







PROVIDING ENERGY ACCESS: SOLÉVOLT OFF-GRID SOLAR SYSTEM

EXPERIMENTATION RESULT

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KOPERNIK

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Electricity is important to support regional development, yet people in Wae Sano Village, East Nusa Tenggara (NTT), still struggle to have access. The absence of electricity in this village has hampered many activities, including the expansion of SMEs (small-medium enterprises). The Tungku Mose group, an association of herbal medicine *(jamu*) producers in Wae Sano, have been attempting to increase their production as their product's market expands, however their lack of electricity has impeded this growth.

Solévolt's Enterprise off-grid solar system, generating enough power for a house or small business, offers a solution to their problem. In this experiment a Solévolt system was installed at the Wae Sano village office. Alongside this system we also installed an electric grater to help with *jamu* production, and a cellular signal router to help Tungku Mose reach its customers and improve the village's communications. In this experiment, we were testing whether the Solévolt system had sufficient capacity to power the electrical appliances required by Tungku Mose. We evaluated:

- The capacity of the solar system to power lights, a grating machine, and a cellular signal router;
- The consumption of electricity per day by the Tungku Mose group; and
- The hours per day needed to charge the solar system to meet output needs.

In addition, the village office also used the electricity source to power electrical appliances used for their office work and this consumption was also included in our calculations. The results showed that the Solévolt system had sufficient capacity to power lights, a grating machine, and the cellular signal router, as well as the village office's printer, laptops and could charge mobile phones. The average charging time for the system was 11 hours per day, and the power consumption was only 164Wh, much less than the 481Wh capacity generated.

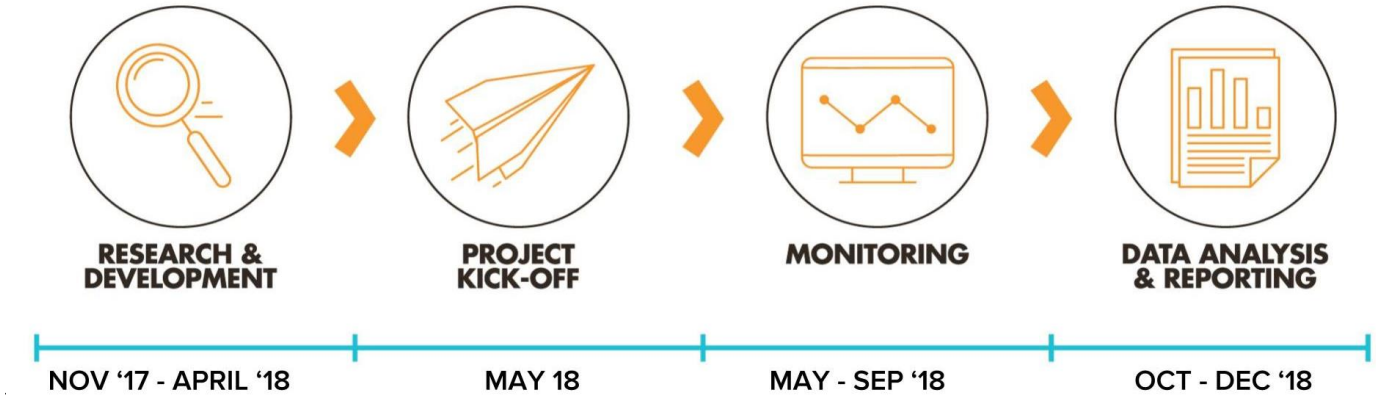
Special points of interest:

- People in Wae Sano Village still struggle to access electricity.
- Solévolt's System had sufficient capacity to support local activities.

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TIMELINE



CONTEXT

Electricity access remains a significant challenge in rural parts of Indonesia, especially in East Nusa Tenggara (NTT) province. Of the roughly one million people living in poverty in NTT, 74 percent do not have access to electricity in everyday life. This[1] presents a huge challenge to the local population as electricity access is known to be an important element supporting regional development.

These energy challenges exist in Nunang sub-village, Flores, NTT, a region famous for its *jamu* (traditional herbal medicine). This remote village is home to Tungku Mose, a *jamu* production association comprised[2] mostly of local women. The members of Tungku Mose produce *jamu* in their homes and sell their products at the local market, *Pasar Werang*, and further afield in Labuan Bajo. Tungku Mose members have been trying to increase production as they see their market expanding, however they lack the electricity needed to support this growth.

