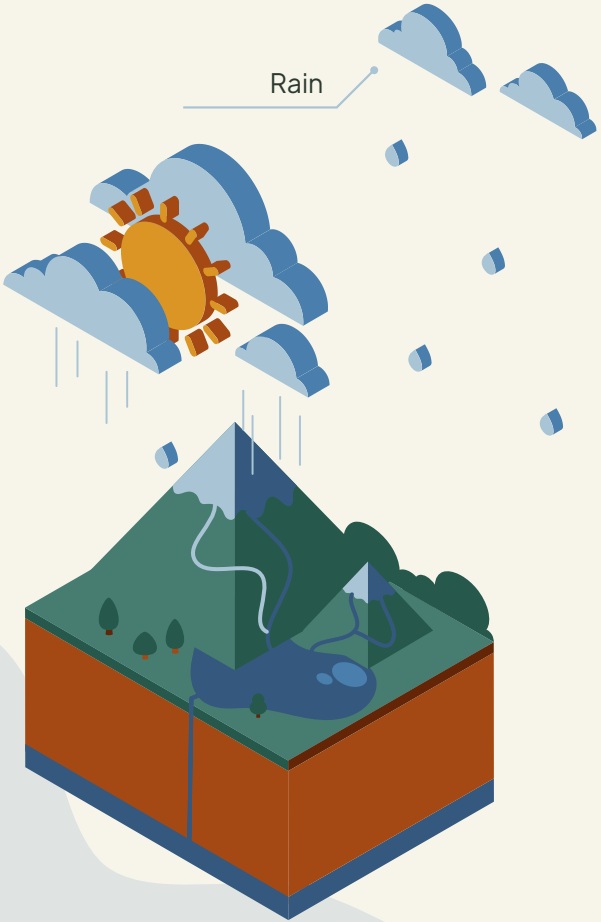
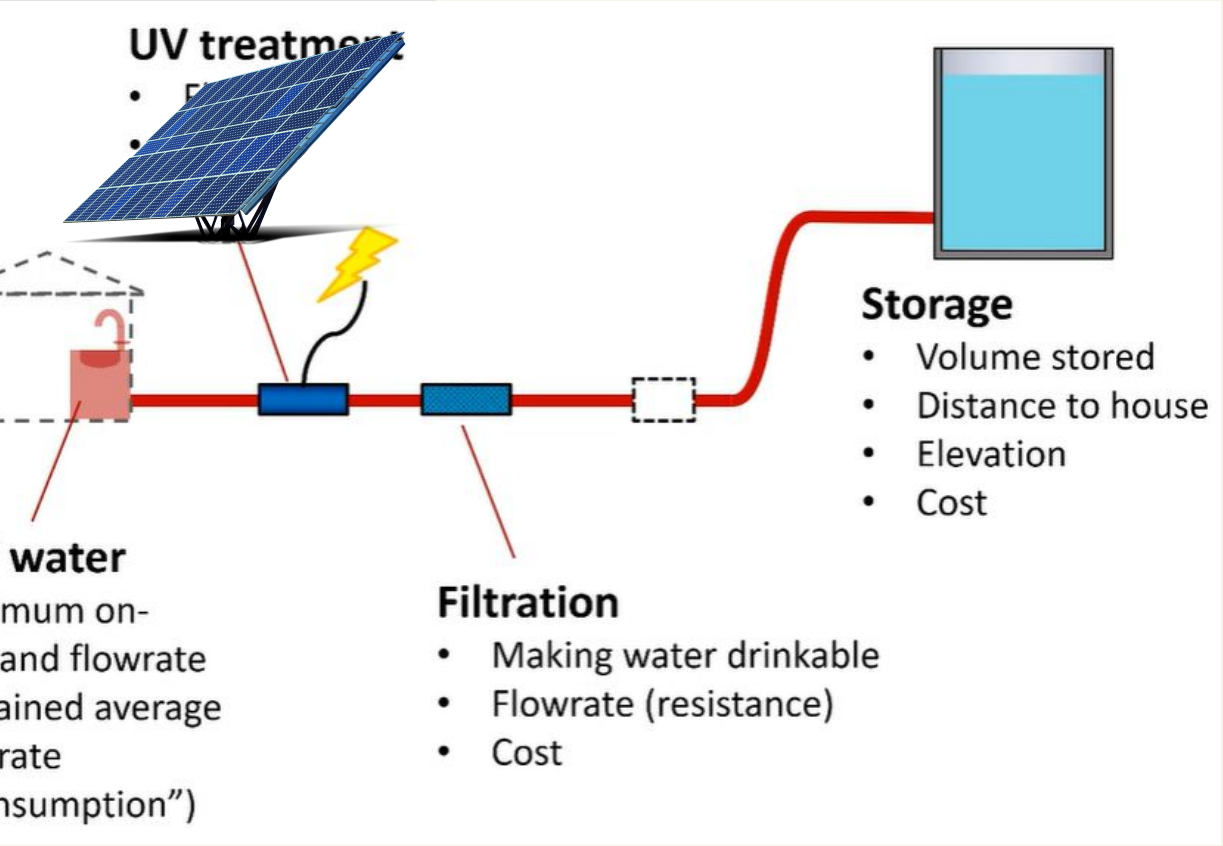



