Incorporating Co-Benefits and Environmental Data into Corporate Decision-Making

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This case study deals with The Dow Chemical Company’s (Dow) and the City of Midland, Michigan’s decisions on how to restore two adjacent pieces of property. Dow aimed to restore a greenbelt area with historical issues, and the City of Midland aimed to restore a brownfield property that bordered Dow’s greenbelt area. Dow has a stated goal to apply a “business-decision process that values nature” and to deliver $1 billion in “value through projects that are good for business and good for ecosystems.” The City of Midland has developed a 20-year Master Plan that includes goals for Midland to connect and maintain open spaces. In line with these goals, Dow and the City of Midland wanted to restore the greenbelt area and brownfield property by enhancing habitat and ecosystem services in a way that was also beneficial to Dow’s bottom line and the residents of Midland, respectively. This case study presents three alternative restoration designs along with detailed financial cost and environmental data for each design. Students perform a cost-benefit analysis, highlighting potential differences between how costs are calculated in a public setting relative to a private setting. In addition, students assess how the inclusion of important non-financial environmental data may be used to inform decision making.

Key words: Corporate social responsibility, sustainability, ecosystem services, cost-benefit analysis.

JEL codes: A22, M14, Q51, Q57.

In 2015, both The Dow Chemical Company (“Dow”) and the City of Midland, Michigan were facing a decision regarding how best to restore and enhance two adjacent decommissioned industrial sites. Dow project managers aimed to develop a data-based argument as to how the restoration project could offer shareholder value while also addressing the company’s commitment to nature in its 2025 Sustainability Goals. City of Midland officials aimed to develop a data-based argument regarding how the restoration project could be a cost-effective use of tax-payer money and how it fits into the City’s 20-year Master Plan.

In April 2015, Dow announced a suite of 2025 Sustainability Goals that the company is implementing over the next ten years (The Dow Chemical Company 2015). Like many companies, Dow’s 2025 Sustainability Goals include goals aimed at reducing its footprint through, for example, emissions reductions and freshwater intake reductions. In addition to its footprint goals, Dow, in its 2025 Sustainability Goals, committed to generating $1 billion in business value through projects that are good for Dow’s business and better for nature. To achieve this goal, Dow

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This teaching case study was selected by the AAEA Case Study Committee for presentation at the 2018 Agricultural and Applied Economics Association annual meeting, after which it was subjected to an expedited peer-review process.

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Amer. J. Agr. Econ. 101(2): 615–623; doi: 10.1093/ajae/aay095
Published online January 17, 2019

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Electronic copy available at: https://ssrn.com/abstract=3578964
is developing a business decision process incorporating the consideration of the value of nature into all of its business decisions. The company has coined this goal the “Valuing Nature Goal,” or simply the “Nature Goal.”

At the same time, Dow, like all private companies, strives to increase total shareholder value. Thus, project managers within the company needed a way to successfully incorporate the full business value of Nature Goal projects, that is, projects that have the potential to increase or enhance the services that the company and neighboring community can obtain from nature. These managers would like the business value to capture both the financial value of the project and the project’s nature value in a way that is in line with shareholder needs and goals.

The City of Midland’s current Master Plan was adopted in 2013 and lays out planned future development of the community over the next 20 years, including recommendations for future land use, transportation, and community development in Midland (City of Midland 2018). In particular, the Master Plan includes a future land use goal of encouraging the “integration or mixture of appropriate uses to create great places, promote a healthy walkable community, and reduce vehicle trips.” The Master Plan also includes the goal of pursuing transportation alternatives through the continued “development of a continuous system of pathways and sidewalks,” while a community development goal aims to ensure that “new parks … are conveniently located to serve residents.” (City of Midland 2018).

The City of Midland is a public entity, receiving over 80% of its revenue from property taxes in 2015 (City of Midland 2015). As such, the City must ensure that all uses of its money are cost-effective and in the best interests of the residents of Midland.

