

Upgrade or Replace? – Carbonate removal system

(ACPA7002)

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1.0 Introduction

At The Royal Mint, the current carbonate removal system is approximately twenty three years old. When designed, the serviceable life was twenty years. The carbonate removal system is starting to fail, causing a decrease in plant availability leading to expensive repairs and increased waste disposal costs.

The Royal Mint have decided that a project must be completed to avoid further lost production time.

2.0 Project

The Royal Mint decided it was best to assess two different options before committing to a project and raising a business case and capital expenditure (CapEx) project. Both projects will be measured over a **five year period**. Maintenance required for both options are identical.

2.1 Option 1 - Upgrade

The first option was to upgrade the current carbonate removal system. This included introducing a newer, more efficient technology for forming carbonate, reusing old parts after significant maintenance and improvements, and a new safety system included interlocks with the production plant.

The upgrade would take **six to eight weeks**, from order to installation.

The carbonate removal system would be removed, improved and **replaced within a four day working window** by The Royal Mint staff, with software modifications taking place alongside this over two days. When complete, the carbonate removal system would be commissioned (**three days**) and operators familiarized with the improved equipment with training over a **two day period**.

2.2 Option 2 – New system

The second option was to replace the carbonate removal system for a brand new unit. This unit comes equipped with the latest technology and superior energy efficiency when compared with the proposed upgrades of option one.

From order to installation, the expected timeframe is **twelve to fourteen weeks**. The installation will take place offline to current production plant, so no production outage is required.

Commissioning of the unit is expected to take just **one day**, with minimal software upgrade required. The manufacturer will then provide **five days of training** to plant operators (added expense).

3.0 Financial appraisal

A financial appraisal was completed for both options. This and a number of other contributing factors would determine which option is most favourable. Once an option was preferred, a project would be raised requesting capital expenditure (CapEx). CapEx is any type of expense that a company capitalizes or shows on its balance sheet as an investment rather than on its income statement as an expenditure.

3.1 Project cost

The project cost was calculated using quotes from suppliers, as well as internal costs from resources used belonging to The Royal Mint. Extended list in

	OPTION 1 (UPGRADE)	OPTION 2 (REPLACEMENT)
TOTAL	£31,610.00	£68,650.00

3.2 Payback period – PP

The payback time of a project is the length of time from when a project is initiated through to when cash flow/ saving becomes positive, recovering all invested funds.

	OPTION 1 (UPGRADE)	OPTION 2 (REPLACEMENT)
Payback period (PP)	2 years 9 months	2 years 8 months

Both option one and option two have a payback period of less than three years and are largely comparable. – ARR

3.3 The accounting rate of return – ARR

Accounting rate of return (ARR) can be used as an indicator of the potential profitability of investments of a period of time. The ARR formula can be found in Equation 1.

The residual value of both the upgrade option and replacement option has been calculated at £500. This is attributed to the chemical (cyanide) contamination of the machine from the time that it is first used.

	OPTION 1 (UPGRADE)	OPTION 2 (REPLACEMENT)
Average net income	£13,000.00	£30,000.00
Average investment	£16,055.00	£34,575.00
ARR	81.0%	86.8%

3.4 Net present value – NPV

Net present value takes into account the future value of money. One unit of currency in one year, will be less than one unit of currency today, this is attributed to inflation.

For this project, we demonstrate NPV over the five years using a company discount rate of 7%

The NPV is calculated by adding the sum of the future value of the total years' cash-flow, divided by the investment (see Appendix 2 & Appendix 3)

	OPTION 1 (UPGRADE)	OPTION 2 (REPLACEMENT)
NPV	£9,852.37	£26,537.91

The NPV for both project options give good positive figures. This shows that risk of investment for both projects is low.

3.5 Profitability Index – PI

The profitability index is a calculation of a potential profit of the proposed project. A PI value greater than '1' is desirable. The PI equation can be found in Equation 2.

	OPTION 1 (UPGRADE)	OPTION 2 (REPLACEMENT)
PI	1.31	1.39

PI for both projects are both above '1', this is indicative that risk of investment in either option is low.

3.6 Internal rate of return – IRR

Internal rate of return (IRR) is a method of calculating an investment's rate of return. It is the discount rate at which NPV for the cash flow is zero.

	OPTION 1 (UPGRADE)	OPTION 2 (REPLACEMENT)
IRR	26%	28%

The IRR for both projects are largely comparable.

3.7 Benefit cost ratio - BCR

	OPTION 1 (UPGRADE)	OPTION 2 (REPLACEMENT)
BCR	0.65	0.75

Benefit cost ratio (BCR) was also calculated. It is used as an indicator showing the relationship between the relative costs and benefits of a proposed project, expressed in monetary or qualitative terms. The equation for BCR can be seen in Equation 3.

4.0 Discussion

There were a number of non-financial considerations for the organisation to make. These are outlined below:

Size - The upgraded system will be fitted into the space of the current system, whereas the new system would be installed in a separate location

Speed of implementation - Installation of the upgraded carbonate removal system is likely to be much faster than installing a new system. Although, during installation, the new system would not affect the operation of the production plant, the upgraded unit would re

Staff skills - As the upgraded system operates using the same principles, there will be a fair amount of knowledge carryover with option 1 when compared to option 2.

Operational efficiency – The new system would operates in a continuous cycle, this maximises efficiency, as well as having the latest technology ready to use.

Resources - Option 2 would rely heavily on contractors from the manufacturer of the new system. Option 1 would utilise resource from The Royal Mint

5.0 Conclusion

The Royal Mint decided on option 2, a replacement new unit. The decision was reached when considering all financial and non-financial factors. The new machine also aligns with the organisations five year plan of technologically advancement within the business.

6.0 Equations

$$ARR = \frac{\text{Average annual profit}}{(\text{Initial investment} + \text{future residual value})/2}$$

Equation 1 - The accounting rate of return (ARR)

$$PI = \frac{\text{Net present value}}{\text{Initial investment}}$$

Equation 2 - Profitability index (PI)

$$BCR = \frac{\text{Average annual profit}}{\text{Initial investment}}$$

Equation 3 - Benefit to cost ratio

7.0 Appendix

	OPTION 1 (UPGRADE)	OPTION 2 (REPLACEMENT)
COST	£27,000.00	£67,000.00
DELIVERY	£850.00	INCLUDED
INSTALLATION	£2,160.00	INCLUDED
SOFTWARE	£1,200.00	£400.00
TRAINING	£400.00	£1,250.00
TOTAL	£31,610.00	£68,650.00

Appendix 1 - Breakdown of costs for option 1 & 2

Option 1 - Upgrade		Year				
	Investment	1	2	3	4	5
Present Value	(31,610)	£5,000.00	£15,000.00	£15,000.00	£15,000.00	£15,000.00
Payback	2 years 9 months	Manually Calculated				
Discount Rate (WACC)	7.00%	From Present Value Table				
Denominator	1.00	0.935	0.873	0.816	0.763	0.713
Future Value	(31,610)	4,672.90	13,101.58	12,244.47	11,443.43	10,694.79

Appendix 2 - Option 1 NPV table

Option 2 - Replace		Year				
	Investment	1	2	3	4	5
Present Value	(68,650)	£10,000.00	£35,000.00	£35,000.00	£35,000.00	£35,000.00
Payback	2 years 8 months	Manually Calculated				
Discount Rate (WACC)	7.00%	From Present Value Table				
Denominator	1.00	0.935	0.873	0.816	0.763	0.713
Future Value	(68,650)	9,345.79	30,570.36	28,570.43	26,701.33	24,954.52

Appendix 3 - Option 2 NPV table