# PV ReImagine

## High-Level Feasibility Study

Submitted to:

The Ministry of Digital Economy and Entrepreneurship

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# Executive Summary

The rapid growth of the solar energy industry has led to an increase in solar PV modules reaching the end of their lifecycle, presenting significant environmental challenges. PV ReImagine addresses the need for sustainable management of solar panel waste by repurposing discarded modules into valuable products. This project aims to reduce the environmental footprint and promote a circular economy through reuse and recycling practices.

The renewable energy sector in Jordan is experiencing significant growth, with solar PV accounting for a large portion of renewable electricity generation. This favorable environment creates an opportunity for PV ReImagine to contribute to sustainable waste management solutions. The business model involves collecting broken modules, salvaging functional cells, and repurposing them into educational kits, eco-friendly gifts, and recycled materials.

Financial projections show positive net profits from the first year, supported by robust indicators such as a positive net present value and an attractive internal rate of return. However, sensitivity analysis indicates the need to achieve projected revenue targets to maintain viability. Key stakeholders include educational institutions, environmental NGOs, renewable energy companies, manufacturers, and government bodies.

To address potential risks such as supply chain challenges, quality control issues, and market acceptance, PV ReImagine will implement comprehensive risk mitigation strategies. These include establishing multiple supplier relationships, conducting extensive market research, and securing diverse funding sources.

In conclusion, PV ReImagine demonstrates promising feasibility but requires additional analysis on projected demand, initial costs, and operational expenses to ensure long-term success in the renewable energy sector.

# 1. Introduction

The rapid growth of the solar energy industry has led to an increase in the number of solar PV modules reaching the end of their lifecycle. This trend presents significant environmental and commercial challenges, as discarded solar panels contribute to electronic waste and require sustainable disposal methods. Current waste management systems are not adequately equipped to handle the specific needs of solar panel disposal, resulting in missed opportunities for material recovery and reuse.

PV ReImagine aims to address the critical need for sustainable management of solar panel waste. The project aims to reduce the environmental footprint of discarded solar PV modules by repurposing them into valuable products. This approach not only mitigates the environmental impact but also promotes a circular economy model within the renewable energy sector. By transforming waste into education tools and eco-friendly products, PV ReImagine supports both environmental sustainability and community education.

PV ReImagine is a workshop start-up dedicated to collecting broken or discarded solar PV modules and giving them a new life through reuse and recycling practices. The start-up offers a range of products and services, including educational kits designed to teach students about solar energy and sustainability, eco-friendly gifts crafted from repurposed materials, and material recycling and resale to minimize waste. This multifaceted approach leverages the potential of discarded solar PV modules, turning them into valuable resources that contribute to a greener future[1] [2] [3].

# 2. Market Analysis

The renewable energy sector is experiencing significant growth globally, driven by increasing environmental concerns, technological advancements, and supportive governmental policies. As countries strive to meet their sustainability goals, and reduce carbon emissions, investments in renewable energy, particularly solar power, have surged. This trend is expected to continue, creating a favourable economic environment for initiatives like PV ReImagine that focus on sustainable practices and waste management.

The solar energy industry is projected to grow substantially over the next decade. According to the International Energy Agency (IEA), solar power is set to become the largest source of electricity by 2050. Global solar PV waste is anticipated to reach between 5% and 15% of total generation capacity by 2030, considering the average 25-year lifespan of solar panels. Furthermore, according to the International Renewable Energy Agency (IRENA), the proportion of global PV panel waste to new installations is estimated to increase steadily over time, reaching 4-14% in 2030 and climbing to over 80% in 2050[4]. The recycling and repurposing of solar PV modules represent an emerging niche with potential.

Several key economic indicators underscore the potential success of PV ReImagine in Jordan:

- Growth Rate of the Renewable Energy Sector: According to the 2022 annual report of the Ministry of Energy, Jordan's energy mix is shifting towards renewable energy. In 2021, electricity generated relied heavily on natural gas at 73%, with renewable energy sources contributing 26%. Jordan aims to reach 50% dependence on renewable energy sources by 2030.
- Solar Energy Generation: In 2022, solar PV dominated the renewable energy mix, accounting for 76% of renewable electricity generation followed by wind energy at 24%[5].
- Government Policies and Incentives: The Jordanian government has implemented various policies and incentives to promote renewable energy[6].

[1] Hashemite Kingdom of Jordan Ministry of Agriculture Environmental and Social Management Checklist for Improving Energy Security
[2] Jordan secures top spot in renewable energy capacity, with potential to grow — Kharabsheh
[3] AL-Zoubi, O.H.; Shawaqfah, M.; Almomani, F.; Damash, R.A.; Al-Zboon, K. Photovoltaic Solar Cells and Panels Waste in Jordan: Figures, Facts, and Concerns. *Sustainability* **2022**, *14*, 13313. https://doi.org/10.3390/su142013313
[4] https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_IEAPVPS_End-of-Life_Solar_PV_Panels_2016.pdf
[5] https://www.memr.gov.jo/EN/ListDetails/Projects/72/18
[6] https://www.memr.gov.jo/EBV4.0/Root_Storage/EN/Project/Law_No(13).pdf

Despite the appealing features of PV plants as a source of clean energy, it is not a completely benign technology. While solar PV energy can guarantee zero gas emissions during its operational lifetime, the amount of waste produced after its end of life (EoL) raises significant concerns. The primary issue regarding solar PV cells and panels arises when they expire or need replacement. In Jordan, this problem has not yet gained attention because the panels currently in use, whether in small-scale or large-scale planets, have not reached their EoL. Additionally, Jordanian regulations have not provided a safe approach to managing and disposing of PV waste. This gap presents an opportunity for PV ReImagine to lead the way in developing sustainable waste management solutions for solar PV modules.