A lack of electricity effects *jamu* producers in two ways. Firstly, it hampers the mechanization of the production process, meaning production is still largely done using manual methods rather than using machines. Some producers rent a mechanical grater powered by a diesel generator, but this leads to a significant increase in production costs. Secondly, *jamu* producers find it difficult to connect with buyers, especially those outside Wae Sano, as they do not have access to a mobile phone network. To get a phone signal, people in Nunang must travel 2.5 km to Ta'al Sub-Village, limiting the group's sales opportunities to external markets. By providing electricity to Wae Sano we will assist to overcome these challenges, improving the situation for the Tungku Mose group by providing lights, a grating machine and a cellular signal router.



Figure 1. Turmeric root that Tungku Mose use in their products



Figure 2. Ibu Mathildis, one of Tungku Mose's members holding turmeric herbal powder

[1] *TNP2K (2012) Data Terpadu Program Penanganan Fakir Miskin. Retrieved from Satu Data Indonesia*

[2] *Based on an interview conducted with the Village Head of Wae Sano, August 2017*

HYPOTHESIS

We hypothesized that the Solévolt Enterprise off-grid solar system had sufficient capacity to power lights, a grating machine and a cellular signal router, increasing business productivity for the Tungku Mose group.



Figure 3. The installation process of the Solévolt System

METHODOLOGY

We worked with the secretary of Wae Sano Village, who is also a spokesperson for Tungku Mose, to gather the necessary data. Over four months we collected information regarding the capacity of the Solévolt system to power electrical appliances, the total electricity consumption per day, and the hours per day needed to charge the solar system.

We also asked Tungku Mose about production capacity and sales before and after the Solévolt system was installed to see if the provision of electricity helped to expand their business.



Figure 4. Pak Marsel, Village Secretary is photocopying documents using a printer powered by Solévolt System



Project Location is at Wae Sano Village, North Manggarai District, Flores

FINDINGS

Technology Performance

The Solévolt Enterprise energy system is a solar-powered, off-grid electricity generator and storage system. It has a 1.2kWh capacity lithium-ion battery and can generate up to 500Wh of power. The system was installed at the Wae Sano village office and successfully powered a grater machine (used by Tungku Mose's members), a cellular signal router, and the village office's electrical equipment.

The main product that Tungku Mose members produce is a herbal powder from turmeric (*temulawak*). The electric grater was provided to process the turmeric powder from its plant form. In addition, the Solévolt system was used to power four LED lights, a laptop, a printer and scanner, and to charge mobile phones belonging to the village officers. We also installed a cellular signal router to improve communications in the village and help the Tungku Mose reach their customers, receive orders, and to promote their product.



Figure 5. a) Solar panels were installed on the roof of Wae Sano village office. b) The grater machine used to process turmeric. c) The Wae Sano Village secretary using their printer. d) One of four LED lights installed in the village office.

After a four-month test period, we found that the Solévolt system produced 481Wh of power a day on average. This showed that the system worked more or less as intended at a capacity of 500Wh of power from sunlight. It took an average of 11 hours of charging to generate this power. While the average daily power consumption in the village was only 164Wh, our experiment showed that this system had an additional 300Wh capacity and could therefore handle much larger equipment and fuel a larger SME.

Business Productivity

Turmeric is a famous plant known for its culinary and medicinal uses. The plant has been proven to be anti-inflammatory, an antioxidant, antimicrobial, hepatoprotective (protects the liver), and antimutagenic (helps prevent new cancer caused by radiation therapy)[3][4][5][6][7]. Due to its medicinal properties and the fact that it is grown easily in Indonesia, turmeric has been used for many generations and has a stable market demand.

Due to promising market opportunities, turmeric farmers in Wae Sano Village received training in 2003 from a local organization, AYO Indonesia, to make turmeric products that met market standards. Since then, the village has become quite famous as a major turmeric *jamu* producer in West Manggarai. Every week, one producer grates approximately 15 kilograms of turmeric by hand, a process which can take up to 9 hours. Ibu Mathildis, a Tungku Mose member reported that the electric grater machine reduced the grating time by up to 72 percent, from 9 hours per 15 kilograms down to 2.5 hours (Figure 2). In addition, the technology also increased the quality of the product, producing a smoother turmeric powder than the manual process.

