Examples with Explanations for Using NACFAM's Sustainability Framework Model
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Jeffrey Mittelstadt
Vice President for Sustainable Manufacturing
National Council for Advanced Manufacturing (NACFAM)
Washington, D.C.

User questions should be referred to NACFAM at 202-367-1178

Table of Contents

Purpose of Examples & How to Use this Document

These examples take the user through the process of using the *NACFAM Sustainability Framework Model* step by step. These examples do not go through all of the ways this *Model* can be used, but provides examples of a few of the many ways it can be used. This is to supplement the cell-by-cell input manual.

This document presents three examples (with the time it took a new user to complete each one)

1. Chemical Management Analysis (24 minutes)
   This example shows how a company can utilize this *Model* to compare different management techniques. It analyzes moving from the typical scheme in which your company purchases, owns and manages the chemicals you use to a scheme in which the chemical provider owns and manages them. The directions will take you through every input to do this kind of analysis for chemicals, concentrating on the financial impacts but also showing that this type of scheme limits or eliminates chemical waste for the company.
2. Metals and Material-related Decisions (41 minutes)
   In this example we will look at a confluence of issues, including energy usage, material usage, and the upstream impacts of the metal material we use. This will illustrate how increasing energy use in one place during manufacturing while greatly decreasing metal inputs would actually decrease the energy use throughout the upstream activities of a company. In this case, upstream refers to the extraction, refining and smelting of metal. The example illustrates why energy efficiency in a facility or manufacturing process alone might inhibit innovative thinking that could have a much larger environmental impact as well as greatly reduced costs. When looking at the whole lifecycle a company may be able to have a larger positive impact from an environmental and a financial perspective.
3. Packaging and Pallets-related Decisions (49 minutes)
   In this example we will look at packaging and pallet choices. This part of the *Model* is based on the Use Reusables model at http://www.usereusables.org/cost/cctool.html#, the Reusable Packaging Association and the StopWaste Partnership. The example, specifically, will focus on trading in corrugated cardboard (or light wood) containers for reusable plastic containers.

These examples will ALL be done in the same spreadsheet file in order to show the user how to use the *Model* to look at multiple projects individually and as a group. The directions will show the user how to turn each example on and off in order to weigh different combinations of potential sustainable manufacturing projects against each other along both financial and environmental metrics. One person, who had NEVER used the *Model* before nor seen it presented in full was able to finish all three examples in under 2 hours and one example in under 25 minutes. Go through this step-by-step in order to see how the *Model* can be utilized to analyze potential projects with very limited data – one of the strengths of this *Model*. As a user gets more and better data, those data can be utilized to get more and more specific output data from analyses.

Example 1: Chemical Management Analysis Directions

The *Model* can be used to analyze different management options for chemicals. For example, you can do an analysis of changing from a management scheme in which your company purchases, owns and manages the chemicals you use to a scheme in which the chemical provider owns and manages the chemicals you use. In the latter scheme the chemical provider is selling you their service rather than the chemical and can reduce chemical usage by up to 30% according to Chemical Strategies Partnership (http://www.chemicalstrategies.org/). The chemical provider would then take the chemical back at the end of its use reducing your costs related to chemical containers and chemical waste.

Here is the known data for this example:

Baseline – Manufacturing Process Input

- 8,000 lbs. of chemical
- $1.00 per lb. ($8,000)
- 20 lbs. per delivery container
- $20 per container ($1,200)
- 4 tons of hazardous waste
  - Tipping Fee $290/ton ($1,160)

Comparison Scenario – Surface Finishing Input

- 6,500 lbs. of chemical
- $1.20 per lb. ($7,800)
- 20 lbs. per delivery container
- $0 per container
- 0 tons of hazardous waste

BASELINE

For Baseline Inputs, always start with the **"General INPUT & ASSUMP"** tab. For the sake of this example we will say we are in northeastern Pennsylvania.

1. Go to cell C6, click on the little arrow/drop-down to the right of the cell. When the drop down menu appears click on Pennsylvania. This will automatically fill in the State tax rate and the average electricity rate and natural gas rate from 2008 throughout the *Model*. If you have a more specific rate to input, we will show you how to do that on the "Manufacturing Process Input" sheet.

2. Enter your Federal Tax Rate in cell C7 as a percentage; if you don't know it assume 35%. In this example we will use 35%.

3. In C9 enter the beginning year of the financials – this refers to the first year of purchase of any equipment. Any equipment purchase or initial cost will be considered to occur at the end of the year entered here. For this example we will assume the equipment and initial costs will occur at the end of 2010, so we enter 2010 in this cell.

