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INTERNATIONAL SWITCH ENERGY
CASE COMPETITION 2022

POLARIS CONSULTING

MYANMAR: SPARKING A BETTER FUTURE

A 30-Year Plan for Energy Accessibility and Healthy Cooking

INTERNATIONAL SWITCH ENERGY
CASE COMPETITION 2022

Myanmar has struggled to meet energy demand and continues to rely on inefficient cooking methods; the country needs to bring electricity access to its most rural citizens and provide a safer method to cook.

Executive Summary

Goal

Eliminate energy poverty within Myanmar, reduce the health consequences of cooking with biomass, and create a long term plan for sustainable energy development.

Question

How can Myanmar navigate the myriad of potential risks it faces in its energy development, including an ongoing civil war, a potential global recession, and widespread energy poverty, and emerge with a healthier and more robust economy?

Sparking a Better Future

Solar Rentals

Coupled with a **long term expansion** of **hydroelectric** power

Clean-Cooking Stoves

Working in **tandem** with investments in pioneering **solar cooking** technology for **long-term** dividends

Chinese Public and Private Equity

Expand **partnerships** with other local rapidly developing nations

Impact

95% **reduction in energy poverty in 30 years**

3 years of **increased life expectancy** for the average person living in Myanmar

Myanmar is one of the largest country in Southeast Asia and experienced a military coup very recently. The major issues that Myanmar face today are energy access inequality and dependence on firewood for cooking.

General Information

Myanmar at a Glance

Myanmar is the **largest country** in **Mainland Southeast Asia**. The country's capital is **Naypyidaw** and the largest city is **Yangon**.

54M

Myanmar Total population 2022

Myanmar experienced a **military coup** in Feb. 2021 in which conflicts broke out all over the country. There is still an **ongoing civil war** between the civilian government and the military, but **less active** conflicts.

$65.1B

Myanmar GDP in 2022

Main Exports

Natural gas, gemstones, Jade, dry pulses

Main Export Countries

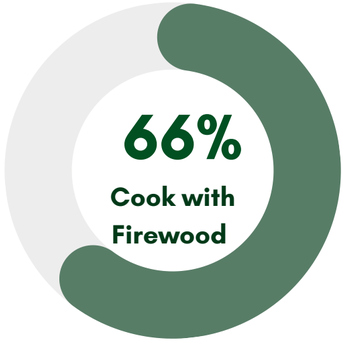
China, Thailand, Japan, Singapore, India

Issue Breakdown

1 Access Inequality

60% of rural pop. has **no access** to **electricity**

2 Dependence on Firewood



Around **36 million** Burmese still **cook with firewood indoors**. Not only is this a **fire hazard**, it also has **health implications** as people breath in **toxic chemicals** on a daily basis.

Existing initiatives has made substantial progress towards a renewable energy shift and focus should be placed on increasing energy access in rural areas

Myanmar Energy Background

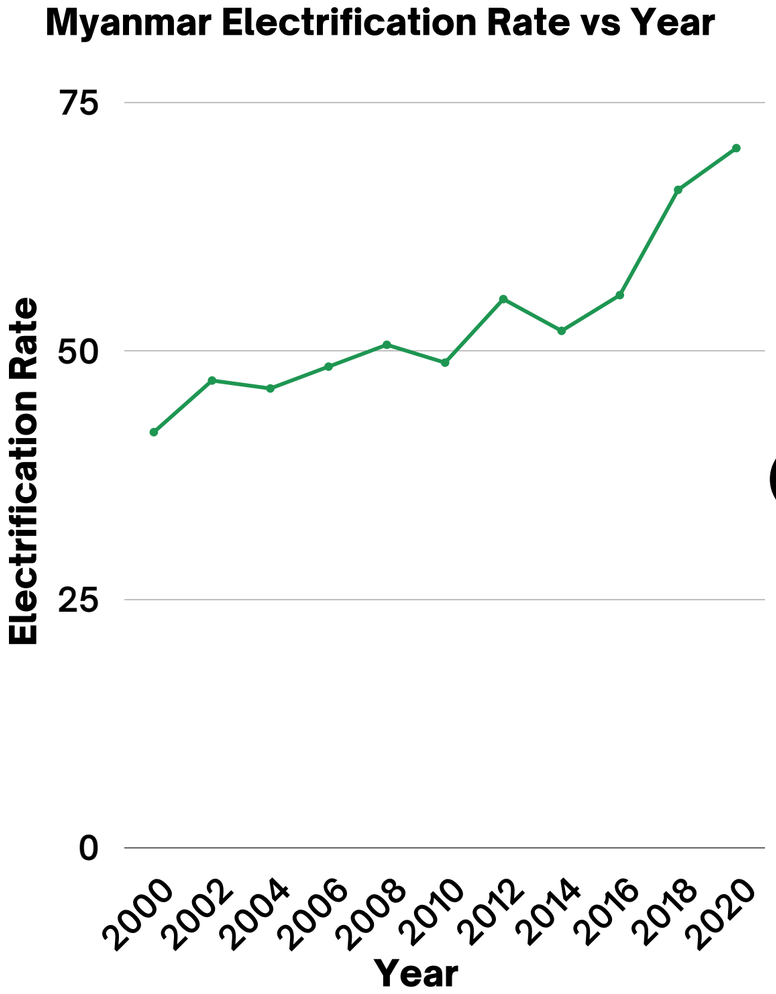
Renewable Energy Growth

Renewables generation rate reached **58.85%** in 2015, an overall increase in the past decade, although there had been slight setbacks due to internal conflicts

The Myanmar **Energy Master** Plan aims to achieve **universal electricity access** with renewables contributing **62%** of the total generation in **2030**.

