Letter of Intent

Implementation:

Pumped Hydro Energy Storage (PHES)

for Mosselbaai Power Supply

By Virtue of

Community Syndication

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1. *Proposition Remit*

The objective is mustering the community renewable energy resources of Mosselbaai to attain a system that caters for large scale energy storage.

By making use of the surrounding mountains a PHES solution can achieved storage rate of between 150 - 180 c/kWh (in 2023 value) with an annual increase less than half the inflation rate.

2. *Relevance of PHES for Mosselbaai*

By employing the natural phenomenon of the physical height difference in the mountain top relative to valley floor it renders the possibility of deploying of hydro energy storage installations that can power the pump station is when primary energy sources are not available. The most conventional method is by pumping water to the mountain top during off-peak periods and regenerate electricity during periods of peak demand by letting it run down again.

A prominent feature of the mountains around Mosselbaai is the number of sites where a net height difference of more than 800 meters is commonplace. Such a situation then provides a significant increase of energy to be stored relative to the volume of water required as demonstrated in figure 1 where an increase in height lead to a higher generating capacity.

The main parameter determining the capacity of a PHES scheme are the:

a. net height of the bottom to top reservoir
b. designated water flow rate
c. net volume of the water reservoir &
d. overall efficiency due to system losses

Whilst the first item is a physical given, the next two parameters are set by the functional specification. However, it is the last item which should become the focus for innovation as the full cycle average for energy recovery is generally less than 75%.

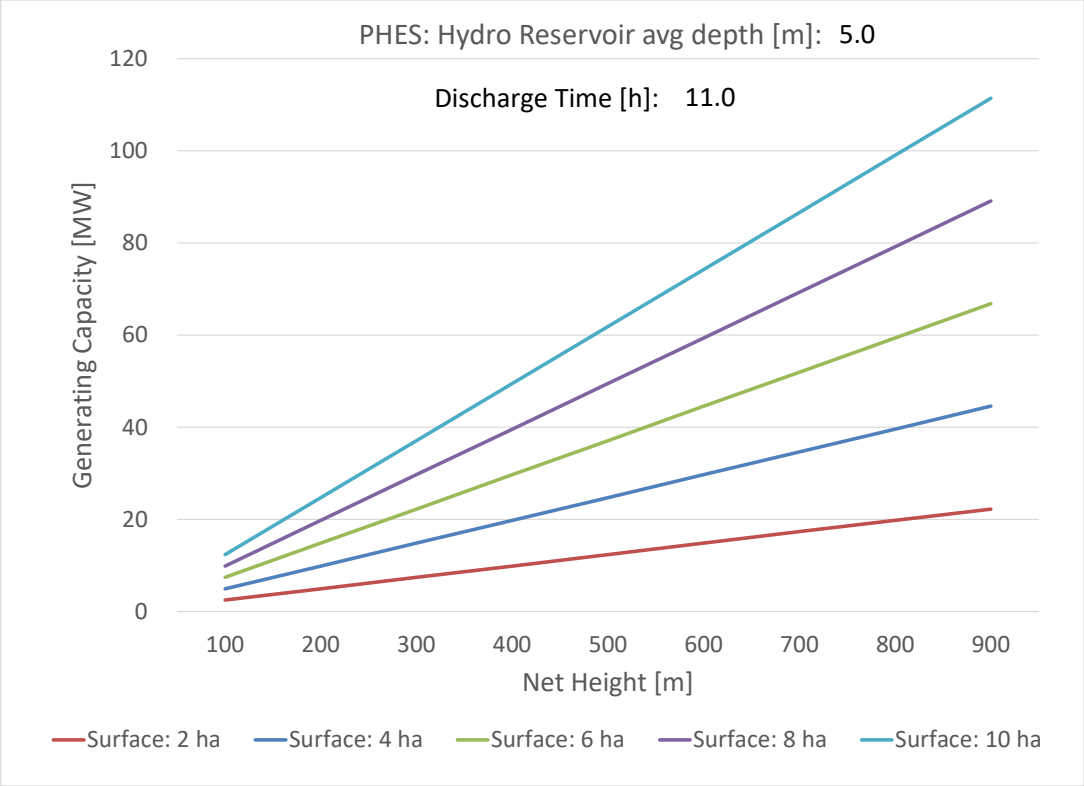


Figure 1: Energy storage relative to mountain height

Subsequently, the ambit this proposal is to let hydro energy storage be complimentary to other energy sources. Such an integrated scheme can then address the critique on the intermittency of renewable energy.