# Rainwater Harvester System

# Table of Contents



**UV treatment**

- F
-

**Storage**

- Volume stored
- Distance to house
- Elevation
- Cost

**water**

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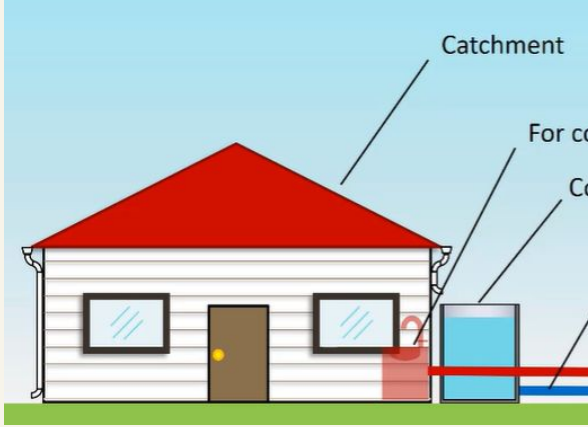
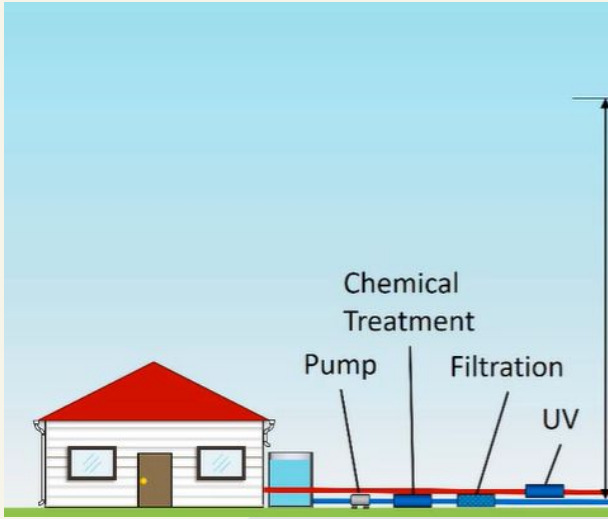
nsumption")