PV waste originates from three main sources:

1. End of Life (EoL): Waste generated after panels complete their theoretical lifespan.
2. Early Loss: Mid-life wear and tear of panels
3. Damage: Waste due to damage during production, transportation, installation, and operation

Furthermore, solar panels lose about 0.5% of their electricity performance per year (also known as degradation), leading to gradual efficiency decline and eventual need for replacement[7].

The regulatory environment in Jordan supports the growth of the renewable energy sector. The Renewable Energy and Energy Efficiency Law No. 13 of 2012 and subsequent amendments demonstrate Jordan's focus on renewable energy and attracting investments. However, the lack of specific regulations for the disposal and recycling of solar PV waste highlights the need for comprehensive policies to address this emerging issue. Compliance with future regulations will be essential for PV ReImagine's operations. Additionally, Jordan's commitment to international agreements and frameworks, such as the Paris Agreement, drives the adoption of sustainable practices and the development of green technologies.

PV ReImagine targets a diverse audience, including educational institutions, environmental enthusiasts, DIY hobbyists, and businesses/NGOs interested in sustainable practices. This market is characterized by a growing interest in renewable energy and sustainability. Specifically, PV ReImagine will focus on educational institutions such as schools, colleges, and universities that are looking to incorporate renewable energy education into their curricula. In Jordan, there are about 3,093 private schools, 51 community colleges, 27 universities, and 60 vocational training centers that are operated by the Vocational Training Corporation and the National Employment and Training Company. The project aims to target 100 of these establishments in the first year, with the assumption that each will purchase 2 kits. Additionally, corporates and NGOs focused on environmental sustainability are the target market for the 'reimagined' PV panels as giveaways or gifts, appealing to their commitment to green practices. Moreover, PV ReImagine will sell the aluminum and glass that remains after the production of the educational kits and gifts to manufacturers and workshops by weight, thereby ensuring minimal waste and contributing further to the circular economy.

[7] Rahman, Tuhibur, et al. "Investigation of Degradation of Solar Photovoltaics: A Review of Aging Factors, Impacts, and Future Directions toward Sustainable Energy Management." *Energies*, vol. 16, no. 9, 1 Jan. 2023, p. 3706, www.mdpi.com/1996-1073/16/9/3706, https://doi.org/10.3390/en16093706

A household survey conducted by Germany's Research Institute for Sustainability - Helmholtz Centre Potsdam (RIFS) found that people in Jordan overwhelmingly want an energy transition, with 91% of respondents expressing support of renewable energy sources in the country[8].

Currently, there are no direct competitors in this niche, although the traditional recycling or industrial waste collectors pose an indirect type of competition. PV ReImagine's focus on sustainability, educational value, and repurposed products provides a competitive edge in the market.

To effectively address the growing interest in renewable energy and sustainability, PV ReImagine's business model is structured to cater to its diverse target audience. By concentrating on educational institutions and environmentally conscious organizations, the start-up aims to offer practical, sustainable products that meet consumer needs. The process of collecting and repurposing solar PV modules into educational kits and eco-friendly gifts not only minimizes environmental impact, but also creates a viable business opportunity. Additionally, the sale of recycled aluminum and glass to manufacturers and workshops reinforces PV ReImagine's commitment to supporting a circular economy.

# 3. Business Model

PV ReImagine's business model is cantered on creating value from discarded solar PV modules. The process begins with the collection of broken or discarded solar PV modules from various sources, including solar farms and energy businesses. These collected modules are subjected to a thorough testing process to salvage functional cells. These cells are repurposed to create educational kits designed to teach students about renewable energy and sustainability.

The production process involves the creation of eco-friendly gifts, utilizing repurposed materials that are also collected from the PV modules. Artisans are hired and compensated on a per-unit basis to craft these unique gifts. Lastly, the remaining aluminum and glass from the disassembled modules are sold by weight to recyclers, workshops, and buyers of scrap metal and glass.

Strategies for marketing and sales include targeting educational institutions, environmental enthusiasts, and businesses/NGOs through various channels. Emphasis is placed on showcasing the educational and sustainability value of the products. Sales will be supported by a dedicated website featuring photos of the products, detailed descriptions, and purchasing options. This online presence will facilitate broader reach and convenience for potential customers.

The educational kits will continue to be developed into a range of offerings, allowing the start-up to generate repeat business from the same customers who could then purchase different models of the kits.

The core team of PV ReImagine consists of the Founder/CEO, who oversees operations and strategic direction as well as managing the technical aspects of the recycling process and

[8] https://www.rifs-potsdam.de/en/news/jordanians-keen-harness-community-benefits-energy-transition

functionality of salvaged components. The Technician assists in the disassembly, testing, and sorting of solar PV modules. The Sales team focuses on market outreach, customer relations, and sales. Finally, the Industrial Designer handles the design and creation of educational kits and eco-friendly products from repurposed PV modules.

