools and universities, which allow students and other young entrepreneurs the opportunity to develop and launch their business. Training should also target the city personnel, since many of them will be directly involved in implementing some of those solutions.

Demand generation:

Update procurement and other public bidding processes and/or develop incentive mechanisms that may facilitate the hiring of startups that otherwise would have difficulty in competing with established companies in the market.

Tier 3 Recommendations

Consulting:

Include free legal and management advice; infrastructure, such as startup centers with affordable space and services for new businesses; marketing support, such as fairs to introduce new business and help in accessing foreign markets; and support for Angel Investor networks and startup co-management.

Model building:

Promote activities aiming not only to raise awareness to the theme, but also creating spaces for promotion of new ideas, sharing experiences and reward best practices. The organization of hackathons and competitions for innovative startups and activities and campaigns to increase public attention and promote entrepreneurship.

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