4. In cell C13 click on the drop-down menu and select whether you would like to use eGRID Emissions Factors or State-Specific Emissions Factors for calculating some of the emissions related to the electricity you purchase and use in your location. We highly suggest using the eGRID Emissions Factors as they are the factors used by EPA.

5. After you select eGRID Emissions Factors in C13 click on the drop-down menu in C14 to select the grid you get your electricity from. You can determine that grid by looking at the map to the right. Since we are using northeastern Pennsylvania as our location, we can see that according to the map to the right northeastern PA is part of the RFCE grid. So we select RFCE in the drop-down menu in C14.

6. Then enter a cost of funds number (the opportunity cost you place on your funds) in C34. A good estimate would be 3% if you do not know how your company values this.

7. Next is the discount rate for projects in your company. You can go about this two different ways. 1) If you have a company-specific discount rate skip straight to step #8 (Note: This is the easiest and quickest method if you have a discount rate to enter). Or, 2) if you decide you would like to calculate a Weighted Average Cost of Capital (WACC) based on financial indicators then follow the directions in the *Model* Manual on page 6 for "Cost of Capital". C45 will automatically populate with the WACC if you have entered the proper inputs for the WACC calculation process, so do **NOT** change this cell if you are using this method.

8. If you have decided to enter a company-specific discount rate, enter that into cell C46. For our example, we will use 6%. Then, select which discount rate you would like to use for the *Model* from the drop down menu in C47 (IMPORTANT: This box MUST have a non-zero number in it for calculations to work!). For this example, we will select the 6% discount rate from the drop-down menu.

To continue with the Baseline Inputs (whether facility or product-related) go to the "Manufacturing Process Input" tab. Go to the "Industrial and Organic Chemicals and Fluids" section beginning at cell A46. There is room for 3 chemicals to be listed at once (chemical 1 begins at cell A48, chemical 2 at cell A58, and chemical 3 at A68). However, you do **NOT** have to fill in all three if you are only looking at one chemical at a time. If looking at only one chemical you only need to use the block of cells for one of them; e.g., A48 through D56.

1. You can enter the name of the chemicals you are addressing in A48, A58 and A68. In those same cells it will be helpful to add in parentheses after the name of the chemical the units the chemical is measured in (for example, lbs. or gallons) so you can always remember what unit you are analyzing for that particular chemical. Example of what A48, A58, and/or A68 should read like:

   "Ethyl Alcohol (gallons)"

   We will refer to our chemical as "Chemical 1" for this example and it will be measured in lbs. for this example.

2. Enter the number amount of the chemical your company receives ANNUALLY in cell C48, C58 or C68 (do not enter units in this cell, only enter those in parentheses after the name of the chemical in the corresponding A cell). We will use 8,000 lbs. of chemical 1 for our annual input in cell C48.

3. Enter the dollar amount per unit that your company is paying for the chemical in cell C49. We will use $1.00 for our example. If you wish to enter a growth rate for analysis past year 1 enter it in cell D49 – e.g., if you have observed an average 2% growth rate (our number in our example) in the price of a chemical per unit purchased over time you can enter the number 2 in cell D49.

4. If you receive the chemicals in containers, pay for those containers, and have an estimate or hard data on the volume or weight (depending on the unit of measurement for your chemical) of chemical per container you receive enter it in cell C51. In our example, we are using 20 lbs. per container.

5. The blue cell in C50 will automatically calculate the number of containers shipped to you ANNUALLY. If you pay a price for each container enter that price in cell C52. We will use $20 per container.

6. If your company already has a chemical partnership in place where the chemical manufacturer/supplier actually owns and manages the use of its chemical during your company's manufacturing process click on cell C55, click the down arrow and click on "yes". If it does not either leave C55 blank or click on "no" on the drop-down menu. If "yes" enter the cost as a cost per unit of measurement in cell C56. In our example, we will not have a chemical partnership in the baseline because we are comparing no chemical partnership to implementing a chemical partnership so we select No for cell C55.

7. Repeat process for other two chemicals if you have more than one chemical, starting with cells A58 and A 68 respectively. We will not do that in this example.

8. Scroll down to the Waste portion (line 78) of the Manufacturing Process Input tab. In cell C81 enter the annual hazardous waste related to the chemicals in tons. We will enter 4. Then enter the tipping fee (include pick-up and transportation) for getting rid of each ton of hazardous waste in cell C82. For this example we will use $290 per ton.

9. Finally, in order to make sure there are no division errors throughout the model we simply need to make sure that all of the cells that ask for a volume of a container have a number in them. We will enter "1" into cells C61, C71, C88, C91, C94, and C103.

Diagram 1: Chemicals Management Example Manufacturing Process Input Sheet

The following shows the sheet from the *Model* that you have just filled out.