There are four revenue streams for PV ReImagine:

1. Educational Kits: Revenue generated from the sale of education kits to schools, colleges, universities, and vocational training centers. The kits are designed to teach students about solar energy, electronics, and sustainability. They include functional solar cells salvaged from broken PV modules along with instructions and components for building small solar-powered projects.
2. Eco-friendly gifts: Revenue from the sale of eco-friendly gifts crafted from repurposed PV modules. By creatively repurposing materials from broken PV modules, PV ReImagine produces unique, eco-friendly gifts such as decorative items and gadgets.
3. Material Recycling: Revenue from disassembling PV panels and selling left-over aluminum and glass to other recyclers.

*Table 1: Revenue projection*

| Description / Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Projected Demand (Quantity) Educational Kit | 200 | 250 | 300 | 350 | 400 |
| Price / Unit Educational Kit | 200 | 200 | 200 | 200 | 200 |
| Sub-total Educational Kit | 40,000 | 50,000 | 60,000 | 70,000 | 80,000 |
| | | | | | |
| Projected Demand (Quantity) Eco-friendly Gifts | 300 | 400 | 450 | 500 | 500 |
| Price / Unit Eco-friendly Gifts | 30 | 30 | 30 | 30 | 30 |
| Sub-total Eco-friendly Gifts | 9,000 | 12,000 | 13,500 | 15,000 | 15,000 |
| | | | | | |
| Projected Demand (Quantity) Material Recycling (kg) Aluminum | 1,500 | 3,000 | 3,000 | 15,000 | 15,000 |
| Price / Unit Material Recycling Aluminum | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| **Sub-total Material Recycling Aluminum** | 750 | 1,500 | 1,500 | 7,500 | 7,500 |
| | | | | | |
| Projected Demand (Quantity) Material Recycling (kg) Glass | 6,000 | 12,000 | 12,000 | 60,000 | 60,000 |
| Price / Unit Material Recycling Glass | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| **Sub-total Material Recycling Glass** | 1,200 | 2,400 | 2,400 | 12,000 | 12,000 |
| | | | | | |
| **Total Revenues (JOD)** | **50,950** | **65,900** | **77,400** | **104,500** | **114,500** |

The product mix includes Education Kits, Reimagined Gifts, and Material Recycling (Aluminum and Glass), each contributing differently to the total quantity and revenue over five years. Educational Kits make up a significant portion of the total revenue (85%) but constitute a smaller portion of the total quantity sold (1.5%) due to their higher price per unit. ReImagined

Gifts represent 1.8% of the total quantity and contribute 11% to the total revenue, showing a balanced contribution relative to their price. Material Recycling (Aluminum and Glass) are priced per tonne but contribute less than 4% of the total revenue. They are, however, important to manage the warehousing.