The following information represents the situation and background available to both Dow and the City of Midland as they each considered alternative restoration designs.

Corporate Sustainability Goals

The concept of sustainability has come under increasing focus during the last two decades. A Web of Science search reveals that roughly 1,000 articles published in 2000 contain the term “sustainability;” that same search shows nearly 15,000 such articles from 2016 (Web of Science 2018). Similarly, in the private sector, slightly less than 20% of S&P 500 companies reported on sustainability; by 2016 the share had increased to 82% (Governance & Accountability Institute 2017). Globally, three-quarter of companies (or nearly 3,600 companies) in the N100—a KPMG sample of 4,900 companies that represent the top 100 companies by revenue in 49 different countries—reported issuing corporate responsibility reports in 2017 (Blasco and King 2017).

Companies’ sustainability goals have become more ambitious and more rigorous as they have developed over the last 20 years. For example, as of March 2018, nearly 370 companies had pledged to set emissions reductions targets that align with the most current climate science (Science Based Targets 2018). Dow’s Valuing Nature Goal aims to incorporate ecosystem service thinking into all of Dow’s business decision-making processes. The aim of this goal, as Dow states on its website is as follows:

“At Dow, we’re committed to making business decisions in a way that appreciates and incorporates the value of nature’s services. . . . If companies understand and value the benefits nature provides to their bottom line, they will be more likely to plan, manage and invest in these resources in smarter, more productive and mutually beneficial ways” (The Dow Chemical Company 2018).

Natural Capital and Ecosystem Services

The U.S. Department of Commerce defines “natural capital” as the “earth’s stock of natural assets” including human societies, animals, plants, and all nonliving environments (U.S. Department of Commerce 2018). This stock of natural assets is a key component of the world’s ecosystems, which the Millennium Ecosystem Assessment (MEA) defines as “a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit,” (MEA 2005a).

Humans and businesses are an integral part of all ecosystems. The benefits that humans and businesses obtain from ecosystems are generally referred to as “ecosystem services.” Any change in natural capital impacts an ecosystem’s functioning and the provision of its ecosystem services. Ecologists and conservation scientists categorize ecosystem services...
into one of four groupings: (a) provisioning services; (b) regulating services; (c) cultural services; and (d) supporting services. Table 1 provides a description and example of each of these four ecosystem service groupings.

The MEA, a groundbreaking report commissioned by then Secretary-General of the United Nations’ Kofi Annan, measured the impacts of human society on the environment. The assessment showed that 15 of the 24 ecosystem services assessed were currently being degraded or used unsustainably (MEA 2005a). Dow hypothesized that by incorporating the ecosystem service impacts of a project into the decision-making process, the company would move toward decisions that are both better for business and better for nature. The challenge lies in developing a systematic way to account for the value of ecosystem services in the decision-making process.

### Midland Restoration Opportunities

In 2015, Dow was developing plans for the closure of an ash pond site in Midland, Michigan, which was under the oversight of the Michigan Department of Environmental Quality. The ash pond site was initially constructed as a cooling pond in the 1940s to serve a coal-fired power plant, which was in operation until the 1980s. The ash pond site covered 23 acres of land and was adjacent to both Dow’s Michigan Operations plant and the Tittabawassee River, a roughly 70-mile river that runs through downtown Midland.

At the same time, the City of Midland was looking to restore a 14.5-acre brownfield in what was an abandoned concrete facility, referred to as the 4-D property, which sat adjacent to the ash pond site. In its Master Plan, the City of Midland has prioritized beautification along the Tittabawassee River (City of Midland 2018); the 4-D property site is a focus area of the City of Midland’s Master Plan.

Traditionally, a site like the ash pond site would be remediated through capping—which involves leaving the ash in place and covering it with natural and synthetic materials—along with long-term treatment and/or monitoring of the groundwater. This traditional closure approach would also include long-term operational and maintenance activities such as maintaining the fenced in area and keeping the land properly mowed. The traditional closure limits access to the site to Dow personnel only.

