

# Preparing for Commercial Field Testing of the Janicki Omni Processor

Lessons Learned by DELVIC Sanitation Initiatives in Dakar, Senegal

November 2019

This report captures lessons learned by DELVIC in preparing for the commercial field test of the Janicki Omni Processor, a fecal sludge waste-to-resource technology. The lessons may be useful to others planning commercial evaluations of fecal sludge waste-to-resource technologies.

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The Sanitation Technology Platform (STeP) helps transformative technologies reach the 4.5 billion people worldwide who don't have access to safely managed sanitation. STeP provides a full range of services including field testing, market intelligence, and user insights to help inventors and industry develop products and services that address market and consumer needs. STeP is a collaboration of global experts and organizations that removes risk and streamlines the path to market, fostering greater success for its clients. As a department within RTI International, Innovation Advisors is the implementing partner of STeP.



## ACKNOWLEDGMENTS

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## Project Background

DELVIC Sanitation Initiatives has operated a pilot-scale Janicki Omni Processor (J-OP) at a fecal-sludge treatment plant (FSTP) in Dakar, Senegal, since 2015. Operating this J-OP has proved its ability to treat fecal sludge (FS) and generate pathogen-free by-products. However, to date, no revenues have been generated from the by-products. In 2020, a commercial-scale J-OP will be installed in Dakar, and DELVIC will conduct a field test to validate its commercial viability. The result of this commercial field test will inform the decision and strategy to scale up the J-OP to other sites in Senegal and abroad. It also will underpin the financial model and capital raise strategy for the J-OP.

**This report captures lessons learned by DELVIC in preparing for the commercial field test that may be useful to others planning commercial field testing for FS waste-to-resource technology.**

Lessons learned are reported out across five areas of project development:

- treating fecal sludge as a feedstock, not as waste,
- navigating the permitting process,
- selecting and developing by-product sales channels,
- preparing for a capital raise, and
- executing a capital raise.

### The Janicki Omni Processor (J-OP)

Designed by Sedron Technologies in partnership with the Bill and Melinda Gates Foundation (BMGF), the J-OP is a community-scale treatment system that processes FS solids, biosolids, and other waste streams into clean water, electricity, and ash. The J-OP can achieve complete pathogen destruction of human waste, resulting in improvements to human health and the environment. The sale of J-OP by-products can be used to offset its operational costs. Along with Dakar, Senegal, J-OP pilots also are underway in China and India.

The J-OP is based on patent WO 2016-077241 and an associated family of granted patents and applications. The intellectual property has been retained by BMGF, with the right to manufacture, sell, and distribute the technology licensed in accordance with the Foundation's Global Access Policy.