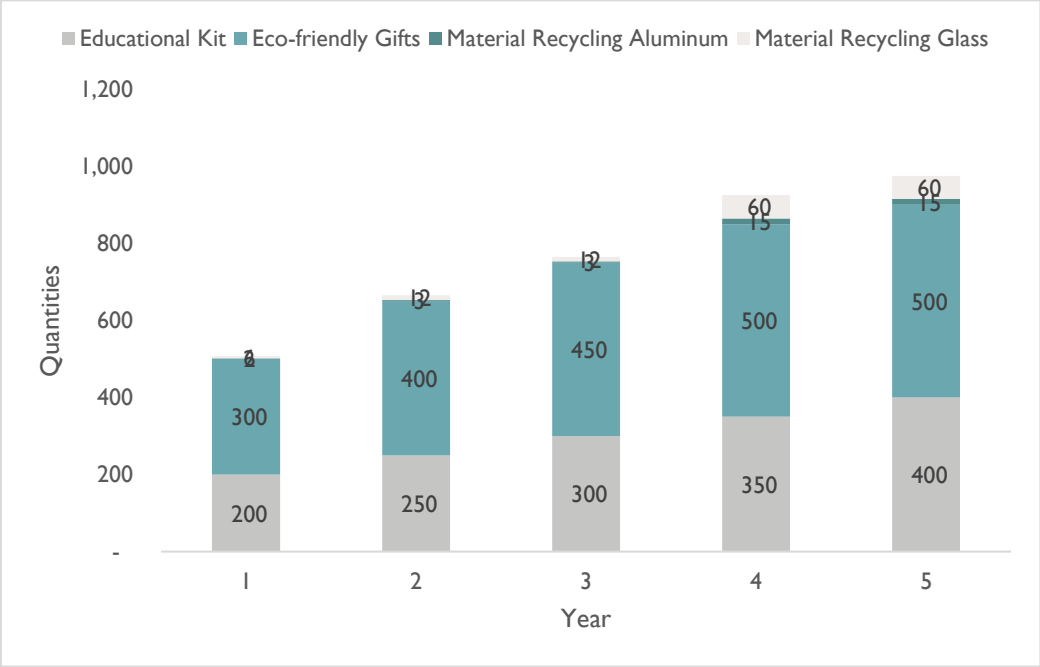


*Figure 1: Product Mix by Quantity*

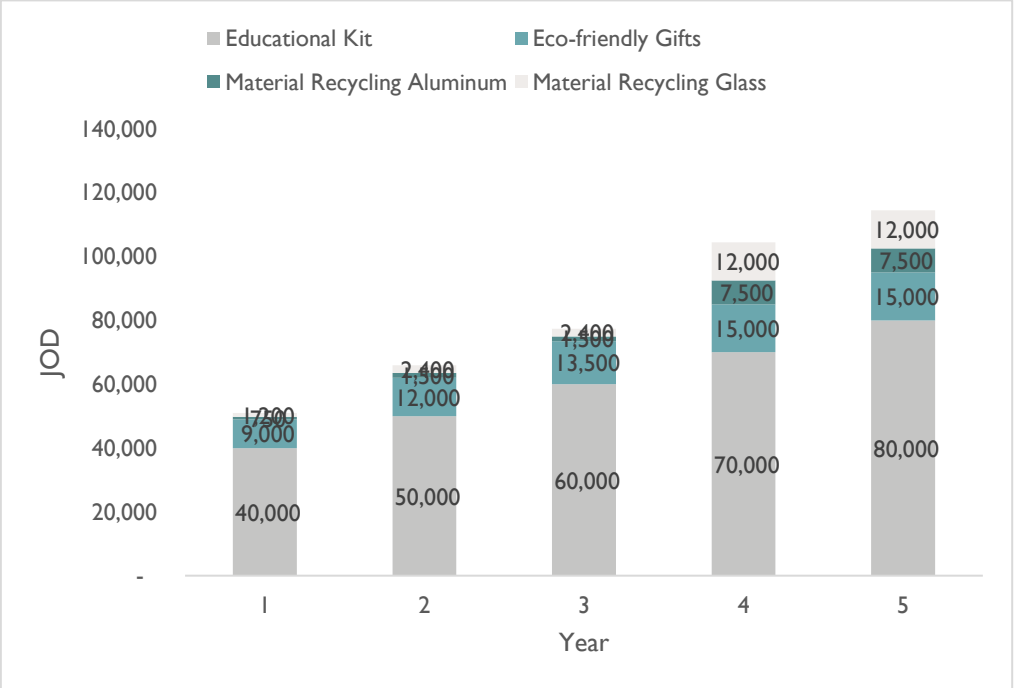


*Figure 2: Product Mix by Revenue*

# 4. Technical Analysis

The cost of goods sold (COGS) for PV ReImagine's products align with the demand, reflecting costs around the following:

1. Educational Kits: COGS per unit remains consistent at JOD 15 for the five years, The total COGS for education kits rises from JOD 3,000 in Year 1 to JOD 6,000 in Year 5.
2. ReImagined Gifts: COGS per unit remains constant at JOD 10 throughout the five years, with the quantity demanded increasing from 300 to 500. This cost is attributable to the hiring fee of the artisans who will produce the gifts.
3. Material Recycling (Aluminum): The cost is related to the transportation costs of collecting the panels remains quite small.
4. Material Recycling (Glass): COGS which involve transportation costs are included in the Aluminum material recycling.

Overall, the total COGS for PV ReImagine's products increases from JOD 6,040 to JOD 11,400, a necessary rise due to expanded operations but modest in comparison to growth in revenue.

*Table 2: Cost of Goods Sold – Five Year Projection*

| Description / Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Projected Demand (Quantity) Educational Kit | 200 | 250 | 300 | 350 | 400 |
| COGS / Unit Educational Kit | 15 | 15 | 15 | 15 | 15 |
| Sub-total Educational Kit | 3,000 | 3,750 | 4,500 | 5,250 | 6,000 |
| | | | | | |
| Projected Demand (Quantity) Eco-friendly Gifts | 300 | 400 | 450 | 500 | 500 |
| COGS / Unit Eco-friendly Gifts | 10 | 10 | 10 | 10 | 10 |
| Sub-total Eco-friendly Gifts | 3,000 | 4,000 | 4,500 | 5,000 | 5,000 |
| | | | | | |
| Projected Demand (Quantity) Material Recycling (kg) Aluminum | 500 | 1,000 | 1,000 | 5,000 | 5,000 |
| COGS / Unit Material Recycling Aluminum | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| **Sub-total Material Recycling Aluminum** | 40 | 80 | 80 | 400 | 400 |
| | | | | | |
| Projected Demand (Quantity) Material Recycling (kg) Glass | - | - | - | - | - |
| COGS / Unit Material Recycling Glass | - | - | - | - | - |
| **Sub-total Material Recycling Glass** | - | - | - | - | - |
| | | | | | |
| **Total COGS** | 6,040 | 7,830 | 9,080 | 10,650 | 11,400 |

The Founder/CEO will lead the company throughout the five-year period. The number of Technicians will increase incrementally from two in Year 1 to five by Year 4. This gradual increase aligns with the anticipated growth in production volume and the need for more hands-on work to manage the collection, testing, and repurposing of solar PV modules. By Year 5, the technician team will stabilize at five members, reflecting a mature phase of operations where the team is optimized for efficiency.