Project managers at Dow and city officials in Midland were hoping to identify alternative restoration plans for the ash pond site and 4-D property that would enhance the level of ecosystem services provided by the restored sites and better align them with the company’s Valuing Nature Goal and the City’s Master Plan, respectively. Project managers for both sites needed to find a way to advocate for the benefits of an alternative restoration plan that accounted for the value of ecosystem services in a way that would be convincing to Dow’s stakeholders and Midland City officials.

### Alternative Ecological Restoration Plans

The first step was for Dow, the City of Midland, local employees of The Nature Conservancy, and EcoMetrix Solutions group to assess the baseline ecosystem services provided by the sites and to develop an alternative ecological restoration plan. The final alternative ecological restoration plan that was developed for the ash pond site involved excavating all 90,000 cubic yards of ash and restoring the landscape to native forest, prairie, and wetland. In planning for the ecological restoration, Dow identified an opportunity for the City of Midland to implement a similar

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**Table 1. Ecosystem Service Groupings**

| Ecosystem Services (A) | Description (B) | Example Service (C) |
|------------------------|-----------------|---------------------|
| (1) Provisioning Services | Goods or products obtained from ecosystems | Freshwater |
| (2) Regulating Services | An ecosystem’s control of natural processes | Wetland purification of water |
| (3) Cultural Services | Nonmaterial benefits obtained from ecosystems | Recreation |
| (4) Supporting Services | Natural processes that maintain other ecosystem services | Water cycling |

Source: (Hanson et al. 2012).
ecological restoration on its 14.5-acre 4-D property with connecting trails and overlooks between the two sites. Together, these two restoration projects would improve nearly one-mile of riverfront in Downtown Midland and connect an expansive network of parks, open spaces, and trails in the city.

Figure 1 shows the three final restoration designs developed by the project team.1 Figure 1(a) on the left depicts the restored sites following the traditional restoration, where the sites are capped and then covered in grass. Figure 1(b) and (c) depict the restored sites following an ecological restoration on just the Dow site and both Dow and the City’s site, respectively. The ecological restoration involves excavating and disposing of the ash and concrete, backfilling with clean soil to create various site features such as upland areas and wetland features, and planting the areas with native plants. Upon completion of the ecological restoration, the sites are expected to have more than 60 species of native plants, including trees, shrubs, and grasses.

Assessing Ecosystem Service Impacts
Project managers at Dow and Midland City officials needed a systematic way of comparing and assessing the ecological restoration design options in relation to the traditional capping remedies. Previously, Dow, The Nature Conservancy, and EcoMetrix Solutions Group had joined forces to create a specialized modeling tool called the Ecosystem Services Identification & Inventory Tool (ESII Tool). The ESII Tool works as a free iPad application for data collection supported by a web-based interface for ecosystem service modeling. This tool is designed to quickly and effectively generate information on the environmental impact of proposed changes to natural areas (Guertin et al. 2019). Dow decided that the ESII Tool was the appropriate tool to use to understand the ecosystem service tradeoffs between the restoration designs.

The ESII Tool output focuses on measuring ecosystem service performance for eight specific ecosystem services. Table 2 lists the eight ecosystem services that are captured within the ESII Tool as well as the actual thirteen components measured within the tool.

First, for each of the 13 ecosystem service components shown in column (B) of table 2, the ESII Tool calculates a percent performance metric. The percent performance metric rates how well the proposed landscape performs for a specific ecosystem service relative to the highest possible performance of that ecosystem service across all landscapes. With the percent performance metrics, one can directly compare site performance across two restoration designs and across two landscapes.

Second, performance of the ecosystem service components on the sites can also be expressed in engineering units that represent the physical amount of services provided. For

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1 The complete project team included Dow employees, environmental engineers from AECOM, scientists from The Nature Conservancy, and collaborators from EcoMetrix Solutions Group.