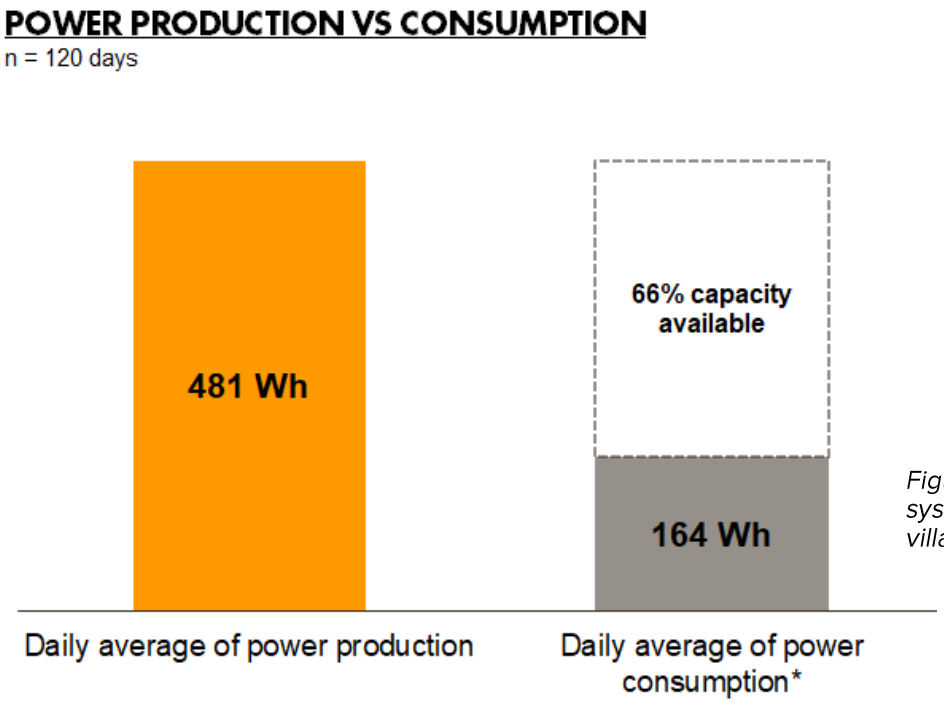


Figure 6. Power input generated by the system and power consumption in the village

[3] *Ammon HP, Safayhi H, Mack T, Sabieraj J (1993). Mechanism of anti-inflammatory actions of curcumin and boswellic acids. Journal of Ethnopharmacol. 1993;38:113–9.*

[4] *Ramirez-Bosca A, Soler A, Gutierrez MA (1995). Antioxidant curcuma extracts decrease the blood lipid peroxide levels of human subjects. Age. 1995;18:167–9.*

herbal powder from the 15 kilograms of turmeric root. The powder is sold in 500 gram packs for IDR40,000 (USD2.75) per pack. In theory, the reduction in processing time from the use of the electric grater could increase the production of turmeric powder from 5 kilograms to 17.5 kilograms per producer, assuming enough turmeric root is available and the market demand for the additional product volume exists. Therefore, the mechanization of this process has the potential to greatly increase productivity.

While this result is promising, the sales numbers reported by the group did not significantly increase. The group admitted that they had not used the grater machine to its full capacity because it was not initially installed properly by the village office. Once the installation errors were fixed by the Kopernik team during a monitoring visit in late August, they started using the machine more frequently. Having the machine in just one location was also a barrier for some producers who had to travel a long way to use it.

The cellular signal router we installed did not pick up an effective signal and therefore did not have the desired effect to enable Tungku Mose to gain telephone/text message orders. The router was installed on the roof of the village office at a height of approximately 8 meters. We think that it was perhaps not high enough to catch the signal from the nearest tower and will undertake further troubleshooting to try to rectify this situation. With more time to optimise the use of the electric grater and to resolve the router's problems, we believe these technologies would certainly increase the productivity of the Tungku Mose group.