*Table 3: Manpower recruitment plan – five-year projection:*

| Title / Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Founder/CEO | 1 | 1 | 1 | 1 | 1 |
| Technician | 1 | 2 | 3 | 4 | 4 |
| Industrial Designer | 1 | 1 | 1 | 1 | 1 |
| Cumulative Total HR | 3 | 4 | 5 | 6 | 6 |

The following table outlines the projected cost of human resources for PV ReImagine over a five-year period, including salaries, social security, and health insurance costs:

*Table 4: Manpower total cost – five-year projection*

| Title / Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Founder/CEO | 7,200 | 8,400 | 14,400 | 18,000 | 18,000 |
| Technician | 3,600 | 8,400 | 14,400 | 24,000 | 26,400 |
| Industrial Designer | 3,600 | 4,200 | 4,800 | 6,000 | 6,600 |
| **Total HR Salaries** | **14,400** | **21,000** | **33,600** | **48,000** | **51,000** |
| Social Security Cost | 2,052 | 2,993 | 4,788 | 6,840 | 7,268 |
| Health Insurance Cost | 900 | 1,200 | 1,500 | 1,800 | 1,800 |
| **Total HR Cost** | **17,352** | **25,193** | **39,888** | **56,640** | **60,068** |

The table below outlines the projected operational expenditures (OpEx) for PV ReImagine. These costs encompass a variety of essential business expenses, including rental fees, utilities, registration fees, tools, and others. Advertising expenses are expected to increase in the second year and remain steady thereafter to support ongoing marketing efforts. Overall, the total OpEx shows a planned increase over the years, aligned with the company's growth and expansion objectives. The OpEx shown below also include the manpower costs.

*Table 5: Operational Expenditures – five-year projection*

| Description / Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Rental Fees | 2,400 | 2,400 | 2,400 | 4,000 | 4,000 |
| Electricity/Water | 600 | 600 | 600 | 600 | 600 |
| Registration fees | 650 | 650 | 650 | 650 | 650 |
| Tools | 150 | 150 | 150 | 150 | 150 |
| Transportation | 2,400 | 2,400 | 2,400 | 2,400 | 2,400 |
| Telecommunication | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |
| Advertising | 1,200 | 2,000 | 2,000 | 2,000 | 2,000 |
| Legal & Accounting Fees | 2,400 | 2,400 | 2,400 | 2,400 | 2,400 |
| **Sub-total OpEx** | **28,352** | **36,993** | **51,688** | **70,040** | **73,468** |
| Other Costs | 2,835 | 3,699 | 5,169 | 7,004 | 7,347 |
| **Total OpEx** | **31,187** | **40,692** | **56,857** | **77,044** | **80,814** |

In terms of capital expenditures (CapEx) for PV ReImagine, the costs are associated with the setting up and maintaining essential infrastructure over the five years. In Year 0, the primary expenditure is the setup of the workshop which will support the sales of educational kits and eco-friendly gifts.

*Table 6: Capital Expenditures Cost – five-year projection*

| Description / Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Workshop setup | 5,000 | | | | | |
| **Total CapEx** | **5,000** | **-** | **-** | **-** | **-** | **-** |

# 5. Financial Analysis

## 5.1 Financial Study Assumptions

The feasibility study is based on the following key assumptions:

**Discount Rate:** The study employs a conservative discount rate of 14%, reflecting a cautious approach to valuation.

**Financing Structure:** The project is entirely financed by equity. This conservative approach avoids the financial leverage and thus underestimates project value, given the lower cost of debt compared to equity.

**Terminal Value:** The project assumes a zero-terminal value at the end of year five, aligning with the study's conservative outlook.

**Cash Flow Projection:** Cash flows beyond year five are excluded from the analysis, focusing on the initial project phase.

**Tax Rate:** The assumed tax rate of 20% complies with Jordan's income tax law.

**Depreciation Rate:** Capital expenditure (CapEx) is depreciated at an annual rate of 20%. Any deviation from this rate may impact projected profitability but not project feasibility, as depreciation is a non-cash expense.

### Working Capital Assumptions

Operational liquidity requirements are guided by the following assumptions:

- **Cash Reserves:** The project will maintain cash equivalent to 30 days of projected annual operational expenses, ensuring robust liquidity management.
- **Accounts Receivable (A/R) Collection Period:** The average collection period for receivables is 45 days, reflecting expected credit sales conversion into cash.
- **Accounts Payable (A/P) Payment Period:** The average payment period for payables is 0 days, indicating the timeframe for settling supplier obligations.
- **Inventory Management:** Inventory levels will be maintained to cover an average of two months of sales quantity, ensuring optimal stock levels to meet demand efficiently.

**Capital expenditures** expected to be incurred in the first year were included as part of the initial costs of the project.

**Provisions** were made within the initial cost to cover any potential negative net free cash flow that may arise during the first five years of operation, if needed.

## 5.2 Financial Study:

### 5.2.1 Projected Working Capital

This table shows that the net working capital needed for the project in its first year of operation is JOD 9,974, which has to increase steadily year over year to reach JOD 22,947 in its fifth year. The steady increase in working capital covers the rapid rise in project operations and the increase in projected revenues.

*Table 7: Working capital projection (JOD)*

| Description / Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **Cash** | 2,599 | 3,391 | 4,738 | 6,420 | 6,735 |
| **Accounts Receivable (A/R)** | 6,369 | 8,238 | 9,675 | 13,063 | 14,313 |
| **Inventory** | 1,007 | 1,305 | 1,513 | 1,775 | 1,900 |
| **Net Working Capital** | 9,974 | 12,993 | 15,926 | 21,258 | 22,947 |
| **Change in Working Capital** | | 2,959 | 2,993 | 5,331 | 1,689 |

### 5.2.2 Project Initial Cost

The project's initial cost is projected to be JOD 14,974, comprising JOD 5,000 as CapEx and JOD 9,974 as net working capital.

