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Team #214

Energizing Papua New Guinea

~One beat of the drum at a time~

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PROBLEM: Rural areas do not have adequate access to energy

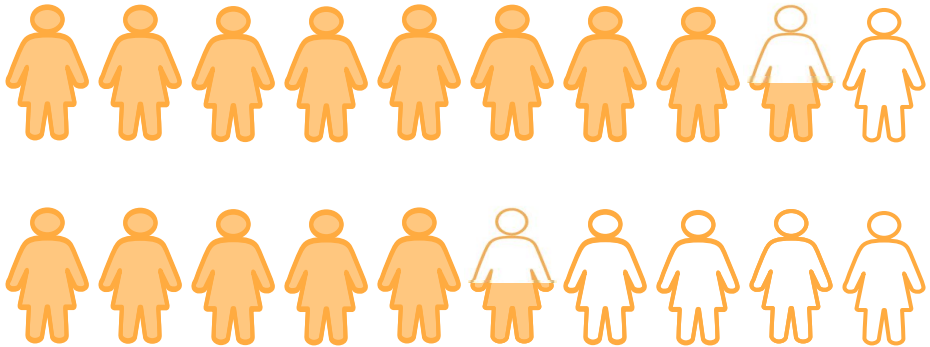
Economic Issues

- Limited funding from government
- No means of efficient energy distribution due to geographic barriers

Cultural Issues

- Land Ownership among tribes
- Tribal Conflict
- Lack of Education

ENERGY ACCESS: URBAN VS. RURAL



82.1% in Urban Areas

55.5% in Rural Areas

(World Bank, 2018)

SOLUTION SUMMARY

Technology:
Utilizing existent
systems to distribute energy

Economic Policy:
Economic & governmental policies
to promote long-term growth

Education:
Promoting education in rural
areas through accessible
resources

TIMELINE

Generate local interest and start preparing joint system with RSDP

Work with local communities to design personalized systems to educate future generations

Roll out national education resources for local use

PHASE 1

Generate international investment & funds

PHASE 2

Begin implementing energy centers at local rural medical clinics

PHASE 3

Begin rolling out wall batteries in local communities, encouraging home-energy usage

TECHNOLOGY

The community approach to energy

USE

People gather at the community center to use the electricity. They may not need it readily available in their home.

GENERATION

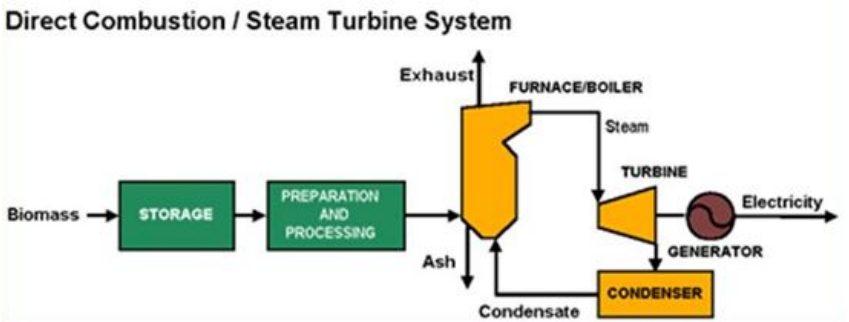
Combination of solar panels and biomass generators on and around the community center generate power for the center itself and the charging batteries.

STORAGE

Rechargeable home batteries power each house and can be traded in and recharged at the community center.

POWER GENERATION

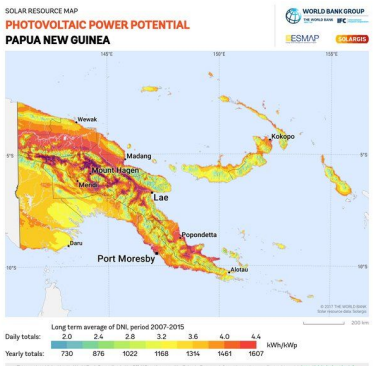
- Biomass Generators → Biomass fuels a combustion system to produce electricity
  - Utilizes agricultural waste as biomass fuel
  - Small, individual generators
  - Simple maintenance that can be taught



https://www.wbdg.org/resources/biomass-electricity-generation#:~:text=In%20a%20direct%20combustion%20system,produce%20mechanical%20or%20electrical%20energy.