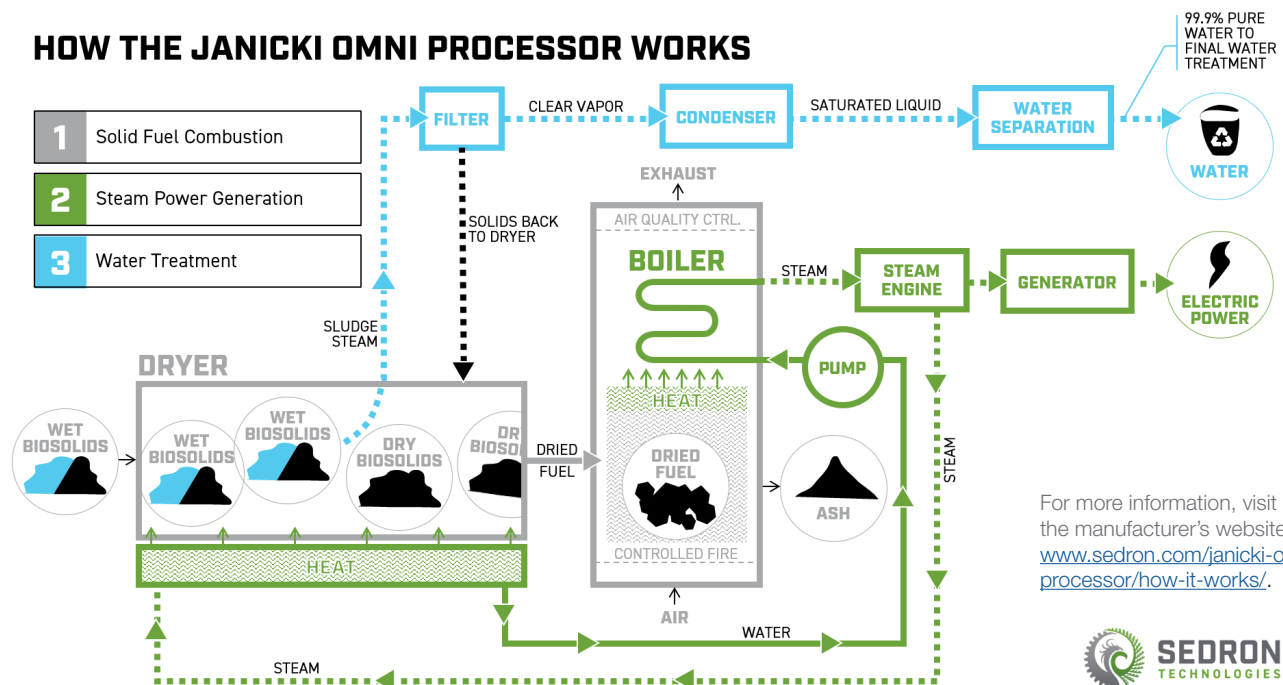
### DELVIC Sanitation Initiatives

DELVIC is a Senegalese owned and operated company whose mission is to provide sanitation solutions adapted to West African market needs. DELVIC operates nine fecal sludge treatment plants (FSTPs) and the J-OP through concession from the Office National de l'Assainissement du Sénégal (the public agency responsible for sanitation in Senegal). DELVIC is a developed (non-startup) company generating revenues.

### The Technical Pilot

The pilot-scale J-OP unit operated by DELVIC processed 700 dry metric tons of FS in its first year of operation. It also generated pathogen-free outputs of ash and clean water while maintaining key operating parameters, such as boiler temperature within desired ranges. DELVIC continues to operate the pilot-scale unit today. Read a detailed report on the technical pilot results [here](#).

## HOW THE JANICKI OMNI PROCESSOR WORKS



For more information, visit the manufacturer's website at [www.sedron.com/janicki-omni-processor/how-it-works/](http://www.sedron.com/janicki-omni-processor/how-it-works/).



**LESSONS LEARNED:****Treating fecal sludge as feedstock, not as waste**

Dry FS is a feedstock for the J-OP. As DELVIC shifted to treating FS as a feedstock and not as waste, they **implemented the following four FSTP modifications** that enable them to maximize dried FS capture at the lowest marginal cost. These modifications, along with work to improve FS collection rates and explore alternative feedstocks, such as municipal solid waste, are important steps for the mitigation of feedstock supply risk.



**Use a brick paver base for the FSTP drying bed to improve fuel quality.**

Dried FS can become contaminated with sand and rock during its removal from a sand-lined drying bed. This contamination increases the inorganic content of the dried FS, reducing its value as fuel. Lining drying beds with pavers (or a locally available alternative) instead of sand can reduce the contamination of FS fuel. In Dakar, DELVIC found this FSTP modification to be effective in reducing fuel contamination, which enabled optimal operation of the J-OP. An additional benefit is that the paver liner provides a smooth surface to facilitate easier removal of dried fuel from the bed.