In Summary**:** Myanmar has made **major progress** towards a **renewable energy** based society

Increasing Electrification



Low Rural Access

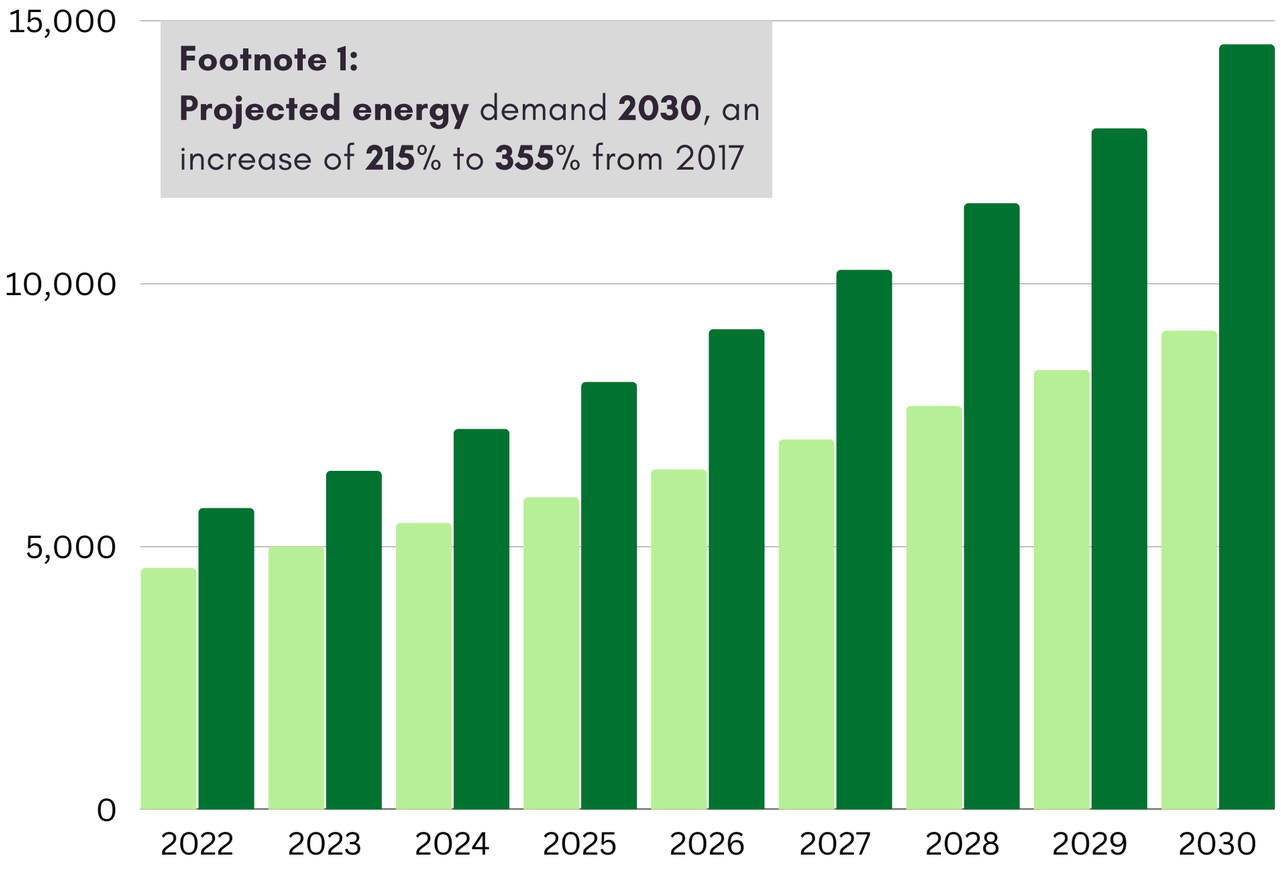
1. **Low Financial Incentive** – private companies aren't interested in grid extension into rural areas, demand is low
2. **Costly Expansion** – Remoteness of sites, dispersed nature of the populations, and difficulty of terrain increase costs
3. **Civil War** – ongoing widespread conflicts in Myanmar increase risk of investment as infrastructures can be destroyed

Myanmar must find a way to share renewable energy developments with rural populations

Myanmar's energy demand is expected to double or triple by 2030. The current energy mix includes hydro, gas and coal. The goal is to introduce solar energy within the next 30 years while expanding hydropower.