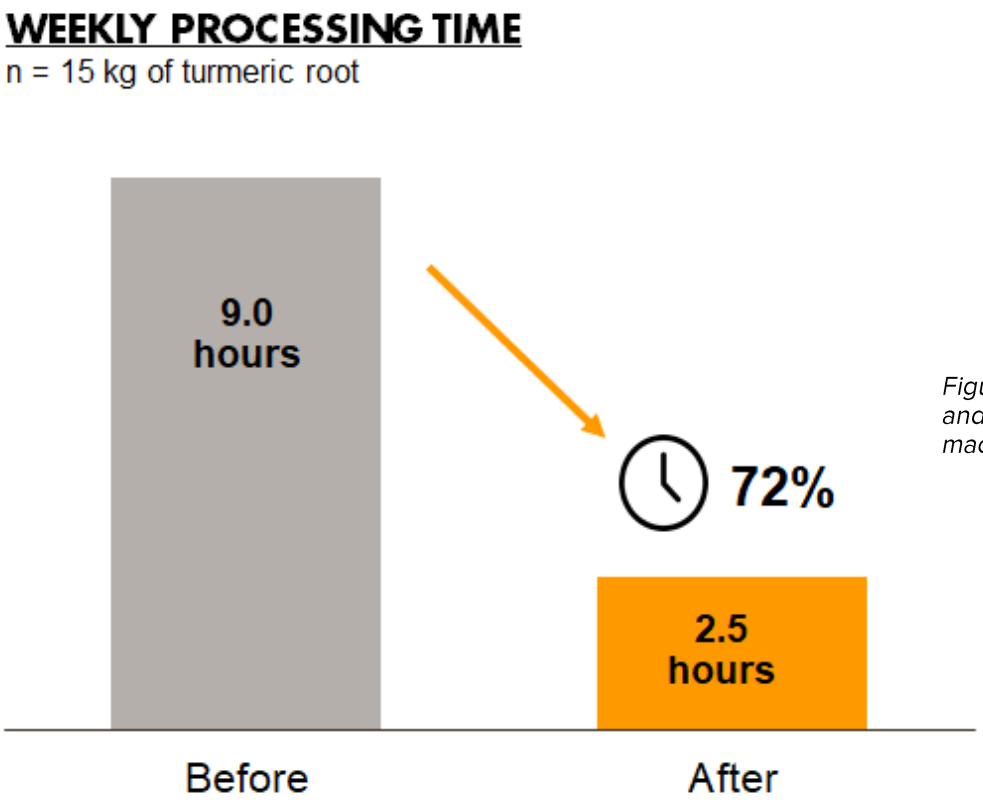


Figure 7. Weekly processing time before and after the Solévolt system and grater machine installation.

[5] *Apisariyakul A, Vanittanakom N, Buddhasukh D (1995). Antifungal activity of turmeric oil extracted from Curcuma longa (Zingiberaceae). Journal of Ethnopharmacol. 1995;49:163*

[6] *Deshpande UR, Gadre SG, Raste AS (1998). Protective effect of turmeric (Curcuma longa L.) extracts on carbon tetrachloride-induced liver damage in rats. Indian Journal of Exp Biol. 1998;36:573–7.*

Impact on the Village

Apart from the impact on the Tungku Mose group, the installation of the Solévolt system also impacted the rest of the village community. During an interview with the village officer, it was reported that the technology had improved the village office's service to the people. The most frequent service needed by the local people is to acquire a *surat keterangan ekonomi lemah*, a statement letter from the village explaining that the family is from a low-income background. The letter is needed to get free healthcare, free tuition fees for children, or subsidies from government programs.

Previously, without electricity, it was challenging for the village officer to print these letters and do other basic activities such as copying important documents. They usually had to buy 2 litres of fuel for the diesel generator to power the laptop and lighting which cost them IDR40,000 (USD2.74) per day. Once a week they also needed to go to Labuan Bajo, the biggest city in West Manggarai, to copy and print important documents. This is almost a 120km round trip by motorbike, requiring 2.5 liters[8] of gasoline and a minimum of four hours to complete.

Since the Solévolt system was installed, important operational activities and requests are now being performed in Wae Sano. The village secretary reported that they no longer need to buy fuel for the diesel generator and reduced their trips to Labuan Bajo for printing and copying important documents. The Solévolt system had the sufficient capacity to power all the electrical appliances in the village office, including the printer. School students and teachers in the area have also used the office to print school.