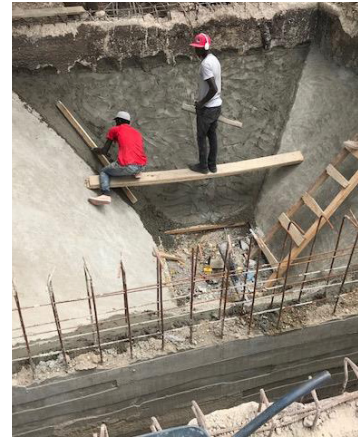
**Install drying bed covers to maintain FSTP fuel production quantities during the rainy seasons.**

At the Niayes FSTP in Dakar, FS production in 2015 and 2016 was 20% lower during the rainy seasons. To improve fuel production, DELVIC installed drying bed covers designed to withstand weather conditions. These covers enable the facility to maintain year-round fuel production capacity. The removable nature of the covers is an important design feature that facilitates quicker drying during sunny days.



**Create a dry FS storage facility to enable aggregation of fuel.**

Although the J-OP produces energy during its steady-state operation, initiating the operation of the machine consumes energy. Consequently, DELVIC identified that aggregating fuel to be added to the J-OP, as needed, was a key requirement for energy efficient operation of the technology and thus for optimal commercial operation. The ideal storage facility is weather protected (roof, walls) to maintain dryness and is forklift accessible. A new build or renovated existing structure may be appropriate. At the Senegalese FSTP Tivaouane Peulh, walls were erected around an existing structure to create the storage facility.



**Utilize flocculation to increase capture of FS solids and reduce loading on effluent treatment facilities.**

The Niayes FSTP in Dakar receives more than 8 times its current design capacity. Due to this undersizing, effluent sent to the adjacent wastewater treatment plant (WWTP) was overloaded with organic matter. In response, DELVIC investigated aluminum sulfate as a flocculation agent. Laboratory and field testing showed a conclusive increase in production of dried FS and a reduction of loading on the WWTP through use of this agent. Based on this research, DELVIC installed full-scale flocculation systems at three FSTPs in Senegal. The result has been an approximately 50% increase in dry FS production.

## LESSONS LEARNED:

# Navigating the permitting process

From start to finish, it took DELVIC over 2 years to secure the J-OP permit in Dakar. DELVIC’s experience and lessons learned when navigating the permitting process can be leveraged for projects in other markets. In applying these lessons, a critical first step is to understand the relevant regulatory and institutional frameworks in the market of interest.

### Regulatory requirements should be included in the cost-benefit analysis for site selection.

In Dakar, the J-OP will be located at the existing Tivaouane Peulh FSTP. This required DELVIC to assess the impact of sea rise on the site because of ocean proximity and meet specific sound emission requirements because of residential community proximity. These added costs were offset by other site benefits, including colocation with 400 m<sup>3</sup>/d of existing drying beds, available land for installing the technology, and proximity to a potential buyer of electricity produced by the J-OP. However, it is important to consider regulatory requirements before selecting a site.

### Innovative technology features can bring unexpected delays.

The J-OP’s boiler converts dried FS to electric power, so DELVIC expected the device to be classified as a boiler for permitting purposes. However, prior to the J-OP, Senegalese regulators viewed dried FS as waste and not as fuel. Accordingly, after

initial review, they qualified the J-OP as an incinerator rather than a boiler. This was a challenge for DELVIC because the incinerator emissions standard would have been technically much more difficult to achieve in the environmental impact study.

Consequently, DELVIC engaged a Senegalese standardization organization and established an expert panel to evaluate the innovative nature of the J-OP and to demonstrate their claims about dried FS as a fuel. At the end of the process, DELVIC — along with universities, other private companies, and public institutions — was able to convince regulators to consider dried FS as a fuel and not as waste. This allowed the J-OP to be classified as a boiler. Although this was a successful outcome, significant time and resources were required to achieve it.