Current Status and Demand

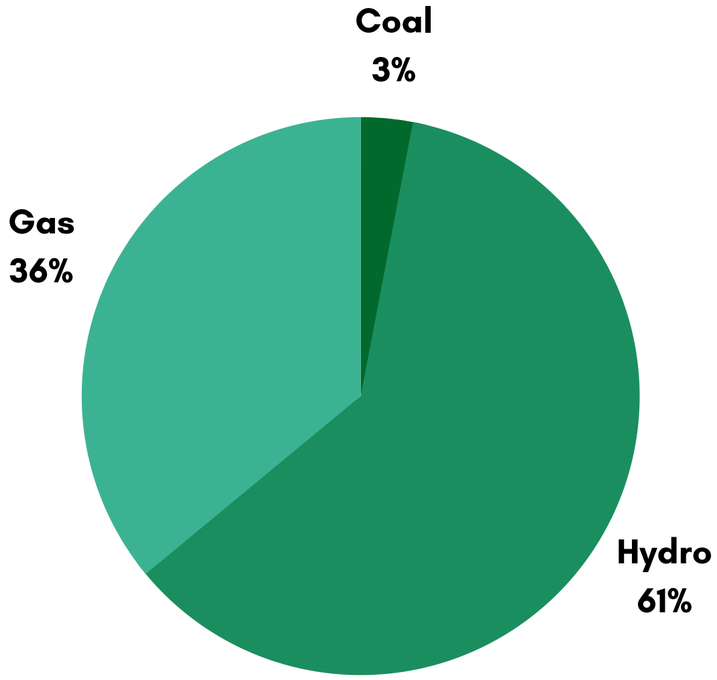
Projected Energy Demand



Footnote 1:
Projected energy demand **2030**, an increase of **215**% to **355**% from 2017

$0.029/kWh **Average electricity price** in Myanmar in 2022

Current Energy Mix



61% of current electricity is produced from **hydropower**. **Gas** is the second biggest source at **36%**

Myanmar faces several unique challenges, largely stemming from an ongoing civil war in 2021 which has spawned international sanctions and a substantial displaced population

What unique challenges does Myanmar face?

Civil War

- In February of 2021, the **military seized power** in a **coup d'état**
- This was in response to a 2020 election that gave the **opposition party majorities** in both legislative houses
- This resulted in broad **international condemnation**, widespread **public protests**, and violent **political repression** by the government
- Several **resistance groups** have engaged in **conflict** with the military

International Sanctions

- Both the **USA** and **EU** have issued **extensive sanctions** on Myanmar in response to the coup
- This targeted **individuals**, **military conglomerates**, and **arms dealers** who engaged with Myanmar
- Notably, **China** did not **condemn** the **coup d'état**, and has normal relations with the country
- The **sanctions** have **not made clear progress** towards ending military repression

Displaced Population

- The civil war has **displaced** over **200,000** people and resulted in **3 million** needing **urgent** humanitarian assistance
- The military focuses on **repression** over governance
- This has been **exacerbated** by the **prosecution** of the **Rohingya** by the military prior to the civil war
- Over 1 **million** displaced Rohingya have **fled Myanmar** for other countries

By implementing the Sparking a Better Future strategy, Myanmar will provide millions of people with immediate improvements in quality of life

Sparking a Better Future: Overview

Sparking a Better Future

Clean-Cooking Stoves

To **immediately decrease** the population's **exposure** to **harmful pollutants**, implement village clean cooking stoves while investing in **long term** solar cookers

Solar Rentals

Immediately connects the population to **electricity**, **jumpstarting** their opportunity to increase their **quality** of **lives** while investing in **long term** solutions like **solar** and **hydropower**

Chinese Public and Private Equity

Funding from **Chinese** government backed companies and private groups, who have **historical interest** in **Myanmar** electrical projects

Our ambition is to **immediately** offer **solutions** to Myanmar populations while **investing** in **longer term** concepts like **solar cookers** and supporting **existing hydro projects**, all backed by the Chinese economy

Myanmar should aim to kick off improvement in quality of life immediately, as growth compounds exponentially and delayed implementations is productivity growth lost to time

Sparking a Better Future: Fundamental Belief

Sparking the Growth of Economic Productivity

We believe access to electricity yields exponential growth over continuous periods of time. This means the earlier we can connect people to electricity, the greater the magnitude of productivity growth. Hence our emphasis on providing them that electricity ***TODAY.***

Nuclear, LNG, and Fossil Fuels are often treated as alternatives to renewable, but aren't efficient in the context of Myanmar due to infrastructure and labor needs

Sparking a Better Future: Alternatives

Why not...

