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9B18M134

Cap and Trade in Ontario: Lafarge

Adam Fremeth and Patrick Shulist wrote this case solely to provide material for class discussion. The authors do not intend to illustrate either effective or ineffective handling of a managerial situation. The authors may have disguised certain names and other identifying information to protect confidentiality.

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As the operations manager for Lafarge’s production facility in Ontario, your normally complex job has just become even more challenging. With the introduction of Ontario’s cap-and-trade system, you now must directly consider the cost of carbon in your decision making, which was the government’s intention from the start. This affects your decision making in three ways: (1) making production decisions, (2) trading permits, and (3) deciding on long-term investments in clean technology.

CARBON POSITION

Given your experience, and the expertise you can draw on from Lafarge’s global operations, you have become an expert in setting production targets for Lafarge’s sole plant in Ontario—the Bath Cement plant—which sits along the shores of Lake Ontario. You have a finely tuned sense of how to predict production needs, considering predicted demand and the cost of production. However, the introduction of a carbon cap-and-trade system complicates this decision-making process. Over the past few years, the plant’s production emitted around 650,000 tonnes of carbon dioxide equivalents (CO2e) per year. This far exceeds the 25,000-tonne threshold for mandatory inclusion into Ontario’s cap-and-trade system. As a result, you will have to obtain emissions permits for all the Bath Cement plant’s emissions. Fortunately, the government of Ontario has stated it will give Lafarge 600,000 emissions permits during the first year of the cap-and-trade scheme. The government’s generosity is to ensure an easy and smooth transition into the program. However, the number of free permits will decrease every year, with Lafarge receiving 580,000 permits in year 2 and 560,000 in year 3. The number of free permits across the entire market for all four firms will see a similar decrease from 1,922,000 permits in year 1 to 1,846,000 in year 2 and 1,772,000 in year 3.

Given the current condition of the plant, for every tonne of cement that the Bath Cement plant produces, 0.93 tonnes of CO2e will be released into the air. This ratio of is known as carbon intensity (CI). Cement, as you well know, is very carbon intensive to produce because it involves heating the raw materials (generally, calcium carbonate, silica, alumina, and iron ore) to 1,500 degrees Celsius, roughly the same temperature as molten lava.[[1]](#footnote-1) To reach these extreme temperatures, the Bath Cement plant must burn fossil fuels, which are the primary culprit for the plant’s carbon emissions.

Last year, the Bath Cement plant’s output quantity was optimized to maximize profit at approximately 700,000 tonnes of cement. The total output was sold at a constant price of CA$450[[2]](#footnote-2) per tonne. Marginal costs, on the other hand, were not constant. Instead, you know that you can model the average variable production cost (AVC) of cement as follows: , where *Q* is the production quantity. In addition, the Bath Cement plant has annual fixed costs of $142 million. These numbers are not expected to change.

In previous years, your job focused on keeping the cost of production down and ensuring smooth logistics to end consumers. However, you realize that carbon pricing will have a large impact on overall profitability. As a result, your new goal is to maximize profit within the bounds of the new policy. To help make the market stable and more predictable, the Government of Ontario is instituting a price floor of $18 per tonne of CO2e emissions and a price ceiling of $54 per tonne. The price floor is the amount that the government will pay for excess permits held by the firm at year-end. The price ceiling will also act as a penalty per tonne of CO2e for firms that do not hold the requisite number of permits at year-end. Considering Lafarge’s average annual emissions of 650,000 tonnes, and the fact that you have only been provided 600,000 permits for next year, you will have a shortfall of 50,000 permits that you need to procure. This shortfall can change if your production levels change. Should the market for permits fall to the price floor in trades with other firms, this would cost Lafarge $900,000, and at the price ceiling it would cost $2.7 million, should you fail to acquire the needed permits. These amounts of money are significant, given the thin margins on cement and the large capital costs involved in setting up the operation.

EMISSIONS-REDUCTION STRATEGY

To avoid additional costs associated with procuring permits, Lafarge can reduce production, although it would mean foregoing sales. Because Lafarge’s permit allocation will reduce every year, production levels would have to continually decrease. Therefore, production changes may be only part of the answer.

Instead, the bulk of Lafarge’s strategy for meeting its permit needs should focus on two key activities: (1) investing in clean technology and (2) trading permits with other firms in the cap-and-trade scheme. In fact, if Lafarge makes sufficient investments in clean technology, it could become a net seller of permits and thus open a new line of revenue. Unfortunately, this is unlikely. Cement is simply too carbon intensive for the needed reduction to be obtainable. Lafarge’s strategy should therefore focus on reducing emissions intensity where it can do so profitably, while simultaneously securing permits on the market from other firms. Pursuing this twin strategy will ensure that minimized costs are associated with the cap-and-trade scheme.

The carbon permits act like a traditional financial instrument. Whichever company is given a permit is the legal owner of the right to emit 1 tonne of CO2e. These permits are fully transferable, so Lafarge can “buy” from other firms the right to further emissions. This is where the concept of marginal-abatement cost comes into play. Because of the nature of their operations, some firms can reduce carbon emissions less expensively than others, through process modifications or investments in more efficient or cleaner technologies. For such firms, it is profitable to reduce emissions *beyond* the level required by the permits they are allocated. These firms can then sell their excess permits to other firms—like Lafarge, for example—for more money than the investment they made in the emissions-reduction technologies or process modifications.