*Table 8 Initial Cost Summary (JOD)*

| Description / Year | JOD |
|---|---|
| CapEx | 5,000 |
| Net Working Capital | 9,974 |
| **Total Initial Cost** | **14,974** |

### 5.2.3 Projected Income Statement

The projected income statement indicates that the project will experience a profit of JOD 10,178 in the first year of operation. Moreover, the net profits are expected to increase gradually over the study period, reaching JOD 17,029 in the fifth year of operation.

*Table 9: Projected Income Statement (JOD)*

| Description / Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Total Revenues | 50,950 | 65,900 | 77,400 | 104,500 | 114,500 |
| COGS | 6,040 | 7,830 | 9,080 | 10,650 | 11,400 |
| **Gross Profit** | **44,910** | **58,070** | **68,320** | **93,850** | **103,100** |

| | | | | | |
|---|---|---|---|---|---|
| OpEx | 31,187 | 40,692 | 56,857 | 77,044 | 80,814 |
| **Net Profit Before Tax and Depreciation** | **13,723** | **17,378** | **11,463** | **16,806** | **22,286** |
| Depreciation | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| **Net Profit Before Tax** | **12,723** | **16,378** | **10,463** | **15,806** | **21,286** |
| Tax Expense | 2,545 | 3,276 | 2,093 | 3,161 | 4,257 |
| **Net Profit** | **10,178** | **13,103** | **8,371** | **12,645** | **17,029** |

In its first year of operation, the project is anticipated to achieve a 20.0% profit margin. Furthermore, the gross profit margins are expected to gradually increase in the subsequent years. However, the net profit margins are projected to decrease slightly, reaching 14.9% by the fifth year of operations.

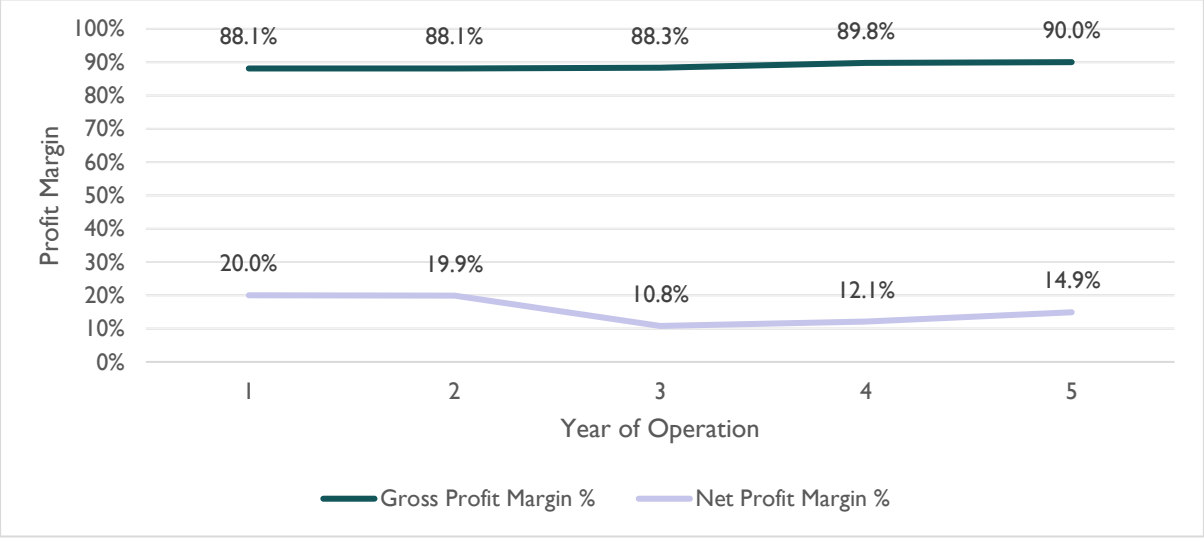


*Figure 3 Gross vs Net Profit Margin*

On the asset management side, the study shows that the return on investment will increase steadily from 68% in the first year of operation to 113.7% in the fifth year.