1 Nuclear

- Nuclear requires a **highly trained** labor force that would take a **long time** to educate
- Nuclear takes **many years** to **construct** and large/**expensive infrastructure**
- Nuclear is **ineffective** at **delivering** energy to **rural** areas **without** a **main grid**

2 Liquified Natural Gas

- LNG would require **large infrastructure** investments to both **transport**, **hold** LNG
  - These infrastructures are unrealistic considering the **ruralness** of our **target groups**
- Also requires a **trained labor face** to undertake **maintenance** of such infrastructure

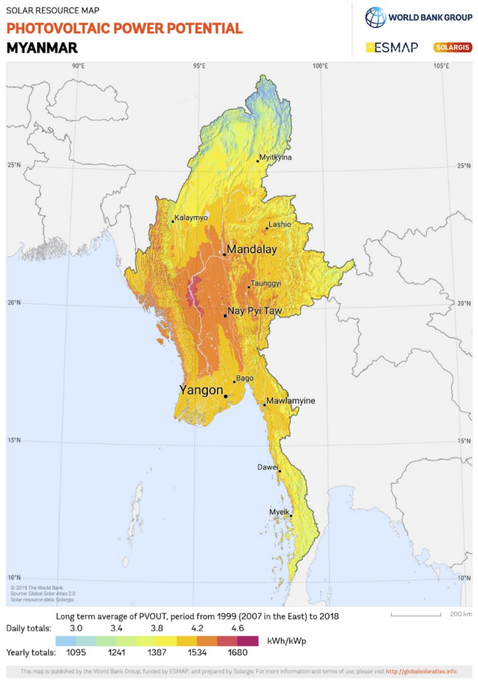
3 Fossil Fuels

- **Fails** to address how energy can be more **consistently** delivered to **rural areas**
- **Inefficient** on **smaller scales** for minigrids
- **Costly** to maintain in small scale, requires **more labor** and **infrastructure**

The immediate problem to target is short term electrification to eliminate energy poverty via mini solar grids for entire villages, providing power to rural communities with no electricity access

Sparking a Better Future: Solar Mini-Grids

Solar Mini-Grids

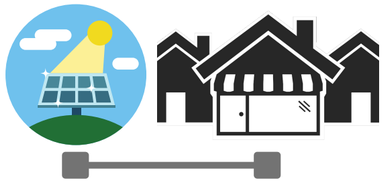


Myanmar has the **highest photovoltaic potential** of countries in the Great Mekong Subregion

Renewables have been historically underutilized - only one solar project has been completed in Myanmar

Traditional grid expansion and stabilization **is too slow** and **expensive** to be sufficient

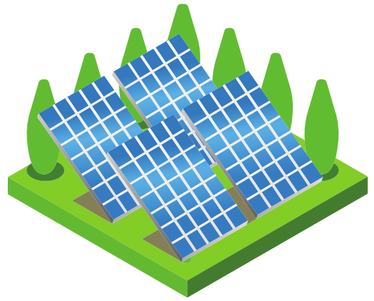
Linking Myanmar's rural communities to **off-grid mini solar farms** provides an interim solution that can be **quickly implemented**



BUT - Investment in solar panels is expensive, requiring massive upfront capital that Myanmar lacks

The **solution:** partnership with the private sector through companies like **REDAVIA**

REDAVIA **leases pre-configured mini solar grids** in developing countries



Each mini-grid can generate **233,600 KWH in a year**, enough for roughly **4000 rural households**

REDAVIA features **modular electricity storage** devices to provide **consistent energy** when the sun isn't shining and **collect excess energy**

After installation by REDAVIA, **day-to-day maintenance is minimal** and passed off to local operators

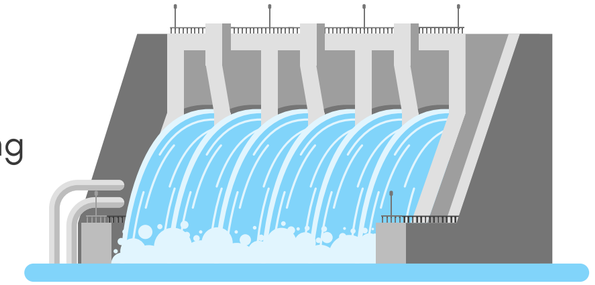
REDAVIA retains ownership of the solar panels, **covering the capital costs and higher risk**, allowing Myanmar to **use solar as a temporary solution** and wait to **invest down the line** as the **cost of renewables continues to fall**.

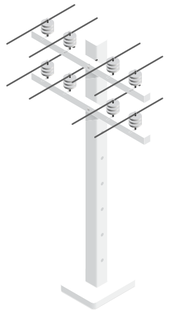
The long-term target of Myanmar involves a combination of hydropower and full scale solar farms connecting everyone to a stabilized electrical production system, increasing electrical grid reliability

Sparking a Better Future: Long Term Energy

Hydroelectric Power

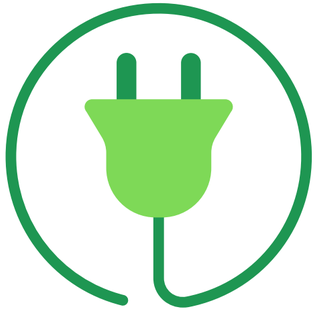
Myanmar has an **extensive** existing network of **over 200** dams, providing **62**% of the power for the country



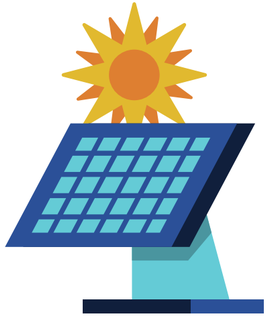


Further investment in hydroelectric power is **already in progress**, with 51 dams in the planning progress, including the **Myitsone Dam**, one of the largest dams in the region

