



## For the Instructor: Teaching Note on “Replacing Ozone-Depleting Chemicals”

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Discussion of the case can begin with an overview of current information about the destruction of the ozone layer. The publications cited in the footnotes contain comprehensive analyses of the history of the problem and how it has been dealt with or avoided. A search of a periodical or newspaper database can update this information.

### **The Analysis**

Table 1a shows cash flow on a monthly basis under the 1/1/91 tax payment scenario. Calculating the cash flow involves using the prior cost of manufacturing Halon as a tax shield because the cost was incurred prior to the analysis. On the spreadsheet it is first deducted as an expense and then added back. The ODC floor taxes are substantial. They are calculated as of 1/1/91 as:

$$3 \times 1.37 \times 1,895,000$$

In January 1992 taxes again apply with the differential between 1/1/91 and 1/1/92 being thirty cents. The thirty-cent differential is multiplied by the ODC factor, 3.0, and the stock-on-hand at that time (1,475,000 lbs.). Again, in January 1993, when the tax rate goes to \$2.65 per lb. PCC incurs additional taxes on inventory. Using a monthly discount rate will severely penalize PCC if it elects to pay taxes on floor stock beginning 1/1/91 and then the subsequent increases based on floor stock because these early negative cash flows occurring closer to the October 1, 1990 decision date are more heavily weighted than consequent income. Taxes are also paid on the Halon that is not subsequently sold.

Table 2a shows the cost of disposing of the Halon on an annually increasing basis per pound multiplied by pounds-on-hand at the critical points in the decision process. These calculations are the same under either tax payment scenario.

Table 3a consists of period-by-period calculations of the present value earnings after taxes shown in Table 1a discounted at 1% per month back to the October 1, 1990, decision date. The different earning periods, 15 months for the initial period and then annually, correspond with the possible cessation of sales of Halon due to the introduction of Pacific's new product. If the product is introduced on January 1st of a particular year, PCC will no longer sell Halon and will then have to pay disposal costs at existing rates at that point in time (Table 2a). Manufacturing costs of \$3 per lb. of stock-on-hand at the cessation of sales would be expensed and a tax shield generated resulting in a positive cash flow from the writeoff.

Table 4a shows the joint probabilities for each possible annual introduction of Pacific's new chemical and the PVCF associated with those probabilities including tax writeoffs and disposal costs.\* For example, if Pacific introduces its new product 1/1/93, the joint probability of this occurring is calculated as  $0.8 \times 0.5$  or 40%, corresponding to the 80% probability of Pacific not introducing its product 1/1/92 and the 50% probability of a 1/1/93 introduction. The PVCF is the sum of the PVCF of  $\langle 485,975 \rangle$ , PVCF of cash flows from 10/1/90 to 12/31/91 which in this case includes the tax on floor

\* For a good discussion and example of decision tree analysis see Brigham & Gapenski, *Financial Management: Theory and Practice*, Dryden, 5th Edition, Chapter 10, specifically page 331.

stocks, plus the present value of a final year CF figure of 4,399,948 which includes PVCF over the period 1/1/92 to 12/31/92 of 3,907,581, the PV of the tax writeoff of the Halon in stock as of 12/31/92, 846,768, less the PV after tax cost of disposal of 354,402 (from Table 2a). The 3,913,973 PVCF (Table 4a) is the present value of the decision to pay the taxes on inventory given that Pacific introduces its product on 1/1/93. That value is multiplied by the joint probability for that introduction date, 40%. Joint probabilities are multiplied by each of their associated PVCF outcomes and summed to arrive at an expected PVCF of 5,548,397 for the decision to pay taxes on floor stocks.

The analysis proceeds in a similar fashion where taxes are paid as the Halon is sold. Earnings after taxes month-by-month are shown in Table 5a for this scenario. Table 6a shows the same type of annual PVCF information for the tax-as-sold case as shown in Table 3a for the floor tax scenario. Joint probability calculations in Table 7a arrive at a considerably higher expected PVCF of 8,946,498.

If PCC were to sell the Halon outright to James Fire Extinguisher after tax revenues, after accounting for the \$3-per-pound tax shield on already expended production costs, would be \$7,550,000:

$$10,00,000 \times (1 - 0.35) + 3,000,000 \times 0.35$$

Paying taxes on the Halon as it is sold has the highest present value, \$1,396,498 greater than selling the Halon today to James Fire Extinguisher. The qualitative aspect of possible future legal actions against CFC producers can now be brought into the decision process. If PCC sells the Halon, paying taxes as it is sold, there may be a possibility of it being held liable for injuries to future litigants. The difference between these sales versus all sales that have gone before is that they have been made with full knowledge of consequences. The federal government has gone so far as to codify a tax law and the phaseout of the manufacturing of the chemical, making PCC culpable after society has recognized Halon as an environmental hazard.

On the other side of the issue, Halon is an effective fire extinguisher. The continued sale of it prior to the introduction of a substitute product could save lives. The class can discuss whether or not this counter-balances the long-term negative impact that 2,000,000 additional pounds of Halon will have on the environment. This type of tradeoff presents a thorny and interesting environmental and ethical issue.



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