POWER GENERATION

- Solar Panels → Solar cells on the roofs of the community center generate electricity
  - Not connected to an external grid, which helps mitigate infrastructure needs
  - Takes advantage of the country's high PV power potential, especially in the inland, rural areas



https://solargis.com/maps-and-gis-data/download/papua-new-guinea

GENERAL USE

- Community Center → Centralized location to use the electricity in each community
  - Not every household will need constant, direct access to electricity
  - People in the communities will already gather in centralized locations
  - Paired with the medical centers, so emergency services have priority access to power
- Households → Access to power without leaving the home
  - Option available to those who want immediate access
  - Rechargeable batteries alleviate the stress of a grid infrastructure

STORAGE

- Community Center → Network of batteries
  - Large batteries store the power generated by solar and biomass
  - Keep the charging house batteries between charges
  - Provide batteries to people for individual use if available
- Households → Single house batteries
  - Single battery to power the household electricity needs
  - Typically around 10 kWh of usable energy (⅓ the daily usage of a typical American home)

ECONOMIC FEASIBILITY: ALTERNATIVES

1 Fossil Fuels

- Somewhat cost-efficient: ~**$0.17/kWh**
- Causes long-term damage to environment → ruins export economy
- Investors may take advantage of locals

2 Hydropower

- Extremely cost-inefficient: ~**$0.85/kWh**
- Setting up infrastructure over the rugged terrain is very expensive

3 Wind Power

- Cost-efficient: ~**$0.06/kWh**
- Would require lots of space which Papua New Guinea does not have
- Setting up solar power for individual houses mitigates infrastructure costs

ECONOMIC FEASIBILITY: SOLUTION

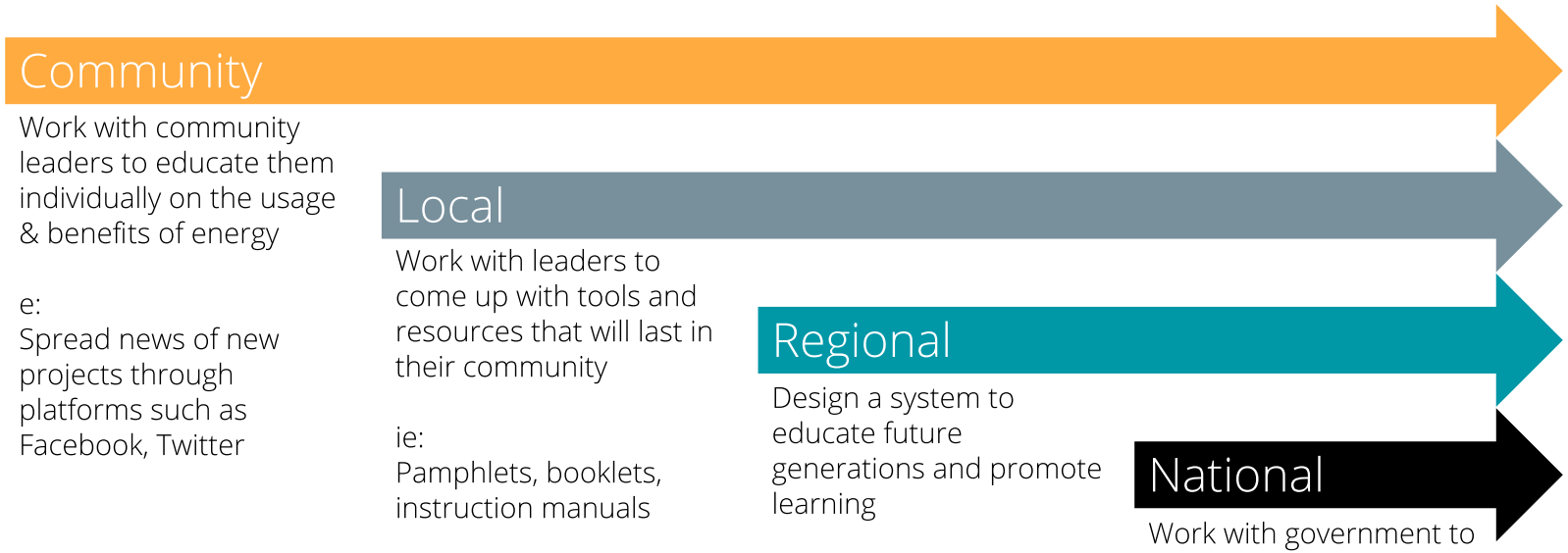
Solar

- Cost-efficient: ~**$0.10/kWh**
- Rather than using microgrids, solar power for individual houses will mitigate many infrastructure costs
- It isn't the cheapest option but it is a great balance between space, energy output, and economic growth