**Filtration**

- Making water drinkable
- Flowrate (resistance)
- Cost

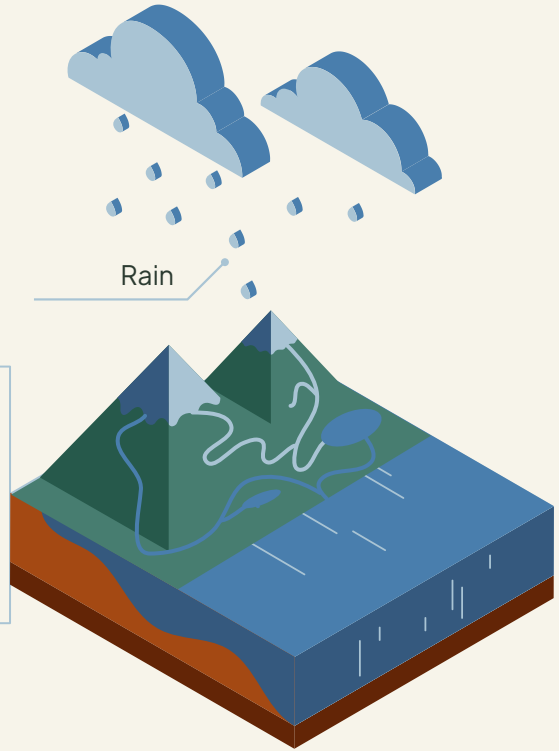


# Context

01 Alleviate water stress in remote communities like Van Anda

02 Recommend a feasible decentralized Rainwater Harvester System for consumption and storage



# Decision Making Process

# Stakeholder Satisfaction Attributes

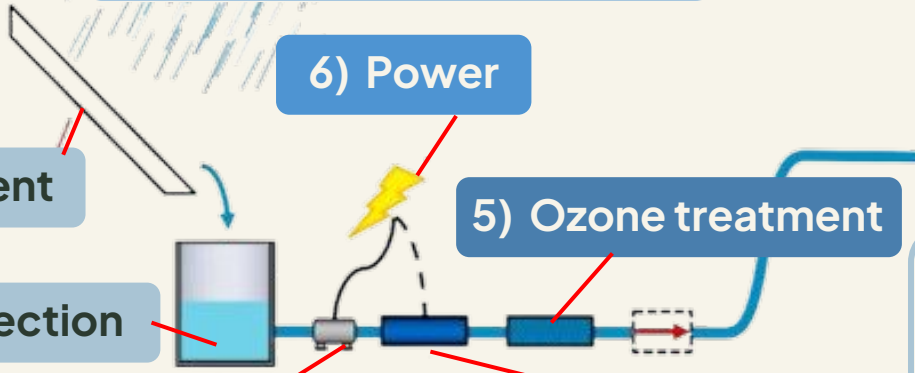
| Attribute | Weighting | System Req. |
|---|---|---|
| Consumption | 10 % | Min. 155 L/day |
| Relative Cost | 23 % | Max. 100% relative |
| Health and Environmental Risk Exposure | 12 % | Max. 32 |
| Power system Greenhouse Gas Emissions | 5 % | Max. 100% relative to shipping water |
| Maintenance Occurrence | 15% | Max. 72 / year |
| On-demand Flow Rate | 10% | Min. 40 L/min |
| Reliability | 15 % | Min. 250 days/ year of reliability |
| Land Use | 10 % | % impact relative to worst case |

# Recommendation Outline

| | |
|---|---|
| **Rainwater collection** | **100 $m^2$** rain catchment |
| | **2.5 $m^3$** collection tank |
| **Storage** | **26 $m^3$** storage tank on **6.2 m** tower |
| **Pumping** | Pump **B** |
| **Filtration** | 3–step: **1 µm** + **5 µm** + **200 µm** filters |
| **Disinfection** | **Ozone + UV** |
| **Power System** | **9** HES - 260 Solar panels |
| | **4** 12V Deep Cycle Wet Lead Acid Batteries |
| | **2.8kW** DC - AC Power Inverter |