However, to the impact of such a venture, whereby extensive use of unspoiled landscapes would be required, a high degree of public support will be necessitated. For this reason, this undertaking's success will be decided by the extent to which the local community's interests are catered for. It is from this vantage point that this proposal is to be pursued.

3. *Development Platform - Mosselbaai JED*

The extent to which the region presents itself for a PHES system can be observed in number of relatively high mountains.

Combined with the development expectations of local communities such an initiative can create a fitting platform whereby community cooperative can trade energy to the Mosselbaai Municipality and in the deriving the extent of the proposal the following assumptions are applied:

	Aspect	Value
I.	Capital Rate – PHES [R/VA]:	15
II.	Substations Rate -HV/MV [R/VA]:	3.0
III.	Power Lines Rate – HV [‘m/km]:	2.5
IV.	Land Requirement – Hydro (m^2/kVA):	1.5

Table 1 – Infrastructure Rates

The foremost aspect in defining the scheme’s configuration will be in respect to its location along with its generation capacities. By virtue of its composition, the energy availability of a PHES cannot exceed 50% to allow for its recharging, Therefore, to achieve a continuous power supply other power sources must be applied but this is outside the scope of this proposal.

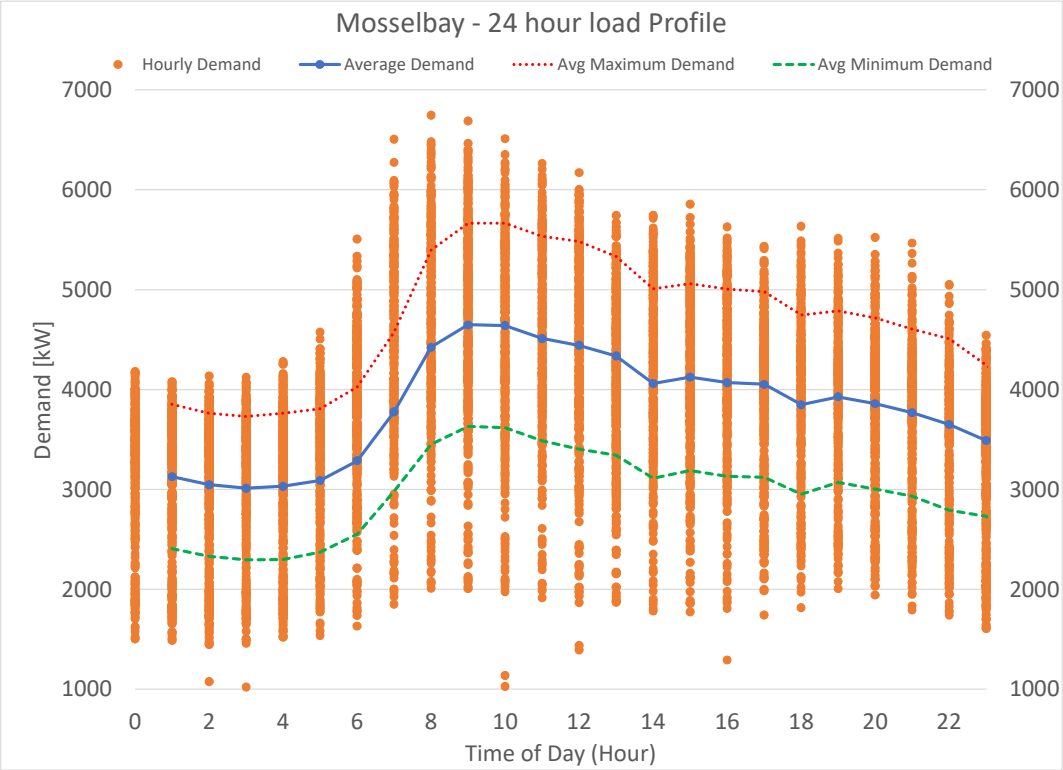


Figure 2: Power Demand Profile - Mosselbaai

The basic suppositions for a PHES are based on the town’s current power demand and (shown in figure 2) is summarized in table 2.

	Element	Value
I.	Min. PHES Availability (pu)	49%
II.	PHES Net Efficiency	70%
III.	Water Volume (h=800 m; η = 75%)	0.61

Table 2 – System Parameters

The extent of the PHES scheme is subsequently depicted in table 3 with an indicative storage tariff in the range of 150 to 180 c/kWh (at 2023 values). The biggest factor in the eventual tariff will mostly be determined by the expectation of the project funders.

Another notable aspect is that more than 50% of this tariff comprise of a fixed capital portion rendering future tariff increases (to cater for rise operational costs) much less than inflation. Extrapolating these values over the medium term, a breakeven point with grid parity can be expected within three to four years. To address this constraint, potential approaches are:

- A tariff structure devised to reclaim present day losses in the future or
- A take-off agreement whereby an initial premium is paid with the prosect of lower tariffs in future.

Power Demand	MW	4.2
Pumping hours - Mosselbaai	Hrs/day	12
Generating hours - PHES	Hrs/day	6
Energy demand per cycle	MWh/day	50.4