ECONOMIC EFFECTS

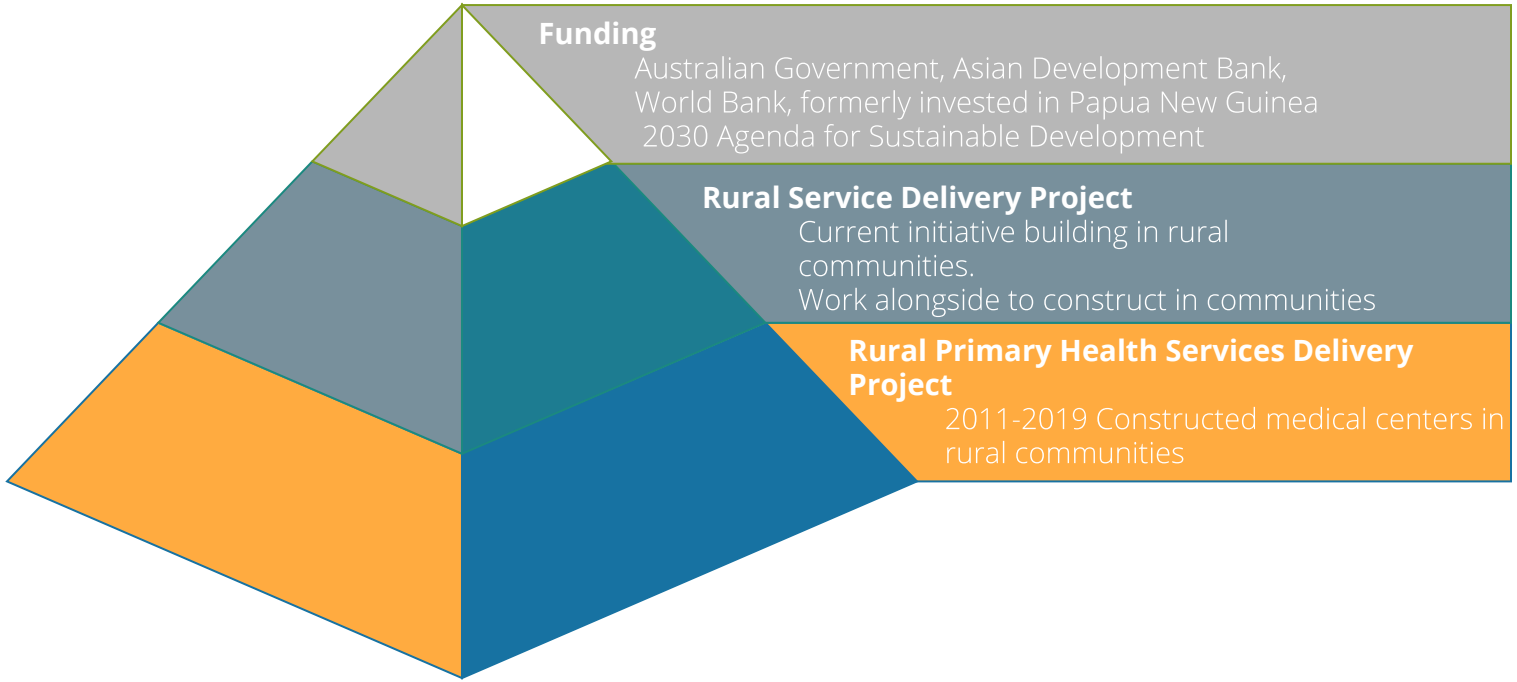
EDUCATION

Educating people from the inside out with longevity in mind

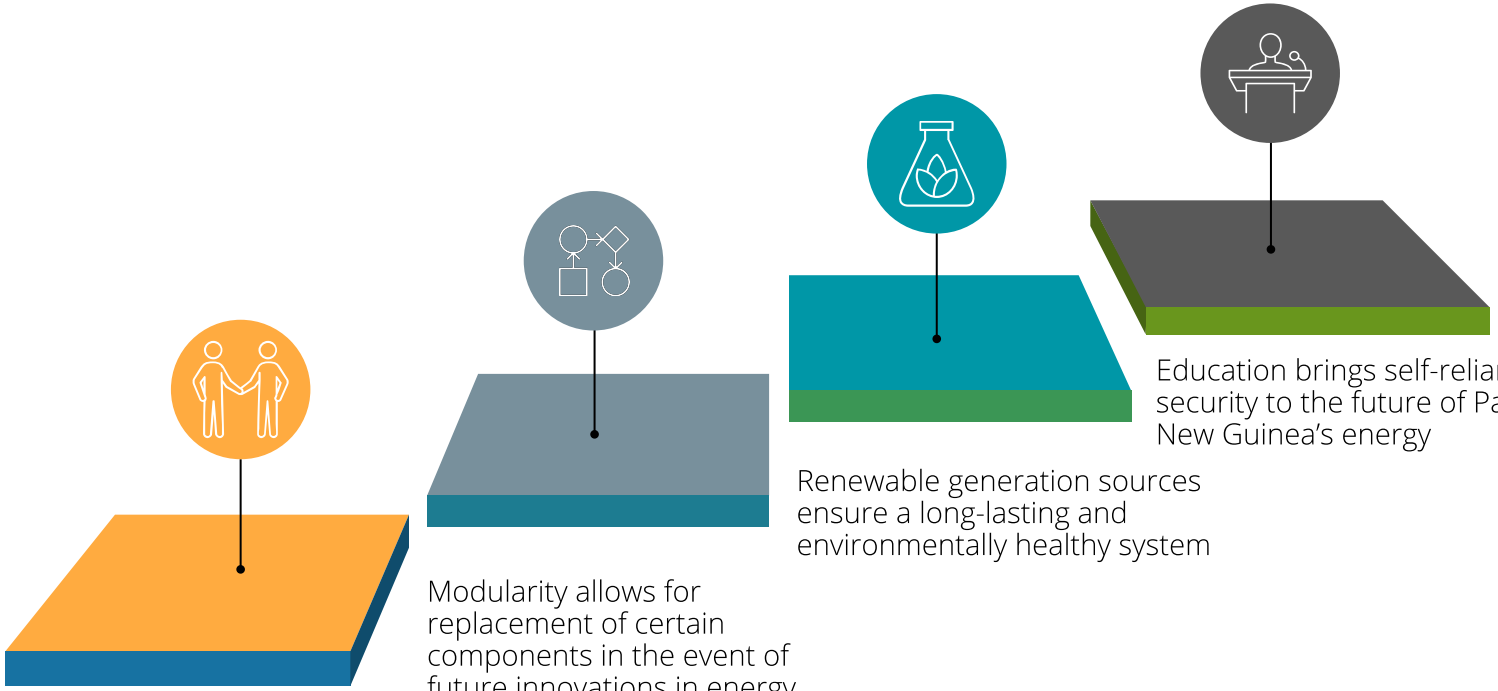


FUNDING & CONSTRUCTION

EXTERNAL GOVERNMENT INVESTMENT



SUSTAINABILITY



Meets the current needs of Papua New Guinea without overspending or overwhelming

Modularity allows for replacement of certain components in the event of future innovations in energy

Renewable generation sources ensure a long-lasting and environmentally healthy system

Education brings self-reliance and security to the future of Papua New Guinea's energy

CURRENT NEEDS

- Rural Needs → Minimal use of electricity
  - Don’t need to provide power equivalent to modern American homes
  - Access need not be available at all times, only when needed
  - Reduce infrastructure costs by conservatively providing power
- Future Needs → Room to grow
  - Solution doesn’t hinder future expansion
  - Potential for more power generation if consumption grows
  - Room for technological innovation in generation, storage, and use

MODULARITY

- Separated Components → Ease of replacement and improvement
  - Generation sources can be interchanged
  - Storage systems can be updated and moved
  - Infrastructure scales with increased consumption
- Innovation Potential → Encourages education
  - Locals can educate themselves and innovate within their community
  - Simple technological design allows for easier understanding