### Prepare for public feedback from diverse stakeholders.

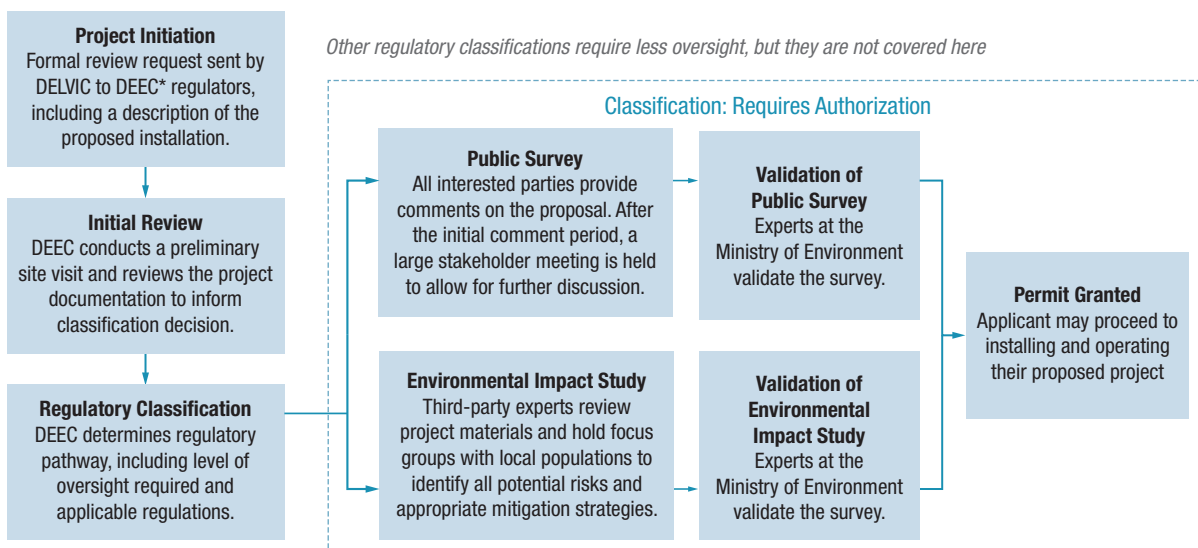
Public feedback processes are often an aspect of the permitting process. For the J-OP in Senegal, a public survey was

conducted with technical experts from relevant national ministries, nongovernmental organizations, and local government and populations. As a Senegalese organization, DELVIC understood the needs and goals of these stakeholders when developing their proposal. One key to a smooth permitting process is to ensure having the necessary expertise to understand diverse market stakeholders.

### New technologies can require expensive testing to meet regulatory requirements.

The J-OP required that data related to air and sound emissions satisfy risk mitigations in the environmental impact study. As a new technology, these data were not already on file for the J-OP. This necessitated testing to produce the data. However, testing can be costly, as it requires expensive equipment and an operational, full-scale device.

## Regulatory Process Followed by DELVIC for the J-OP in Senegal



\*DEEC – or the Division de l’Environnement et des Etablissements Classés – is responsible for environmental protection in Senegal.

## LESSONS LEARNED:

# Selecting and developing by-product sales channels

DELVIC’s commercial field test aims to demonstrate that the sale of J-OP treatment by-products can generate revenue to offset the cost of the technology. DELVIC used a structured, context-specific process for selecting and developing by-product sales channels. Completing this work ahead of the commercial field test will be key in enabling DELVIC to demonstrate the financial value proposition of the J-OP.

### Before starting, build a marketing team to ensure long-term success.

DELVIC are experts in FS management, but when forming their team to drive J-OP by-product sales, they identified a skill gap in marketing to business-to-consumer (B2C) and business-to-business (B2B) customers. In response, they made strategic hires and brought in experienced B2C and B2B marketing experts to lead the team. Existing DELVIC staff rounded out the marketing team to provide Senegal-market expertise and foster capacity development within DELVIC.

### Prioritize sales and distribution channels based on technology and market-specific factors.

Senegal-specific market analysis, existing partnerships, and J-OP technology features — such as water distillation and pathogen reduction inherent to the system design — informed how DELVIC prioritized sales opportunities.