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ten of the ecosystem service components shown in column (B) of table 2, the ESII Tool calculates these performance metrics. These measured unit outputs are shown in column (C) of table 2.

Dow and the City of Midland used the ESII Tool to collect ecological data for both of the restoration sites. The project team used the ESII Tool output to refine the restoration designs of the sites to enhance specific ecosystem services: noise, visual aesthetics, water filtration, water nitrogen removal, and water quantity control. For the final designs, the project team measured both the percent performance and unit output differences between the restoration alternatives. Figure 2 shows the percent performance metrics generated from each of the three restoration alternatives. From figure 2, Dow and the City of Midland identified the five ecosystem service components with the largest difference in percent performance between the traditional restoration alternative and ecological restoration alternative. The measured unit output for these five identified ecosystem service components are shown in table 3.

### Assessing Financial Costs

To properly advocate for the ecological restoration design, project managers at Dow and Midland City officials needed to present a financial breakdown of the alternative restoration designs. Table 4 breaks out the costs

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**Table 2. The ESII Tool's Ecosystem Service Measurements**

| Ecosystem Services Grouping (A) | Ecosystem Services (B) | Measured Unit Outputs (C) |
|---------------------------------|------------------------|---------------------------|
| (1) Water Provisioning          | Water Provisioning     | Gallons/Foot²;           |
|                                 |                        | Gallons/Map Unit         |
| (2) Air Quality Control (AQ)    | Nitrogen Removal       | Pounds/Acre/Year;        |
|                                 | Particulate Removal    | Pounds/Map Unit/Year;    |
| (3) Climate Regulation          | Air Temperature Regulation | BTU Reduction Shade (BTU/Foot²/|
|                                 |                        | Hour);                  |
|                                 |                        | BTU Reduction Shade (BTU/Map |
|                                 |                        | Unit/Hour);             |
|                                 |                        | BTU Reduction Shade (BTU/Foot²/|
|                                 |                        | Day);                   |
|                                 |                        | BTU Reduction Shade (BTU/Map |
|                                 |                        | Unit/Day)               |
| (4) Erosion Regulation          | Carbon Uptake          | No Unit of Measure       |
|                                 | Erosion Regulation     | Acres <35%               |
|                                 | Mass Wasting           | No Unit of Measure       |
| (5) Water Quality Control (WQ)  | Nitrogen Removal       | Nitrogen Removal - Milligrams/|
|                                 |                        | Liter;                  |
|                                 | Water Filtration       | Max Nitrogen Removal - Milligrams/Liter; |
|                                 |                        | TSS Removal - Milligrams/Liter; |
|                                 |                        | Max TSS Removal - Milligrams/|
|                                 |                        | Liter                   |
| (6) Water Temperature Control   | Water Temperature      | No Units of Measure      |
|                                 | Regulation             |                          |
| (7) Water Quantity Control      | Water Quantity Control | Water Quantity Runoff - Inches|
|                                 |                        | Across Site;            |
|                                 |                        | Water Quantity Runoff - Gallons/|
|                                 |                        | Acre;                   |
|                                 |                        | Water Quantity Runoff - Gallons/|
|                                 |                        | Map Unit                |
| (8) Aesthetics                  | Noise                  | Noise Attenuation - Decibals |
|                                 | Visual                 | Visual Screening - Acres |

*Source: (Guertin et al. 2019), and The ESII Tool, available at http://www.esiitool.com/. Accessed December 11, 2018.*
separately for the Dow site and the City of Midland site for both the traditional restoration alternative and the ecological restoration alternative. The financial cost breakdown reveals that the ecological restoration design can have higher upfront costs, such as costs for planting, but that the long-term annual maintenance costs related to the ecological restoration alternative are always lower than that of the traditional restoration alternative. Project managers and Midland City officials opted to consider the restoration alternative costs over an estimated 30-year duration of the projects.