# Recommendation Outline

# Catchment to storage



**9** HES - 260 Solar panels
**4** 12V Deep Cycle Wet Lead Acid Batteries
**2.8kW** DC - AC Power Inverter

**6) Power**

**7) Storage**

**1) Catchment**

**5) Ozone treatment**

**2) Collection**

**26 m³** storage tank on **6.2 m** tower

**100 m²** rain catchment
**2.5 m³** collection tank

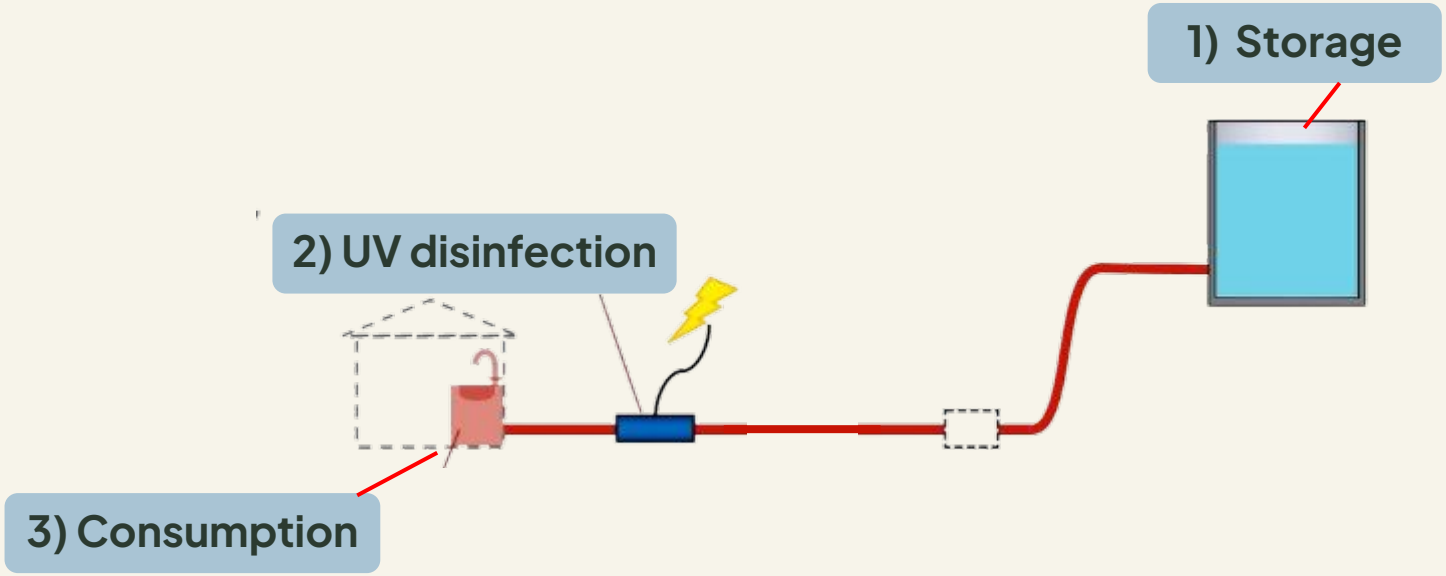
**3) Pumping**

**4) Filtration**

Pump **B**

3–step:
**1 µm + 5 µm + 200 µm** filters

# Storage to consumption



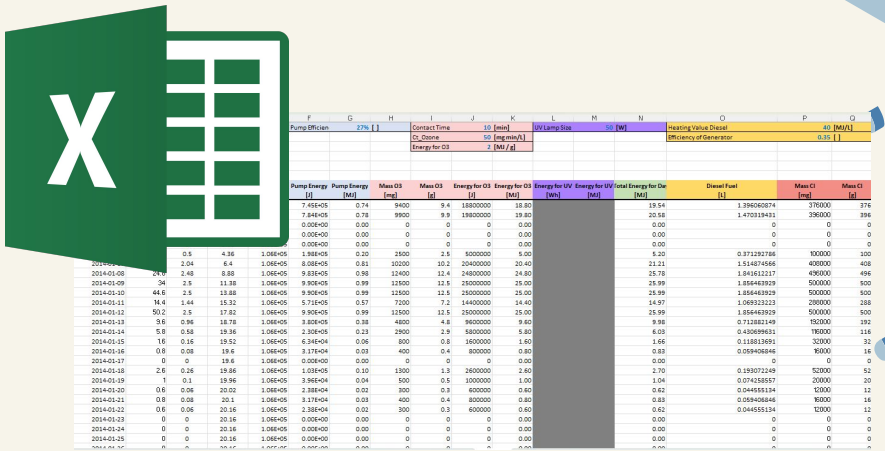
# Alternative Configurations

Energy system, chemical disinfection, land use, consumption

# Prototyping & Simulations

We executed meticulous testing and simulation with Microsoft Excel Spreadsheets.

- Each recommended parameter was rigorously assessed to optimize stakeholder satisfaction.
- Utilized charts and graphs to visualize trends and interpret data.



# Energy System

## Recommendation: Solar

### Pros

Low maintenance

No health and environmental risks associated

### Cons

High upfront cost ($205–$500/panel)

High GHG emissions from production

## Alternative: Diesel

### Pros

Low upfront cost

### Cons

Consistent shipments needed, $325/shipment and frequent maintenance

Burning diesel has high GHG

Health and environmental risks associated with diesel

# Chemical Disinfection

## Recommendation: Ozone

### Pros

Annual maintenance

No health and environmental risks associated

### Cons

High upfront cost ($4000)