Prioritization should be based on rigorous, market-specific research on each potential sales opportunity. Also, key topics should be researched, such as by-product market size and trends, incumbent product pricing, leading brands, distribution channels and associated costs, key buyers, and buyer

preferences. These topics can be explored through a combination of literature reviews, expert interviews, focus groups, consumer preference surveys, trade associations, and ethnographic research.

### Engage sales and distribution channel partners to iteratively develop a product value proposition and to inform direct and indirect costs.

DELVIC undertook small-scale studies to understand buyer perceptions of their products. Feedback allowed them to iterate on their packaging designs and conduct further performance testing, as needed, to facilitate future mass-market success.

## Selecting and Developing Sales Channels for the J-OP By-Products in Senegal

 <p><b>Water</b> Distilled steam from combustion process</p>	<ul style="list-style-type: none"> <li>• Agricultural water</li> <li>• Engine coolant</li> <li>• Other industrial water</li> </ul>	<p><b>Senegal Water Market Analysis</b></p>	 <p><b>Engine Coolant</b></p>	<ul style="list-style-type: none"> <li>• Established chemical concentrate procurement agreement</li> <li>• Engaged distributors for consumer and industrial segments</li> </ul>	<ul style="list-style-type: none"> <li>• Developed high-quality packaging and conducted user studies to understand perceived quality</li> <li>• Field and lab testing of pilot coolant samples to validate quality and performance targets</li> </ul>
 <p><b>Electricity</b> Generated from steam turbine</p>	<ul style="list-style-type: none"> <li>• Internal consumption</li> <li>• Sale to national grid</li> <li>• Behind-grid sale</li> </ul>	<p><b>Senegal Electricity Market Analysis</b></p>	 <p><b>Onsite consumption</b> Supplemented by behind-the-grid sales</p>	<ul style="list-style-type: none"> <li>• Discussed behind-the-grid sales with local WWTP to understand its power usage and willingness to pay</li> </ul>	<ul style="list-style-type: none"> <li>• Developed a micro-grid design enabling J-OP power usage to switch between onsite and offsite users</li> </ul>
 <p><b>Ash</b> Pathogen-free after J-OP combustion</p>	<ul style="list-style-type: none"> <li>• Soil conditioner</li> <li>• Fertilizer</li> <li>• Building material</li> </ul>	<p><b>Senegal Ash Market Analysis</b></p>	 <p><b>Enhanced compost</b> And further building material research</p>	<ul style="list-style-type: none"> <li>• Discussed collaboration and quality control with local composting facility</li> <li>• Connected with distribution outlets in Dakar to understand their requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrated impact of compost through field testing with government partners</li> <li>• Limited product distribution of bagged compost with technical info on labeling to gauge market interest</li> </ul>
<p><b>Consider J-OP treatment by-products</b></p>	<p><b>Identify potential sales opportunities</b></p>	<p><b>Conduct market research to inform prioritization</b></p>	<p><b>Prioritize sales opportunities</b></p>	<p><b>Engage potential sales channel partners</b></p>	<p><b>Test and refine product value proposition</b></p>

## LESSONS LEARNED:

### Preparing for the capital raise

Grant-capital has been an important resource in helping DELVIC pilot the J-OP, but if the commercial field test is successful, DELVIC will need to pursue debt and equity financing to fund their continued growth. Because DELVIC is a buyer and operator – and not a developer or IP-owner – of FS waste-to-resource technology, the following considerations were important in preparing for a capital raise. Based on an organization’s value chain position, organizational structure, and development status, considerations may vary.

#### Define and model the total capital need in the context of the broader strategy to reach breakeven and steady state – not just the cost of capital equipment.

The total costs of purchasing, commissioning, and operating the J-OP were big factors for DELVIC in considering the total capital need. However, DELVIC’s broader business strategy – including FSTP upgrades, expansion opportunities, and working capital targets – also had to be considered. Consequently, use a wide lens to identify all capital requirements before conducting a rigorous financial analysis and define the capital needed to reach breakeven and steady state. Prepare an investor pitch and business plan to communicate the investment opportunity.