For its part, Lafarge has identified three main strategic investments that can be used to reduce the overall carbon intensity of its operations by reducing the carbon emissions per tonne of cement produced. First, Lafarge can substitute raw materials in the production process. In particular, the company can reduce the proportion of traditional inputs by substituting them for limestone, fly ash, or granulated blast-furnace slag. The material substitutes reduce the amount of heating that the cement requires in the kiln, reducing fossil fuel use. Lafarge estimates that substituting these raw materials will reduce carbon intensity per tonne of cement by 0.008 tonnes. For example, the level of carbon intensity will be 0.922 tonnes of CO2e per tonne of cement after this modification, if done in isolation. Importantly though, since energy costs are a substantial cost of cement production, substitution will actually *save* Lafarge money each and every year, making this clearly a positive–net present value project. Your accountant calculates that the net *annualized* savings into perpetuity will be $425,000 per year, which means that you will realize a $425,000 gain *each year* on your income statement for the foreseeable future.

Second, you have recently been speaking with some of the site engineers who note that the kiln is old and inefficient. It has numerous cracks, and the furnace is less efficient than it could be, resulting in heat losses. Your engineers estimate that at an *annualized* cost of $2.2 million for each of the next 15 years, carbon intensity could be reduced by 0.04 tonnes of CO2e per tonne of cement production. This investment in green technology—like all of Lafarge’s options—operates independently of other investments and can be done in conjunction with other efforts to reduce carbon intensity.

Third, your engineer also points out that you could invest in new high-technology insulation. By reducing the heat loss from the kiln, you would reduce the amount of fossil fuel use needed to heat the kiln. The mechanics of this option are similar to improving the insulation of a house. It is estimated that for an *annualized*cost of $4 million for each of the next 15 years, you can purchase and install the new insulation and reduce carbon intensity by 0.01 tonnes per tonne of cement production.

When considering all these investment decisions, *it is important to consider the number of permits you will have, the total emissions you will make based on your production levels, and the total emissions reduction enabled by each clean-technology investment*. Also, any unused permits you own at the end of the year can be sold back to the government at the price floor of $18 per permit. On the other hand, for every permit shortfall at the end of the year, you will have to pay the price ceiling, which is a penalty of $54 per permit.

**ADDITIONAL MARKET INFORMATION**

The trading platform allows for an interactive marketplace where companies will have the opportunity to present offers to buy or sell permits at a stated price per permit, and other participating companies are able to accept those terms or offer counter bids. The government of Ontario has put in place rules to ensure the smooth functioning of the carbon market. Each transaction in the trading platform is capped at 10,000 permits per transaction to ensure the smooth functioning of the market. Finally, information on market transactions will be transparent to all companies, including the number of permits traded and the price per permit.

For assistance with your planning and decision-making, some relevant details are provided, including basic operating information, clean technology investment options, and carbon market details (see Exhibit 1).

Exhibit 1: BASIC Operating INFORMATION

|  |  |
| --- | --- |
| **Operating Item** | **Calculation** |
| Quantity produced (Q) | *Q*, expressed in tonnes of cement |
| Average variable production cost (AVC) |  |
| Total variable production cost (TVC) |  |
| Fixed costs (FC) |  |
| Sales price per tonne (P) |  |
| Total revenue (R) |  |
| Profit (π) |  |
| Baseline carbon intensity (CI) |  |
| Baseline total carbon emissions (TCE) |  |

Clean-Technology Investment Options

|  |  |  |
| --- | --- | --- |
| **Clean-Technology Investment Option** | **Annualized Cost (Savings)** | **Reduction in Emissions Intensity** |
| Substitute raw materials | ($425,000) | 0.008 |
| Kiln repairs | $2,200,000 | 0.040 |
| Improve kiln insulation | $4,000,000 | 0.010 |

Note: It takes one year for all clean-technology investments to come online; therefore, an investment in year 1 changes the emissions intensity of year 2.

Carbon-Market Details

|  |  |
| --- | --- |
| **Carbon-Market Item** | **Calculation** |
| Meaning of one permit | Legally allowed to emit 1 tonne CO2e |
| Price floor for a permit | $18 |
| Price ceiling for a permit | $54 |
| Lafarge’s year-1 permit allocation | 600,000 tonnes of CO2e |
| Lafarge’s year-2 permit allocation | 580,000 tonnes of CO2e |
| Lafarge’s year-3 permit allocation | 560,000 tonnes of CO2e |
| Lafarge’s current annual emissions | 650,000 tonnes of CO2e |

Note: All currency amounts are in CA$; CO2e = carbon dioxide equivalent.

Source: Created by the case authors.

1. “Cement,” Lafarge, accessed June 27, 2018, www.lafarge.ca/en/cement. [↑](#footnote-ref-1)
2. All currency amounts are in CA$ unless otherwise specified. [↑](#footnote-ref-2)