High energy usage

## Alternative: Chlorine

### Pros

Low upfront cost

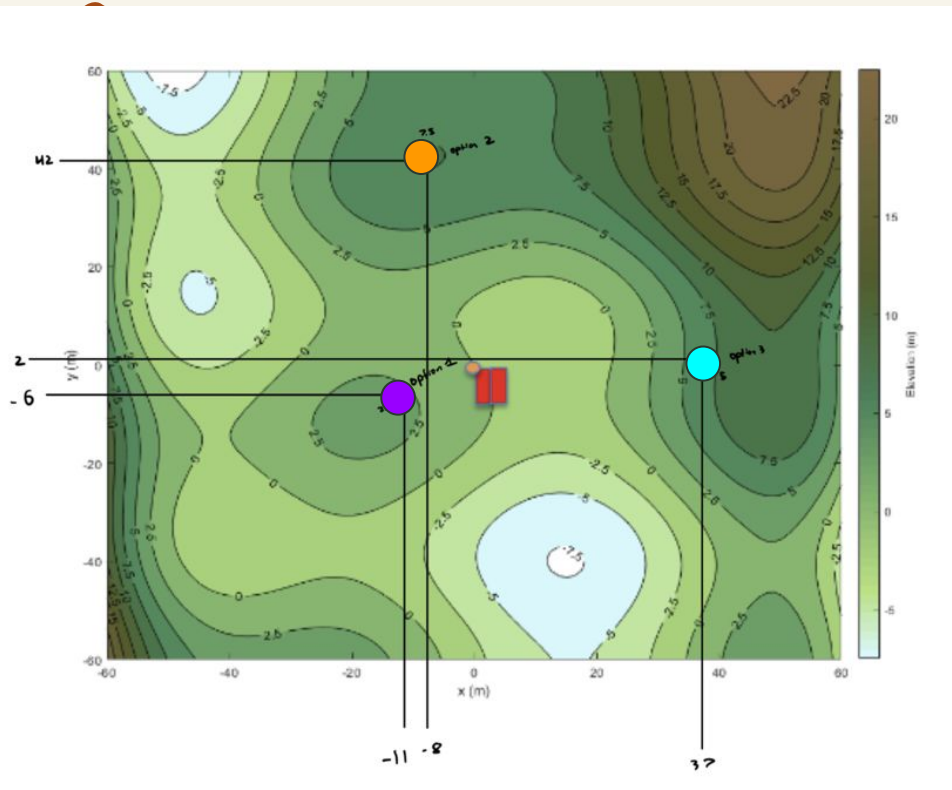
### Cons

High cumulative costs (shipments are required almost biweekly)

Extreme health and environmental risks associated with chlorine

Frequent maintenance

# Storage Tank Locations




- **Option 1:**
  Coordinates : (-11, -6)
  Elevation: 2.5 m
  Pipe Length: 25.554 m

- **Option 2:**
  Coordinates: (-8, 42)
  Elevation: 7.5 m
  Pipe Length: 86. 816 m

- **Option 3:**
  Coordinates: (37, 2)
  Elevation: 5.0 m
  Pipe Length : 74.780 m

# Storage Tank Locations - Con't

## Alternative

**Option 1: Unchanged**

- No extra cost needed, so relative cost is **lower**
- Significantly lower on-demand flow rate (**satisfaction ~10%**)

## Recommendation

**Option 2: Option 1 + 6.2m Tower**

- High upfront cost ($6875)
- Increases on-demand flow rate by **over 200%**
- **Significant boost** in satisfaction

## Alternative

**Option 3**

- With the long pipe length, on-demand flow rate is **reduced**
- Satisfaction was **lower than option 1** with the tower

Created separate spreadsheets for each parameter to be determined and measured satisfaction for all 8 attributes.

Estimated min & max water consumption per household → determine consumption value (initial)

Utilized rainfall data in weather station 1 in 2014 and 2015 →

Selected multiple potential locations for storage tank placement → land use

Evaluated pump performance for each pump (flow rate, pressure, efficiency)

Calculated energy usage for powering system

Examined maintenance for all filter combinations

On-demand flow rate

Calculated all associated costs (initial + maintenance)

Assessed risks and greenhouse gas emissions

# Final Recommendation

| | |
|---|---|
| **Rainwater collection** | **100 $m^2$** rain catchment |
| | **2.5 $m^3$** collection tank |
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| **Disinfection** | **Ozone + UV** |
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| | **2.8kW** DC - AC Power Inverter |

# Rainwater collection

Collection Tank
Capacity: 2500L
Cost: $900

Roof Catchment
Area: 100$m^2$ (whole roof)
Cost: $350

collects up to **5X** the amount of daily water consumption (500L), taking advantage of rainy seasons

**reduces dry days**, saving approximately **$5000** in water shipment costs alone

only uses the roof, **no extra space required** for additional catchment area

# Distribution and Storage

After testing all three pumps, **Pump B** resulted in the highest overall **stakeholder satisfaction**.