#### Determine the right balance and availability of debt and equity financing to pursue.

A business will likely require a mix of debt and equity financing to meet its capital needs. Depending on the stage of the business, consider the advantages and disadvantages of each source of capital to inform the desired capital structure before raising capital.

#### Identify and prioritize a list of investors based on their appetite and suitability to the upcoming capital raise.

Prioritizing investors according to their suitability to the capital raise can help facilitate a more efficient process. The shown suitability analysis was undertaken with DELVIC in mind. When conducting this type of analysis, consider the capital need, the desired mix of capital structures, the business model, sector trends, market opportunity vis a vis risks, and geographic location.

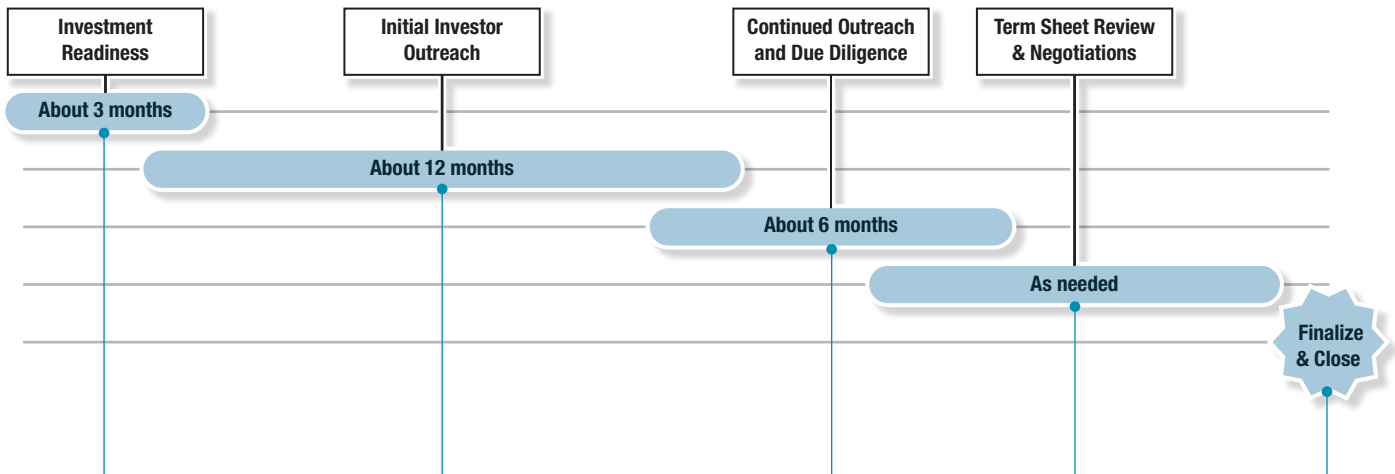
	Debt	Equity	
+	Relatively inexpensive	Relatively expensive	-
-	Amount available based on conservative assessment of ability to pay back	Amount available based on potential future value of company	+
-	Collateralized or personally guaranteed	Unsecured	+
+	No or limited (via covenants) company influence	Ownership control	-
-	Must payback: clear exit	No short-term payback; needs an exit	+
+	Often interest is tax deductible	Dividends are not tax deductible	-
+	Creates leverage effect	Dilutes ownership	-