RENEWABLES

- Biomass Generation → Uses agricultural waste
  - Relies on the abundant agriculture in Papua New Guinea
  - Easy maintenance allows for local self sufficiency
  - Cheap individual cost helps with future growth
- Solar Power → Future-oriented power generation
  - Takes advantage of high PV potential that is unlikely to change
  - Solar is a growth industry and will continue to grow into the future

EDUCATION

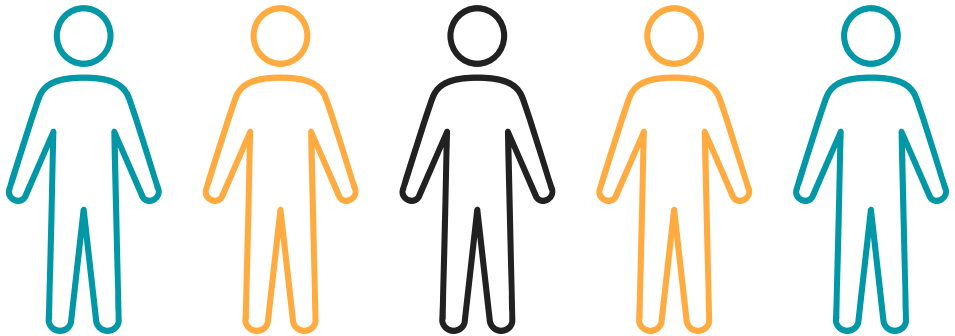
- Local Maintenance → Self sufficiency
  - Teach locals to maintain systems
  - Eventual hands-off approach from external sources
  - Internal security of energy resources
- Young Minds → Brings education to rural areas
  - Access to electricity exponentially increases access to education
  - Educated minds in rural areas bring up the country overall
  - Level education disparity little by little

SCALABILITY

- Does the solution address rural and urban communities?
  - Urban communities have access to energy and we are able to apply our solution to different rural regions of the country
- Are neighboring countries adversely affected?
  - Indonesia and the Solomon Islands will not be affected
  - This plan is partially funded by the Australian government, but they will not be adversely affected

CULTURAL SENSITIVITY

- No mass construction of grids → No governmental or cultural issues regarding land ownership
- Utilizing existing networks between regions → Easy and efficient local distribution without disturbing indigenous populations
- Economic and Education plans → Allows the people to eventually own and understand the systems in place



FUTURE PROBLEMS

Outgrowing the technology

Once Papua New Guinea has a stable energy system economic output will increase

There will likely be a need for other energy production methods that can be scaled for industrial use

Lack of participation

Our plan relies on educating community members with a bottoms-up approach

An incentive program may need to be created to make people more willing to participate

Infrastructure breakdown

If our solution with solar panels turns out to be unviable for any reason, some kind of intervention will be necessary to avoid wasting capital.

Before implementing the idea, solar panels should be tried on a selection of community members to see if it is likely to work.

REFERENCES

Rural Primary Health Services Delivery Project:
https://www.adb.org/projects/41509-013/main#project-pds

Rural Service Delivery Project:
https://pngresourcesonline.com/world-bank-backs-png-rural-services-delivery-project/
https://www.adb.org/projects/41509-013/main#project-pds

https://data.worldbank.org/indicator/EG.ELC.ACCS.RU.ZS?locations=PG

https://www.rpc.com.au/information/developing-countries/power-for-png.html

https://www.state.gov/reports/2020-investment-climate-statements/papua-new-guinea/

https://www.britannica.com/place/Papua-New-Guinea/The-colonial-period

https://medium.com/@wbdynamics/a-case-for-low-cost-renewable-green-energy-to-power-up-papua-new-guinea-8a3cf263ea59

http://www.treasury.gov.pg/html/publications/files/pub_files/2011/png-development-strategic-plan.2010-2030.pdf

https://www.rpc.com.au/information/developing-countries/power-for-png.html

http://www.geni.org/globalenergy/research/sustainable-energy-solutions-for-rural-areas-and-application-for-groundwater-extraction/Sustainable-Energy-for-Rural-Areas-and-Groundwater-Extraction-D.Fong.pdf

https://www.electricchoice.com/blog/generating-distributing-electricity-in-rural-areas/

https://dusp.mit.edu/sites/dusp.mit.edu/files/attachments/project/EMS_Microgrid.pdf

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4366939/