In assessing the financial costs of the restoration plans, both Dow and the City of Midland considered how to appropriately discount these costs over the 30-year duration of the projects. The discounting of future costs and benefits is necessary to make sure that these costs and benefits are expressed in terms of their value today. There are two types of discount rates: a private discount rate and a social discount rate. A private discount rate is the discount rate of a specific company or individual. A social discount rate, on the other hand, is the discount rate of society as a whole. The U.S. Government’s Office of Management and Budget (OMB) has guidelines on how to approximate both of these discount rates (U.S. Office of Management and Budget 2003).²

![Figure 2. ESII tool output: percent performance for alternative restoration designs](source: Guertin et al. 2019).

² OMB states that a real discount rate of 7%, which reflects the average before-tax return to private capital in the United States, should be used as the base-case in all regulatory analysis. OMB states that the social discount rate has averaged 3% in the United States, and that this rate should be used when the change primarily affects private consumption. Finally, the average real rate of return on corporate capital in the United States is 10%, which should be used when resources will be allocated away from private investment in the corporate sector (U.S. Office of Management and Budget 2003).
Assessing Co-Benefits

In addition to the financial project costs, Dow and Midland City officials want to understand how the ecosystem service impacts translate into a set of relevant co-benefits. Co-benefits gained popularity after being used to refer to the non-climate benefits of climate mitigation policies by the Intergovernmental Panel on Climate Change in a 2001 report (IPCC 2001). Although still frequently used in the context of climate mitigation strategies, co-benefits can refer to any number of benefits that are not the primary aim of a policy or decision.

The MEA listed eight potential services that business and industries may receive from ecosystems, or that may be affected by the health of ecosystems (MEA 2005b): (a) license to operate; (b) corporate image; (c) reputation & brand risk; (d) cost of capital & perceived investor risk; (e) access to raw materials; (f) operational impacts and efficiencies; (g) new business opportunities; and

Table 3. ESII Tool Output: Measured Unit Outputs for Ecosystem Services with Largest Percent Performance Difference

| Ecosystem Services          | Measured Unit Outputs               | Baseline | Traditional Restoration, All Sites | Traditional Restoration, Dow Site, and City Site | Traditional Restoration, All Sites |
|-----------------------------|-------------------------------------|----------|-----------------------------------|-----------------------------------------------|-----------------------------------|
| (A)                         | (B)                                 | (C)      | (D)                              | (E)                                           | (F)                              |
| (1) AQ - Nitrogen Removal   | Pounds/Year (Total)                 | 64.50    | 54.83                            | 144.35                                       | 160.00                           |
| (2) Air Temperature Regulation | BTU Reduction Shade (BTU/Hour, Site Total) | 27,000,000 | 23,000,000                       | 56,000,000                                   | 67,000,000                       |
| (3) WQ - Nitrogen Removal   | Milligrams/Liter (Area Weighted Average) | 0.20     | 0.13                             | 0.15                                         | 0.15                             |
| (4) WQ - Water Filtration   | TSS Removal (Milligrams/Liter, Area Weighted Average) | 17.45    | 13.49                            | 11.23                                       | 11.16                            |
| (5) Water Quantity Control  | Water Quantity Runoff (Gallons)     | 1,897,163| 2,419,060                        | 1,240,826                                    | 1,043,422                        |

Source: (Guertin et al. 2019).