#### DELVIC-Specific Investor Suitability Analysis

Investor type	Examples	Form of capital	Rationale for DELVIC suitability
<b>Multilateral financial institutions</b>	<ul style="list-style-type: none"> <li>AfDB (African Development Bank)</li> <li>BOAD (West African Development Bank)</li> <li>IFC (International Finance Corporation)</li> </ul>	Debt, guarantees and equity	Risky commercial venture with high prospects for development impact
<b>Commercial banks</b>	<ul style="list-style-type: none"> <li>Banque Nationale de Développement du Sénégal</li> <li>BOA (Bank of Africa Sénégal)</li> <li>SGBS (Société Générale des Banques Sénégal)</li> </ul>	Debt	Balance sheet of going concern, prior debt history, potential for asset pledged as collateral, and local currency matched to revenue
<b>Bilateral financial institutions</b>	<ul style="list-style-type: none"> <li>AFD (French Development Agency)</li> <li>JICA (Japan International Co-operation Agency)</li> <li>KfW (German Development Bank)</li> <li>USAID Development Credit Authority Guarantee</li> </ul>	Debt, guarantees and equity	Same as two above; not all have local currency; guarantees can attract local capital
<b>Infrastructure funds</b>	<ul style="list-style-type: none"> <li>AIIM (Africa Infrastructure Investment Managers)</li> <li>InfraCo Africa</li> <li>EaIF (Emerging Africa Infrastructure Fund)</li> <li>GuarantCo</li> </ul>	Senior debt, subordinate debt, and equity, guarantees	Same as all above; with added investor focus on infrastructure, private sector participation, and capacity for sophisticated structures
<b>Senegalese Government programs</b>	<ul style="list-style-type: none"> <li>FONSIS (Sovereign Funds Strategic Investment)</li> <li>FONGIP (Priority Investment Guarantee Fund)</li> </ul>	Debt, guarantees, equity and quasi-equity	Government knows the context and values development impact; ticket size often small
<b>Private equity</b>	<ul style="list-style-type: none"> <li>ECP (Emerging Capital Partners)</li> <li>AFIG (Advanced Finance &amp; Investment Group)</li> <li>I&amp;P (investisseurs &amp; Partenaires)</li> </ul>	Equity and quasi-equity	Higher cost due to risk/reward profile; appropriate for higher risk growth and expansion

**LESSONS LEARNED:****Executing the capital raise**

Ahead of their commercial field testing, DELVIC is shifting from the “investment readiness” phase to the “initial investor outreach” phase of the capital raise. A typical capital raise timeline is outlined below, including key activities and priorities for each phase. Consider these activities and priorities when executing a capital raise.

**Capital Raise Timeline**

**Finalize investor materials and hone your pitching skills before outreach.**

Key outreach materials include completed financial modeling (with a summary of key financial outputs that define the capital need), business plan, pitch deck (sales presentation on the opportunity), an investor teaser (no more than a 2-page preview of the opportunity), and outreach emails. Organize files in a data room material list to facilitate investor outreach. Also, practice delivering your pitch before beginning outreach with investors.

**Use investor list to reach out to introduce the investment opportunity, and track results.**

Generate a list of investors that are suitable to the capital raise. Use this investor list to begin outreach and create an investor tracker to record the history of contact with each investor. Share and sign non-disclosure agreements as needed at this stage.

**Continue conversations and provide ad hoc analysis for investors.**

Potential investors may request additional analysis to support their due diligence efforts. This ad hoc analysis – and the outputs from any ongoing value proposition testing – can be incorporated as updates into the outreach materials over time.

**Request term sheets and test/negotiate financing terms.**

Financing terms may not align with the initial targets. Use a financial model to test the impact of different financing terms and negotiate accordingly. Expect multiple rejections on the path to closing the deal.

**Make an informed decision and close.**

After negotiating terms, make an informed decision about the blend of financing options to accept. The decision should balance the preferred terms and the most attractive financial offers. After making this decision, include legal counsel in finalizing the agreement.

## Next Steps for the J-OP in Senegal

DELVIC plans to begin commercial field testing — an attempt to validate the financial value proposition of the J-OP — in Dakar in 2021. The commercial field-testing results will inform DELVIC's decision and strategy to scale the J-OP up to other sites in Senegal and abroad. DELVIC expects to site the commercial-scale J-OP unit at the Tivaouane Peulh FSTP, where the FSTP upgrades detailed in this reported have already been completed.



**The commercial-scale J-OP in Washington State, USA**



**The Tivaouane Peulh FSTP in Dakar, Senegal, the proposed site for the commercial-scale J-OP**