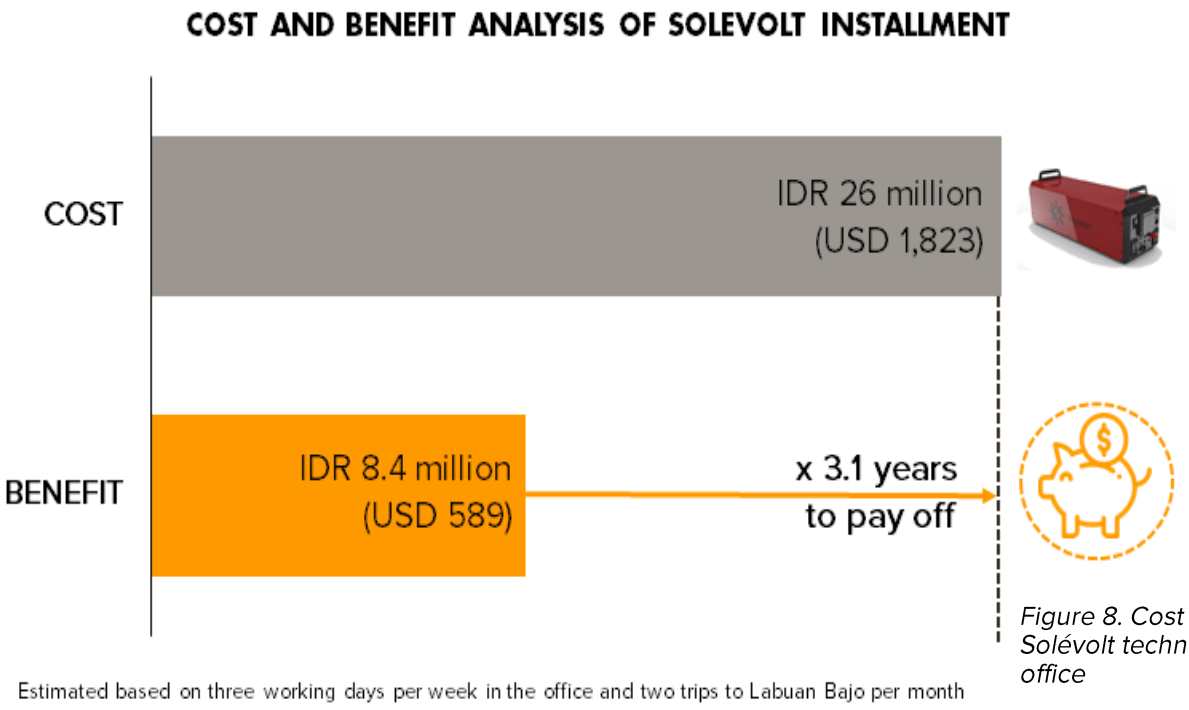


Figure 8. Cost and benefit analysis of Solévolt technology for the village office

[7] *Kawamori T, Lubet R, Steele VE (1995). Chemopreventative effect of curcumin, a naturally occurring anti-inflammatory agent, during the promotion/progression stages of colon cancer. Cancer Res. 1999;59:597–01.*

[8] *Based on the interview, the cost of gasoline in Wae Sano village was IDR10,000 (~USD0.68) per liter*

The economic viability calculations show that it will only take 3.1 years for the village office to pay back the initial investment with money saved from reducing fuel dependence. This is a viable investment when the product has an expected lifespan on 5 years - 10 years. During the final interview, the village secretary stated that the head of the village wanted to buy this technology after experiencing its benefits. Kopernik has offered to provide a discounted rate for the village so they can use their village fund to purchase this technology for their continued long-term benefit.

CONCLUSION

The results of this experiment proved that the Solévolt Enterprise off-grid system has sufficient capacity to power lights, a grating machine and a cellular signal router in Wae Sano Village. The system can generate 481Wh of electricity per day, similar to the manufacturer's reported 500Wh capacity. The average power consumption for this village was still very low at 164Wh, indicating the product could be used for more high-capacity appliances.

For the Tungku Mose group, the Solévolt off-grid system helped to reduce the grating time for turmeric by making an electric grater accessible. Their members can reduce their weekly processing time by up to 72 percent and potentially increase their production by 3.5 times. Unfortunately we were unable to determine a realistic increase in sales by the group, as only a few members had begun to use the grater machine due to initial installation errors. The fact that the cellular signal router did not work also meant it did not have the desired effect of increasing sales further afield by having access to telephone orders. We still hope to rectify this with an adjustment in its installation.

Apart from the potential benefits to the Tungku Mose group, the technology actually had a much larger and an unexpected impact on the village in general. The village office reduced their gasoline consumption as they no longer needed to power a diesel generator or go to Labuan Bajo to print and copy important documents, which resulted in a desire to purchase the product for long-term ownership. The village officer also reported an increase in the villager's satisfaction in their services because of this technology.

"The technology has been helping us to tackle urgent requests such as reference letters needing to be obtained for free healthcare at the hospital. Previously we had to go to Labuan Bajo for printing, now we can produce the letter on the day it was requested. Another great thing is that unlike a diesel generator this technology is not noisy at all so it does not disturb the activities in the office, plus, I can charge my mobile phone now!" - Pak Simon, the Head of Sub-Village

RECOMMENDATION

Based on the results of this experiment, Kopernik recommends that:

- Further adjustments are made to resolve the issues with the signal router to see whether that has an effect on increasing Tungku Mose's sales;
- The village office, in collaboration with Kopernik, seek funding from the village fund for the Wae Sano village to procure the Solévolt off-grid solar technology at a discounted rate.

Please note: Kopernik was notified by the manufacturer of all Solévolt systems, that their production had ceased six months ago so unfortunately Kopernik will not be able to move forward with a second phase for this project to identify ways to encourage wider use and distribution. We will continue to research alternative products and will add an update here if we gain further information.