Table 4. Estimated Financial Costs of Alternative Restoration Designs

| Ecosystem Services          | Dow Site                          | Midland Site                        |
|-----------------------------|------------------------------------|-------------------------------------|
| Traditional Restoration     | Ecological Restoration             | Traditional Restoration             | Ecological Restoration                     |
| Plantings                   | $619,223                           | $1,051,024                          | $164,223                                    | $212,128                          |
| Other                       | $4,792,849                         | $2,775,684                          | $449,742                                    | $1,589,082                        |
| Installation Costs          | $5,412,072                         | $3,826,708                          | $613,965                                    | $1,801,210                        |
| Mowing & Grounds Maintenance| $13,800                            | $1,685                              | $7,200                                      | $591                              |
| Other                       | $43,730                            | $11,794                             | $ -                                          | $4,139                            |
| Annual Operations & Maintenance Costs | $57,530                           | $13,478                             | $7,200                                      | $4,730                            |

Note: Plantings includes planting and invasive species removal. Other installation costs include site features (such as fencing), construction oversight costs, and excavation and capping. Other annual operations & maintenance costs include invasive management, environmental monitoring, and regulatory reporting.

Assessing Co-Benefits

In addition to the financial project costs, Dow and Midland City officials want to understand how the ecosystem service impacts translate into a set of relevant co-benefits. Co-benefits gained popularity after being used to refer to the non-climate benefits of climate mitigation policies by the Intergovernmental Panel on Climate Change in a 2001 report (IPCC 2001). Although still frequently used in the context of climate mitigation strategies,
Innovative technologies for new opportunities. Some of these services directly feed into Dow’s financial reporting through, for example, operation and maintenance costs (e.g., operational impacts and efficiencies), revenue generation (e.g., new business opportunities), or through a company’s borrowing costs (e.g., cost of capital & perceived investor risk). Some of the other services will likely have a more indirect impact on Dow’s long-term financial services (e.g., license to operate and corporate image), which makes them harder to quantify in financial terms.

Unlike Dow, the stakeholders for the City of Midland are the residents of Midland. The MEA also provides a framework for considering how ecosystem services affect human well-being, such as through health services—via food quality, water quality and air quality—or through recreational and cultural services—via trails, fishing opportunities, or aesthetics. The City of Midland values restoring brownfields, such as the 4-D property, in an ecologically conscious way such that it can provide significant benefits to Midland residents living around the site. For example, a recent study found that property values increased, on average, by 5% to 11.5% following a brownfield cleanup (Haninger, Ma, and Timmins 2017). Other studies have considered the benefits of outdoor spaces for fishing, boating or hiking, to name a few (Rosenberger 2016).

Conclusion: Evaluating the Alternative Restoration Plans

Both Dow and the City of Midland need to present evidence to their respective stakeholders on which restoration plan to adopt. Dow’s presentation of its preferred restoration plan needs to include evidence on why the preferred restoration plan provides more shareholder value than the other alternatives, including the preferred restoration plan’s value generated from its provisioning of ecosystem services. The City of Midland needs to convince its residents that its preferred restoration plan will be a cost-effective use of taxpayer money that provides benefits to the residents of Midland. The two organizations are looking to include arguments based on both direct project costs and the co-benefits of the projects related to their provision of ecosystem services.

Discussion Questions

1. What are the appropriate discount rates that Dow and the City of Midland should use to estimate the net present value of the possible restoration plans?
2. What is the net present value of the possible restoration plans? How does the choice of a discount rate affect the net present value?
3. For which restoration plan should Dow project managers advocate? Why? How does the preferred restoration plan support Dow’s Valuing Nature Goal? How does the preferred restoration plan enhance Dow’s stock value?
4. For which restoration plan should the City of Midland advocate? Why? How does the preferred restoration plan support the City’s goals?
5. What ecosystem services should Dow project managers be considering when assessing the possible restoration plans? How might they include co-benefits in their review of the plans? Does the inclusion of the co-benefits affect Dow’s choice of which restoration plan to implement?
6. What ecosystem services should the City of Midland be considering when assessing the possible restoration plans? How might they include co-benefits in their review of the plans? Does the inclusion of the co-benefits affect the City of Midland’s choice of which restoration plan to implement?
7. How does Dow’s choice of a restoration plan affect the City of Midland? How does the City of Midland’s choice of a restoration plan affect Dow?

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