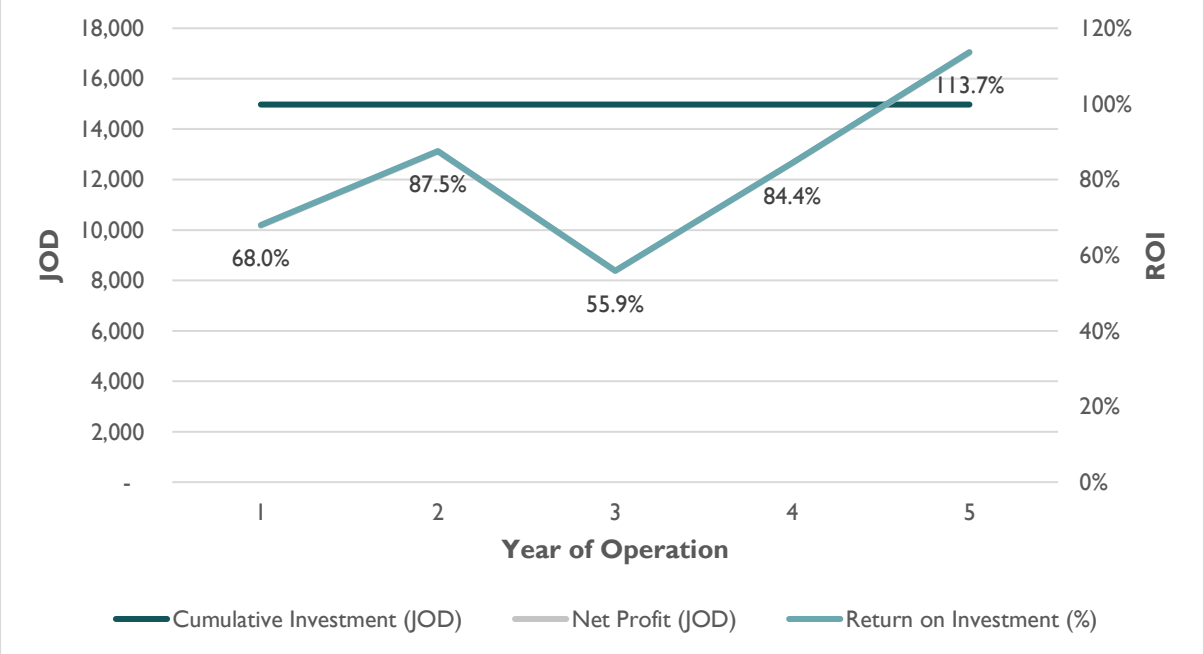


*Figure 4: Return on Investment*

### 5.2.4 Projected Free Cash Flow Statement

The table below demonstrates that the project will generate a positive free cash flow in its first year of operation, JOD 11,178. Moreover, in the following years, it is expected to generate positive free cash flows that increase gradually to reach JOD 16,339 in its fifth year of operation.

*Table 10 : Free Cash Flow (FCF) Projection (JOD)*

| Description / Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **Cash-In Flow** | | | | | | |
| Net Profit | | 10,178 | 13,103 | 8,371 | 12,645 | 17,029 |
| Depreciation | | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Injected Capital | 14,974 | - | - | - | - | - |
| **Total Cash-In Flow** | **14,974** | **11,178** | **14,103** | **9,371** | **13,645** | **18,029** |
| **Cash-Out Flow** | | | | | | |
| Initial Cost | 14,974 | - | - | - | - | - |
| Changes in Working Capital | - | - | 2,959 | 2,993 | 5,331 | 1,689 |
| **Total Cash-Out Flow** | **14,974** | **-** | **2,959** | **2,993** | **5,331** | **1,689** |
| **Free Cash Flow** | - | **11,178** | **11,143** | **6,378** | **8,313** | **16,339** |

Based on these results, the project's feasibility indicators demonstrate its viability, with a net present value of JOD 21,118.7 and a profitability index of 2.41. Moreover, the project's internal rate of return (IRR) is expected to be 63.77%, indicating feasibility is not sensitive to changes in market conditions.

| Feasibility Indicators | |
|---|---|
| Net Present Value (NPV) | 21,119 |
| Profitability Index (PI) | 2.41 |
| Internal Rate of Return (IRR) | 63.77% |

## 5.3 Sensitivity Analysis

To assess the project's sensitivity to market conditions, a sensitivity analysis was conducted involving six unfavourable scenarios:

- Decrease projected revenues by 5% while keeping other variables constant.
- Decrease projected revenues by 10% while keeping other variables constant.
- Increase operational expenditure by 5% while keeping other variables constant.
- Increase operational expenditure by 10% while keeping other variables constant.
- Increase initial costs by 5% while keeping other variables constant.
- Increase initial costs by 10% while keeping other variables constant.

*Table 11: Sensitivity analysis outcomes*

| Sensitivity Scenario | Net Present Value (NPV) | Profitability Index (PI) | Internal Rate of Return (IRR) |
|---|---|---|---|
| Original Case | 21,119 | 2.41 | 63.77% |
| Drop in revenue by 5% | 10,359 | 1.69 | 41.49% |
| Drop in revenue by 10% | 400 | 0.97 | 12.70% |
| Increase in OpEx by 5% | 13,470 | 1.89 | 48.43% |
| Increase in OpEx by 10% | 5,820 | 1.38 | 30.70% |

| | | | |
|---|---|---|---|
| Increase in initial cost by 5% | 20,370 | 2.30 | 60.00% |
| Increase in initial cost by 10% | 19,621 | 2.19 | 56.55% |

The sensitivity analysis shows that, in general, the project is feasible and not sensitive to unfavourable market conditions. Apart from the 10% drop in the revenue's scenario, the project's economic feasibility is strong and viable under all the above-mentioned scenarios. The drop in revenues has a more dramatic impact on the project viability than the increase in the OpEx or initial cost by the same magnitude. It is recommended that investors check and further study the market to ensure that the projected revenues are achievable within the thresholds of the proposed initial cost and operational expenditures.

# 6. Integration with Other Sectors

PV ReImagine can integrate with multiple sectors, fostering a collaborative ecosystem that enhances its impact and sustainability. In the education sector, PV ReImagine's educational kits serve as practical tools for schools, colleges, and vocational training centers, enriching their curricula with hands-on learning about renewable energy. This collaboration not only educates the younger generation about sustainability but also prepares a skilled workforce for the growing green energy market.

In the manufacturing sector, PV ReImagine supplies recycled materials such as aluminum and glass to various manufacturers, promoting a circular economy. This integration reduces waste, lowers manufacturing costs, and supports the production of eco-friendly products. Additionally, by partnering with NGOs and environmental organizations, PV ReImagine can amplify its mission of promoting sustainability and renewable energy adoption, leveraging these organizations' networks and resources to reach a broader audience and drive significant environmental impact.