Energy Storage per cycle	MWh/day	25.2
Net Reservoir Height	Meter	380
Volume of Water	Cubic Meter	24 361
Capital Outlay	R'm	63

Table 3 – Key indicators: Mosselbaai PHES

The salient feature is however that the opportunity savings over the intended operational do stand to become significant relative to grid tariffs.

4. *Implementation Methodology - Mosselbaai JED*

This PHES scheme centres on two key assumptions, namely that the:

A. local community will form an integral of the development team,

&

B. securing an off-take agreement with the municipality.

It is also clear that these provisos can only be bridged by the eventual financial viability of the concept. These expectations set the scene against which the technical team will define a Special Project Vehicle, addressing the expectations of stakeholders as set out in Annexure A.

Should this concept be supported, *a feasibility study is to be executed whereby* the subsequent aspects need to be accounted for:

- Confirmation of land availability,
- Scope of executability and constructability,

- Estimation on the extent of financial and technical sources,
- Delineation on the range of tariffs,
- Conditions for sustainability of operations & maintenance +
- Soliciting principal support for off-take agreements

By addressing these details, it will form:

- Declaration of intent to the investors as well as
- Confirm the off-taker's participation in the scheme.

The eventual objective will be to attain investment into the concept for which the minimum outcomes will have to be to secure a development institution, in the form of the South African Development Bank or similar, who will administer a broad-based stokvel type participation from the communities along with being the project sponsor.

This exercise will inevitably require a promotor / facilitator for which a community-based organization will be most fitting. For this purpose, the Mosselbaai Community Cooperative is to be established.

The eventual platform will be on a recognized governance framework (as highlighted in figure 2) between the community along with institutional developers and private investors that will:

- Finalize the energy trading agreements with the off-taker &
- engineer & commission the relevant power plants as well as
- take care of operation and safeguard the maintenance of plant for the duration of the contract period.

Evaluated against the conditions within the electricity supply industry, there is consensus for exigent interventions and by catering for peer-to-peer agreements it is possible to achieve shortened lead times and incorporation of these energy systems into consumer's power systems.