By **investing** an **additional** $**50 million** into hydro power over the next 30 years, **Myanmar** can create its own **energy independence** and **provide stable electricity access** to millions of people



Full Scale Solar Farm Investments



During the **phasing out** of its rented solar panels, Myanmar should begin to **invest** $**100 million** in full **scale solar farms** which will be even cheaper to invest in than it is now due to the **declining price** of solar

The solar farms will also be **complemented** by the hydroelectric dams being built, which will provide a **reliable source** of **electricity** that can be varied to meet the demand of consumers

By providing **stable electricity access** and expanding the reach of the grid, more people will have **opportunity** and **economic development** will **increase** dramatically

Myanmar has the opportunity to create a sustainable, stable, and independent electricity grid by harnessing the natural resources it has in abundance: water and light

Myanmar should immediately deploy clean cooker stoves powered by biofuels that are better for the environment and reduce toxic emissions while saving money

Sparking a Better Future: Short Term Cooking

Above: an example clean cooker stove

What's a Clean Cooker Stove?

- **Varied** sizes and **materials**, dependent on purpose
- Some are **solar powered**, some are **innovations** on **traditional** stoves

What are the advantages?

- Approximately **43% reduction** in **harmful** emissions
- **Greener environmental footprint** compared to traditional stoves
- Requires **less biomass** to operate, **protecting** nearby **forests**
- minimal **training requirements**
- Can save up to **$150 a year**

How would this work?

- **Large clean cooker** stoves would be **delivered** to **villages**
  - powered by **biomass**, **more efficient** innovations
- **Villages** can **cook together** in bigger quantities, **conserve energy**, **freeing up** time

Alternative strategies to solve the cooking crisis are inefficient due to lack of infrastructure, restrictions on electrical grids, and costly delivery systems

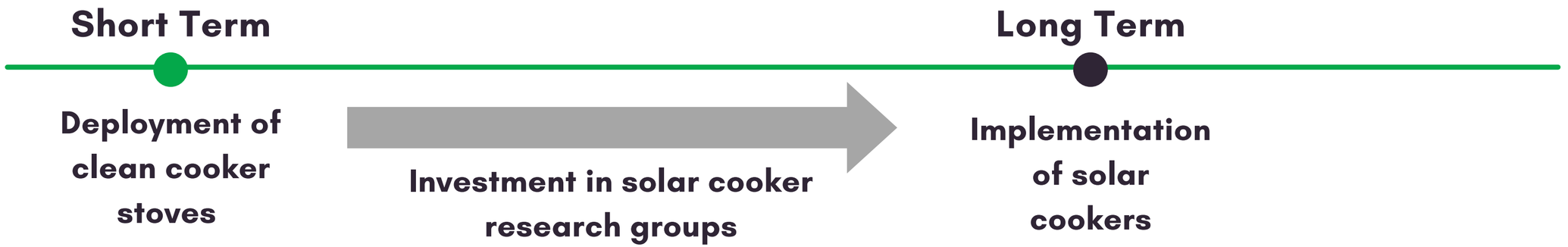
Sparking a Better Future: Alternatives

Alternative	Issue
 **Electric Stoves**	• Requires **consistent** electricity access, not possible until **further development** • People are **experiencing** a **refugee crisis**, infrastructure is not easy to develop
 **Gas Based Stoves**	• Requires **constant delivery** of **gas** ◦ This is **time consuming** with the lack of **rural infrastructure** of Myanmar ◦ Also **costly** to constantly deliver gas
 **Solar Cookers**	• Technology is not **efficient** enough yet • More **modifications** I needed for consistent use under **different conditions**

There are **several alternatives** to improved clean cookers: however, these all have varying issues, including **too early for mass deployment**, **inefficient** fuel deliveries, and **lack** of infrastructure

Alternative strategies to solve the cooking crisis are inefficient due to lack of infrastructure, restrictions on electrical grids, and costly delivery systems

Sparking a Better Future: Long Term Cooking



What progress has been made?

- Engineers in Nigeria have tested a prototype **combining two techniques**:
  - a **parabolic structure** to concentrate rays and a **cooking box** for max efficiency
- Made of **cheap**, **available** materials like **plywood**, **iron** pipes, **aluminum** sheets
- Next steps are further **efficiency modifications**, wide spread experimentation

What's the benefit of our investment?

- Accelerates research that would be hugely **impactful** in **supporting rural cooking** crisis
- Offers us **first access** to the **products** once they're ready for **deployment**
- Provides **information** about the process, **enables** us to **develop training** for **domestic** engineers

Most of our costs are upfront investments in the short term, though there are longer term costs associated with investments in research and infrastructure development

Sparking a Better Future: Cost Breakdown

							MAX 1 YEAR COST	TOTAL COSTS
SHORT TERM ENERGY	**22 M**	people living in rural areas with no electricity	**70**	Percent of the rural population targeted	**883**	Mini solar grids needed	**$37.5 M**	**$375 M**
LONG TERM ENERGY	**$50 M**	Additional invested in hydroelectricity	**$100 M**	Invested in large solar farms	**$13.5 M**	Invested in electricity infrastructure	**$37 M**	**$163.5 M**
SHORT TERM COOKING	**$36 M**	people needing devices	**20**	people per device	**20**	cost per device	**$24 M**	**$36 M**
LONG TERM COOKING	**$1 M**	Annual investment in research	**10**	Years of research	**30**	cost per device	**$30 M**	**$50.5 M**