# 7. Entrepreneur Persona

The ideal entrepreneur to lead PV ReImagine is a visionary with a deep passion for sustainability and renewable energy. This individual should possess strong technical expertise in solar PV technology and recycling processes, ensuring the efficient and creative reuse of solar modules. Their background in environmental science or engineering, coupled with hands-on experience in the green energy sector, will enable them to navigate technical challenges and drive continuous improvement in product development.

Equally important are strong leadership and entrepreneurial skills. The entrepreneur should be adept at strategic planning, team building, and fostering partnerships with educational institutions, NGOs, and industry stakeholders. Their ability to communicate the vision of PV ReImagine and inspire others will be crucial for securing funding, expanding market reach, and driving the company's growth. A commitment to sustainability and a proactive approach to

problem-solving will ensure PV ReImagine's success in promoting renewable energy and sustainable practices.

# 8. Stakeholders

The stakeholders of PV ReImagine encompass a diverse group crucial to the project's success. Primary stakeholders include educational institutions such as schools, colleges, and vocational training centers, which integrate the educational kits into their curricula. These institutions benefit from the hands-on learning experiences that the kits provide, helping to foster a generation knowledgeable about renewable energy and sustainability.

Another significant group of stakeholders is environmental NGOs and sustainability advocates. These organizations play a vital role in promoting the project's mission and expanding its reach. By collaborating with PV ReImagine, they help amplify efforts to reduce solar PV waste and promote renewable energy, leveraging their networks and resources to drive greater environmental impact.

Renewable energy companies are also key stakeholders, as they are the source of the broken or discarded PV panels that PV ReImagine repurposes. By partnering with these companies, PV ReImagine ensures a steady supply of raw materials for their products while helping these companies manage their waste sustainably.

Manufacturers and workshops that utilize recycled aluminum and glass from PV ReImagine form another key stakeholder group. These entities benefit from access to sustainable materials at potentially lower costs, supporting their production of eco-friendly products. Additionally, government bodies and regulatory agencies are essential stakeholders, providing the necessary support, subsidies, and regulatory frameworks to facilitate the project's implementation and growth.

# 9. Risk Assessment and Mitigation

The risks that PV ReImagine might potentially face are detailed in the following table:

| Risk | Impact | Likelihood | Risk Mitigation Technique |
|---|---|---|---|
| Supply Chain Challenges | High | Medium | Establish multiple supplier relationships |
| Quality Control Issues | High | Medium | Implement strict quality control protocols |
| Market Acceptance | Medium | High | Conduct extensive market research and pilot programs |
| Regulatory Changes | Medium | Low | Stay informed on regulations, engage with policymakers |

| | | | |
|---|---|---|---|
| Financial Constraints | High | Medium | Secure diverse funding sources, maintain a reserve fund |
| Technological Obsolescence | Medium | Medium | Invest in ongoing R&D, stay updated on industry trends |
| Operational Inefficiencies | Medium | Medium | Regularly review and optimize processes |

To address the identified risks, PV ReImagine should adopt a proactive approach with comprehensive risk mitigation strategies. Establishing relationships with multiple suppliers ensures a steady supply of PV panels and other raw materials, reducing the risk of supply chain disruptions. Additionally, implementing strict quality control protocols will help maintain the high standards necessary for product reliability and customer satisfaction.

Market acceptance can be improved by conducting extensive market research and pilot programs to better understand customer needs and preferences. This approach will allow PV ReImagine to tailor its products and marketing strategies effectively. Staying informed about regulatory changes and engaging with policymakers ensures that the start-up can adapt quickly to any new regulations and maintain compliance.

Financial constraints are a significant risk that can be mitigated by securing diverse funding sources, such as grants, investments, and partnerships, and maintaining a reserve fund for unforeseen expenses. To prevent technological obsolescence, PV ReImagine should invest in ongoing research and development, ensuring that its products remain competitive. Regularly reviewing and optimizing operational processes will address inefficiencies, improving overall productivity and cost-effectiveness.

The sensitivity analysis shows that a 10% drop in revenues results in a profitability index of less than 1, indicating that the project's returns would not cover its costs under this scenario. This highlights the critical importance of achieving projected revenue targets. Therefore, it is recommended that investors conduct further market studies to ensure that the projected revenues are achievable and to develop contingency plans to handle potential revenue shortfalls.

By implementing these risk mitigation techniques, PV ReImagine can enhance its resilience and position itself for long-term success in the renewable energy sector.

# 10. Conclusion

In conclusion, the project demonstrates promising feasibility indicators based on the assumptions formed during the development of this study. Nonetheless, entrepreneurs are advised to conduct additional analysis on projected demand, initial costs, and operational expenses to mitigate potential risks associated with adverse market conditions that could jeopardize its validity.

## Disclaimer

The Ministry of Digital Economy and Entrepreneurship (MoDEE) and Istidama Consulting have prepared this report using information supplied by its advisors as well as information available in the public domain.

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Founders and investors considering this project are advised to conduct further analysis on projected adoption rates, development costs, and ongoing operational expenses. This additional scrutiny will help mitigate potential risks related to technology challenges, changes in regulations, market penetration, and competitive pressures.

The report does not constitute any form of commitment or recommendation on the part of MoDEE or Istidama Consulting.