Pump B was selected for its **low maintenance** and **high flow rate**

# Filtration

## 1 µm

System Requirement

## 5 µm

Reduces fouling rate of 1 µm filter

## 200 µm

Reduces fouling rate of 5 µm filter

Using **all 3** filters **reduces frequency for maintenance by 50%**.

# Disinfection

## Ozone


- Annual maintenance
- No health and environmental risks associated

## Ultra-Violet (UV)

50W UV System:

- Max treatable flow rate: 40 LPM
- Insignificant relative energy and cost differences

# Final Recommendation (Test Case)

## Cost

Total cost over five years is **$50,000** relative to **$105,000** for the previous system

## Reliability

Confident in providing clean, safe water for **over 90%** of the year

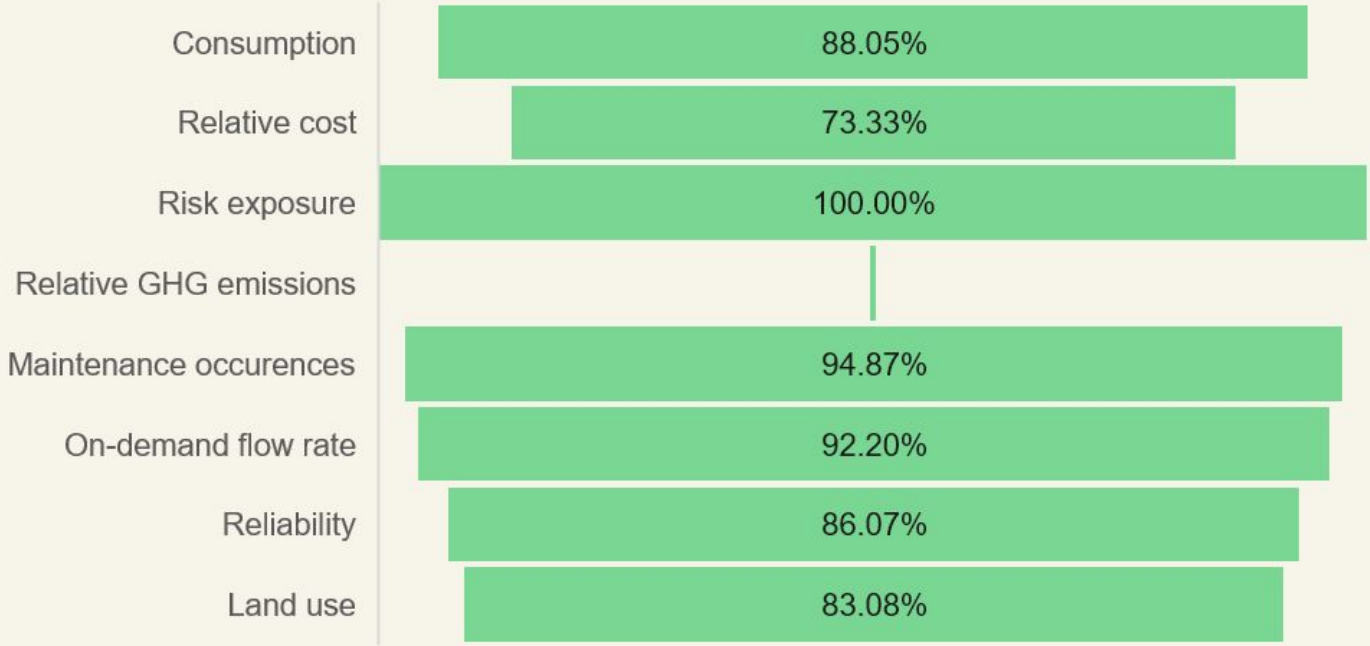
## Maintenance & Risk

Around **16 maintenance days** per year, and **0 health/environmental risk** associated with ozone and solar

## Greenhouse Gas (GHG)

Initial GHG emissions are **7932 kg** compared to **8339 kg** from the existing system

# Stakeholder Satisfaction




**Total Weighted Stakeholder Satisfaction: 82.3%**

# Conclusion

# Thank you