Myanmar has existing diplomatic and economic relationship with China. China has a history of investing in major Myanmar infrastructures related to energy and sufficien

Sparking a Better Future: Funding Sources

Many **Chinese government** owned electricity producers and private groups have been **historically interested** in Myanmar energy projects: tapping into the **largest economy** of **Asia**, one that hasn't sanctioned Myanmar, will be **key**

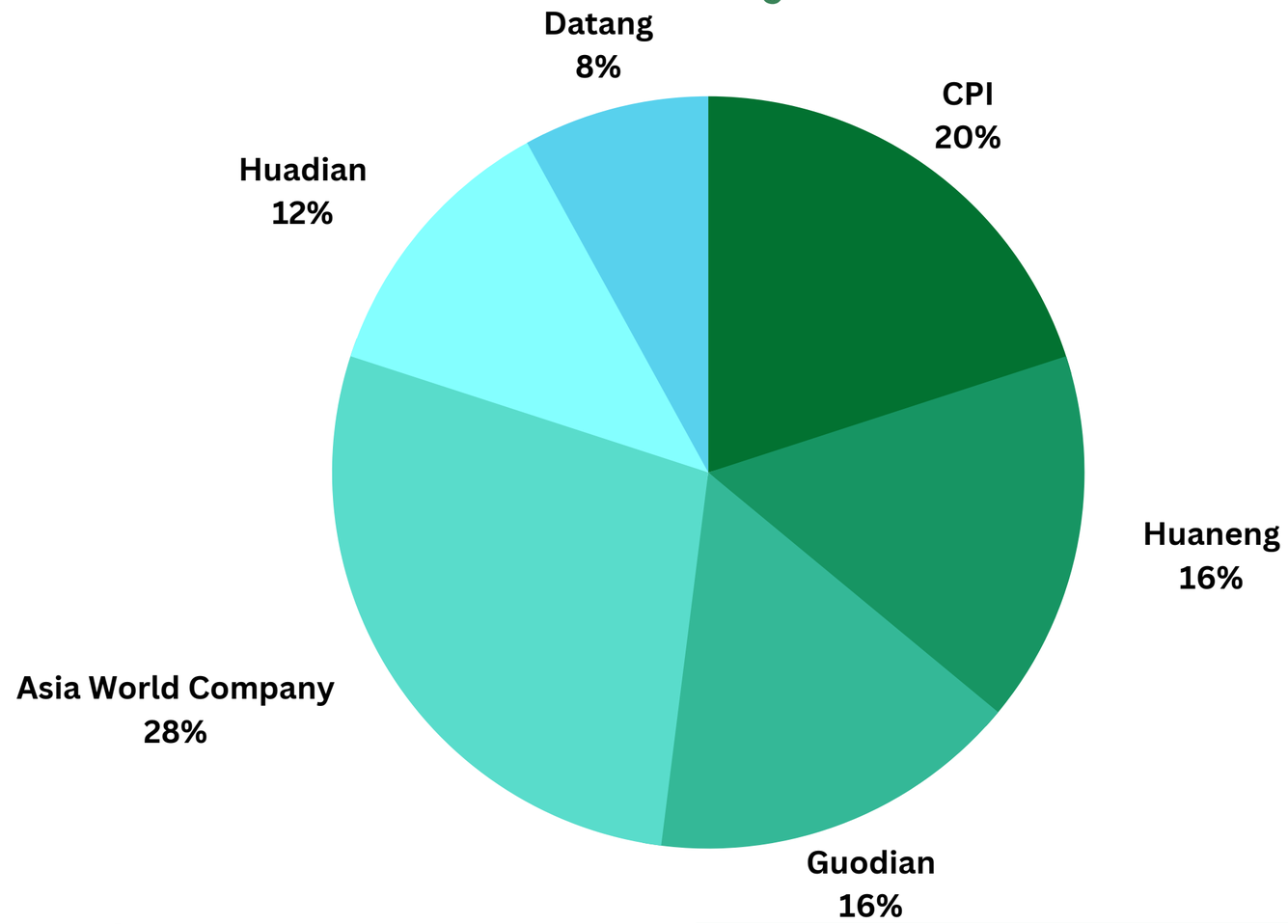
China's Top 5 State-Owned Electricity Producers

- Huaneng: asset value: $78.6B
  - Wants to generate 60% more electricity from power plants on the Silk Road
- China Huadian asset value: $113B
  - Has plans to expand overseas presence, listed Myanmar as one
- China Power Investment (CPI) asset value: $41.55B
  - Has a history of investing in Myanmar dams
- China Guodian: involved in construction and operation power stations in Myanmar
- China Datang: currently has project in Myanmar in hydropower

Asian Developmental Groups

- Asia World Company
  - Based in Myanmar, past investments in Myanmar dams, huge funnel of Asian money into Myanmar infrastructure projects

Breakdown of Funding Sources



For both power generation and cooking, we propose implementing a short term solution in the next 10 years while investing toward a permanent long term solution over the rest of the 30 year period.