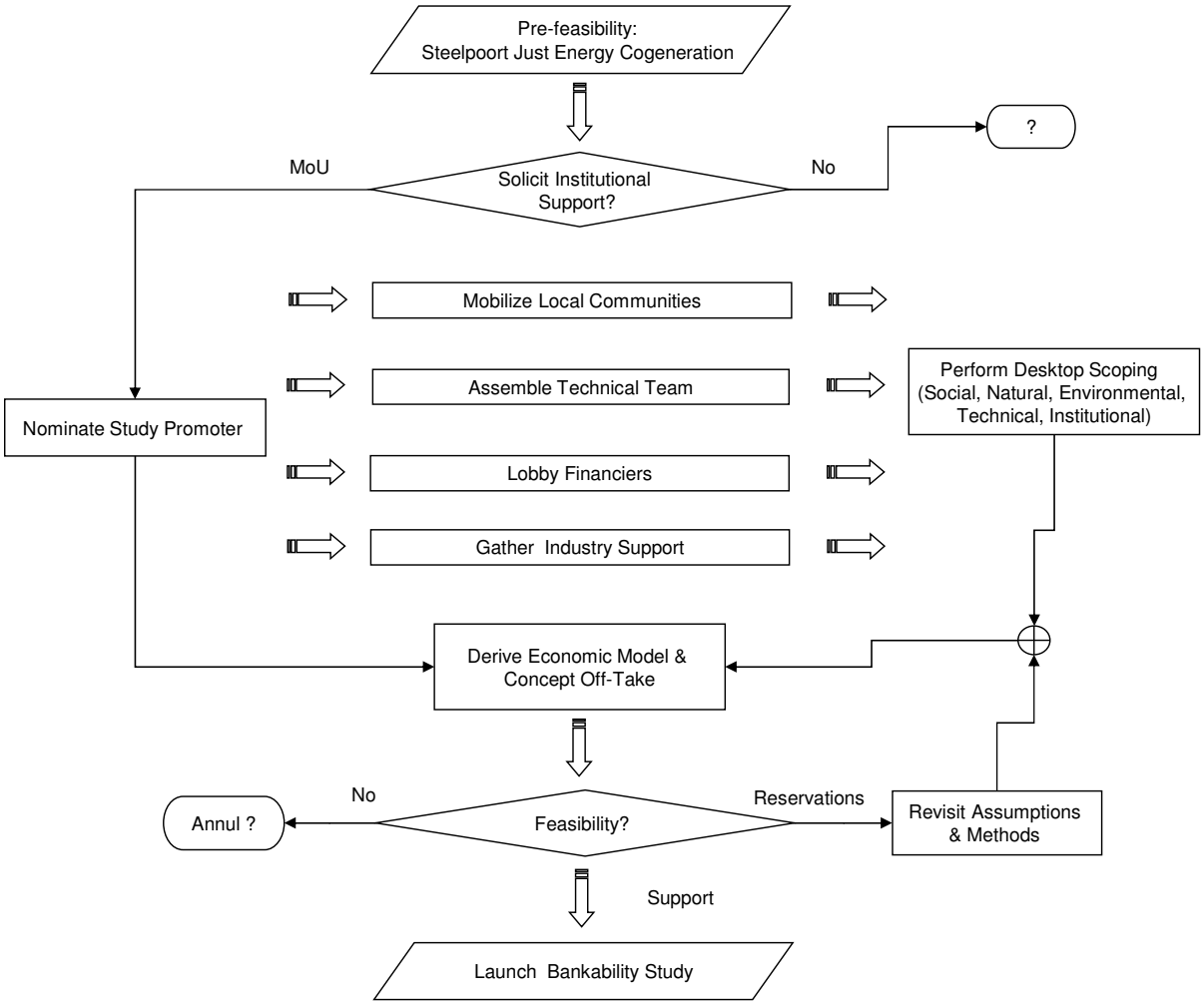


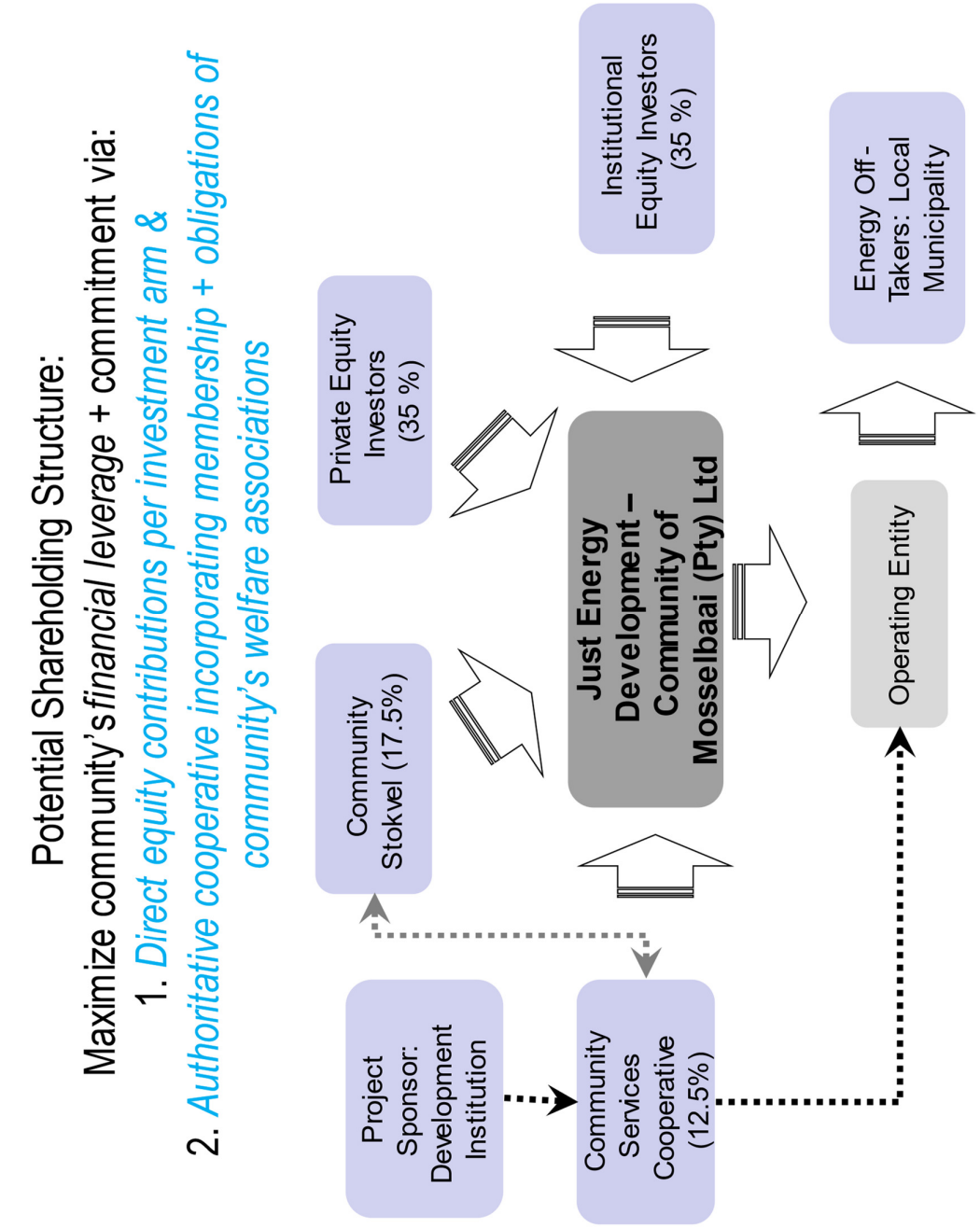
Figure 3: Approach – Feasibility Investigation

5. Proposition

It is the contention of the proposed PHES system that:

- A fit for purpose scheme for Mosselbaai's pump stations can be established &
- such a program will cater for localized manufacturing and construction, due to the manageable type of equipment and components.

Annexure A: Mosselbaai PHES – Indicative Organizational Relationships



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