Sparking a Better Future: Timeline

	2022-2032	2032-2052
POWER GENERATION	Rent farm units REDAVIA	Connect people to the grid while bringing solar and hydroelectric plans online
	Continue investing in long term solutions like existing dam projects and potential solar power farms	
COOKING	Purchase Clean Cooking Stoves	Purchase newly developed Solar Cooking Stoves
	Invest in prototype solar cooker research	Maintain solar cookers as necessary, train locals to maintain independently

● Purchases ● Research and training

Despite challenges in the form of conflict, inexperience, and an unfavorable macroeconomic climate, our proposed solution avoids the majority of these risks and turns others into benefits.

Sparking a Better Future: Risks & Mitigants

	Conflict in Myanmar	Inexperienced Government	Macroeconomic Climate
Risks	Myanmar experienced a **military coup** in Feb 2021, and there is still an **ongoing civil war** between the civilian government and the military	Myanmar's government has **little experience in renewable energy** and has had **trouble developing infrastructure** in the past	The world appears to be entering a **global recession, interest rates are climbing,** and **oil and gas remains expensive**
Mitigants	Despite the ongoing war, the conflicts that do occur happen in the **urban** areas, while our plan **focuses** on **rural** regions	In partnering with the **private sector**, our solution takes advantage of the **built-up experience** there. Allowing **village members** to take charge of **maintenance** further **reduces dependency on the government.**	Private **companies face lower business activity**, giving **Myanmar more leverage** when working with companies like **REDAVIA**.
	Our emphasis on **teaching maintenance** to village residents will **limit** the need for excessive **travel through conflict zones**	A lack of regulation can lead to **faster project development** and **more innovation**, and it this way, can actually be a benefit.	By **avoiding reliance on oil and gas** in our solution, we **limit the impact** of fluctuating oil and gas prices.

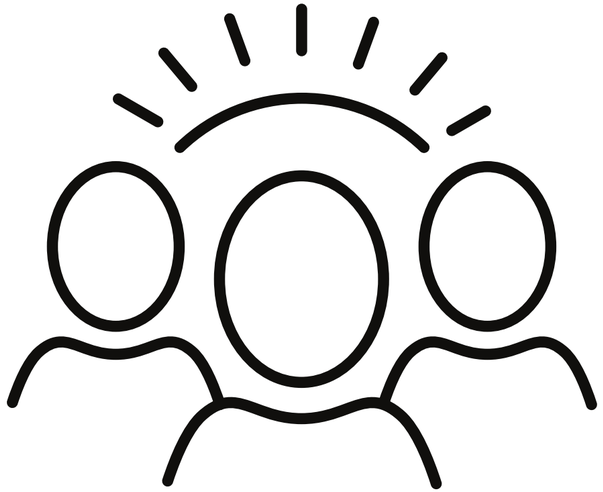
Our short-term cooking solution is a strong cultural fit for a society that emphasizes community and is already accustomed to collectively caring for many of its members.

Sparking a Better Future: Culture

How does our solution integrate with culture?

1. Close Communities

The **Myanmar Times** describes Myanmar's culture as **"collectivist"** and attributes this trait to its basis in a traditional agricultural society.



2. Providing for Community Members

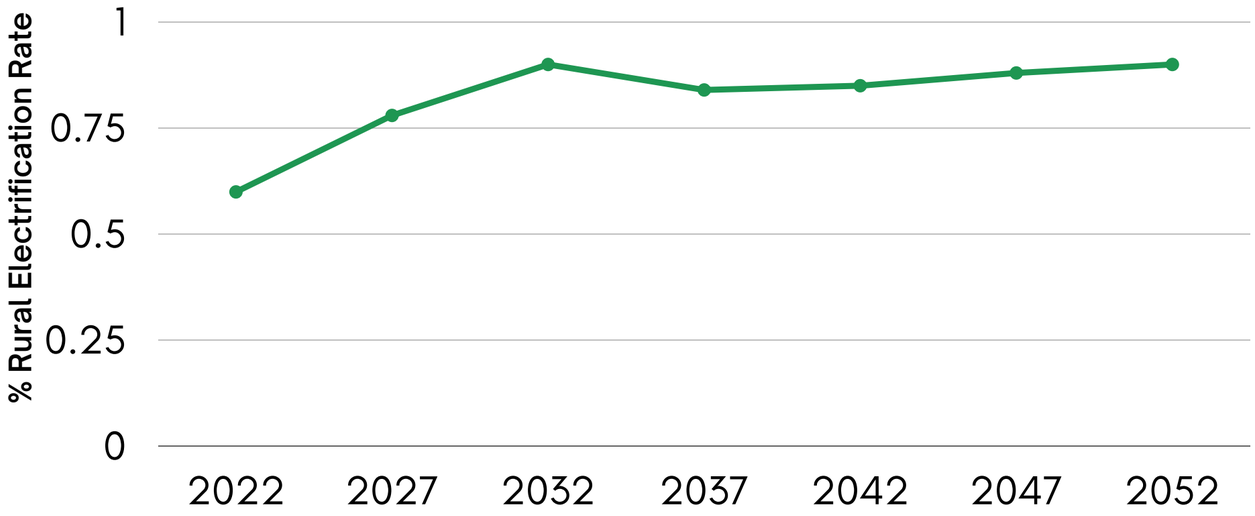
Nearly **90%** of Myanmar's population is **Buddhist**. Since monks are not permitted to hold jobs, **they rely on laypeople** to look after their **food**, clothing, and shelter needs.

The closeness of Myanmar's rural communities and their current practice of providing for community members makes for a simple **adoption** of **communal cooking** to **supplement** current cooking practices

Through the Sparking a Better Future strategy, there's a projected 91% rural electrification rate by 2052 and under 10 million people will be cooking through toxic traditional methods

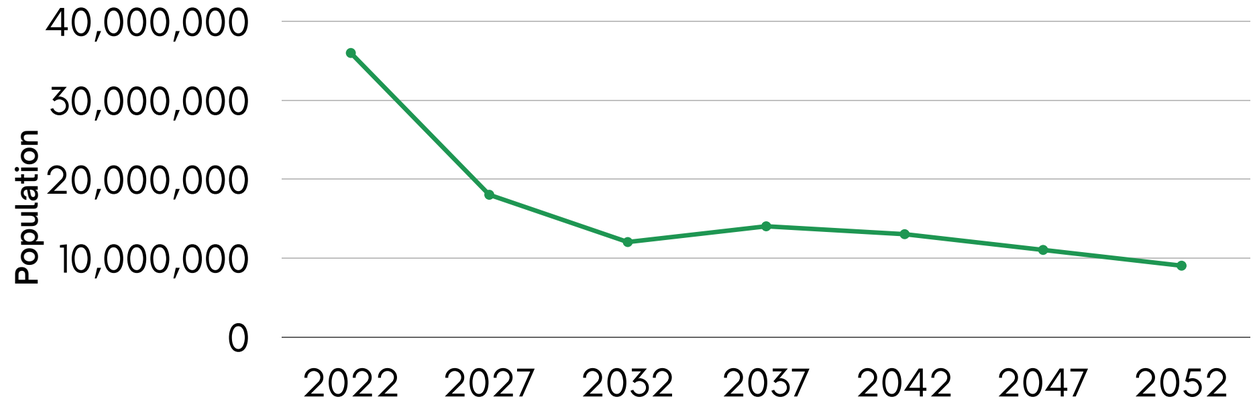
Sparking a Better Future: Projections

Rural Electrification Rate



Rural Electrification Rate: Based on immediate impact of rentals providing rural populations with electricity, factoring in plateau over time as less rural populations can be connected each year and switch over to the invested long term energies

Population using toxic cooking devices



Population Using Toxic Cooking Devices: Based on immediate impact of deploying clean cooking devices, factoring in plateau over time as less people need cooking devices each year and switch over to invested solar cookers

The Sparking a Better Future strategy has numerous health benefits and sustainable development perks, including life expectancy and educational benefits, lower fossil fuel dependency, and fewer emissions.

Sparking a Better Future: General Benefits

Health Benefits

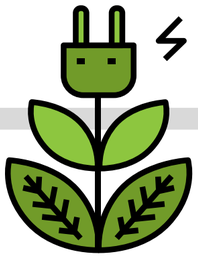
Longer Life Expectancy

Reducing exposure to toxic biogas fumes from open-flame cooking will reduce deaths from lung disease

Higher Educational Attainment

Greater access to electricity will facilitate people studying from home and allow them to pursue higher levels of education

Sustainable Development



No Importation of Fossil Fuels

By producing most of the energy they use, Myanmar will limit their exposure to negative shocks to worldwide energy supply

Fewer Emissions

Relying on clean energy sources such as solar and hydroelectricity will decrease Myanmar's carbon emissions

APPENDIX

Sparking a Better Future: Appendix

	Total Budget	Per Year Max		Total Cost								
	625,000,000.00	215,000,000.00		611,469,000								
Cost of Short Term Energy												
% Rural No Ene	**Rural Pop %**	**Total Pop**	**AVG Household**	**Rural Pop**	**% Actually Helped**	**Rural No E**	**Rur No E Houses**	**# Houses Support**	**# devices needed**	**Cost / Farm**	**Total Cost / Y**	**Total cost over 10 years**
0.60	0.69	54,800,000.00	6.00	37,812,000.(	0.70	22,687,200.(	3,781,200.00	3,000.00	882.28	42,500.00	37,496,900.0(	374,969,000.00
Cost of Long Term Energy												
Solar	**Hydro**	**Infrastrcture**										
100,000,000.00	50,000,000.00	13,531,000.00										
Cost of Short Term Cooking												
Indoor Cooking	**Ppl / Device**	**Cost / Device**	**Longevity / Devi**	**Total Cost**								
36,000,000.00	20.00	20.00	10.00	36,000,000.(								
Cost of Long Term Cooking												
Annual Researc	**# of Years**	**Cost / Device**	**Longevity / Devi**	**Total Cost**								
1,000,000.00	10.00	30.00	20.00	50,500,000.(								

Sources

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