Industrial and Organic Chemicals and Fluids (e.g., coolant)			
Chemicals			
Chemical 1		8,000.00	
Cost ($/gallon or lb.)		*$ 1.00*	*2%*
Number of Drums/Containers		400	
Volume of Containers (gallons or lbs.)		20.00	
Price Paid per Drum/Container		*$ 20.00*	*0%*
Average Distance Transported			
Chemical Partnership?		No	
Alternate Cost if chemical partnership in baseline ($/UOM)			
Coolant			
Annual Input for Coolant (gallons or lbs.)			
Cost ($/gallon or lb.)			
Number of Drums/Containers		0	
Volume of Containers (gallons or lbs.)		1.00	
Price Paid per Drum/Container			
Average Distance Transported			
Chemical Partnership?			
Alternate Cost if chemical partnership in baseline ($/UOM)			
Organic Solvents			
Annual Input for Organic Solvents (gallons or lbs.)			
Cost ($/gallon or lb.)			
Number of Drums/Containers		0	
Volume of Containers (gallons or lbs.)		1.00	
Price Paid per Drum/Container			
Average Distance Transported			
Chemical Partnership?			
Alternate Cost if chemical partnership in baseline ($/UOM)			
Waste			
Annual Solid Waste (tons)			
Tipping Fees ($/ton)			
Annual Hazardous Waste (tons)		4	
Tipping Fees ($/ton)		*$ 290.00*	
Annual non-Hazardous Chemical Waste (tons)			
Tipping Fees ($/ton)			
Waste Transportation			
Transportation Costs - Solid Waste Pickup ($/pickup)			
Tons of Solid Waste per Pickup		1.00	
Transportation Distance of Non-Hazardous Chemical Waste			
Transportation Costs - Hazardous Waste Pickup ($/pickup)			
Tons. of Hazardous Waste per Pickup		1.00	
Transportation Distance of Non-Hazardous Chemical Waste			
Transportation Costs - Non-Hazardous Chemical Waste Pickup ($/pickup)			
Tons of Non-Hazardous Chemical Waste per Pickup		1.00	
Transportation Distance of Non-Hazardous Chemical Waste			
Water Treatment			
Water Treatment Costs per Gallon of Waste Water			
Amount of Waste Water (Gallons)			
Average Monthly Input for Chemicals, e.g. Cl (gallons or lbs.)			
Cost ($/gallon or lb.)			
Number of Drums/Containers		0	
Volume of Drums/Containers (gallons or lbs.)		1	
Price Paid per Drum/Container			
Average Distance Transported			
Legal			
Related Annual Environmental Compliance Costs			
Related Annual Environmental Litigation Costs			
Annual Environmental-Related Lobbying Costs			
Related Annual Environmental Clean-Up Costs			
Equipment Repair & Maintenance			

Chemical 1	
Comparison Scenario	
Chemical Partnership?	
Coolant	
Comparison Scenario	
Chemical Partnership?	
Organic Solvents	
Comparison Scenario	
Chemical Partnership?	

COMPARISON

1. You can pick a module to enter the chemical information. It can be any comparison module on any of the manufacturing stage input tabs (Metal Working, Surface Finishing, Component Assembly, Final Assembly, Equipment-Scale Input: General Onsite Waste Management/Treatment Equipment and Waste Water Treatment/Management Equipment). However, for this example we will use Surface Finishing.

2. For the sake of example we will input the data about our chemical in the Surface Finishing Input tab under "Equipment 4" for the comparison (cell E61).

3. If there is any up-front one-time cost involved in the comparison case enter it into cell G64. If there is no initial cost to take into account simply enter 0.

4. Choose the year of inclusion of any initial cost, even if it is $0. In this case we will choose 2010 from the drop-down menu for cell G65. This initial cost will be treated as if it were to occur at the end of 2010.

5. Choose the year of inclusion of any operation and maintenance costs – this refers to your ongoing costs related to chemical purchasing and management. For this example we will say that the new management scheme will be in place at the end of 2010 so the first year that will realize the related costs will be 2011. Choose 2011 from the drop-down menu for cell G66.

6. Enter 1 into the cell G67 for units – this is a place holder used to calculate overall impacts if you were to purchase multiple units of the same equipment. But, it MUST have the number 1 in it to make the calculations work out for your chemical management comparison.

7. Use a default number of "10" in cell G68 in order to avoid errors in calculations (this number does not matter if you do not have an input for an original equipment cost in cell G64.) If accelerated depreciation is available for the equipment for tax purposes you can enter that in cell G69. In this example we will assume there is no accelerated depreciation and leave it blank so it does not override the number in G68.

8. If there is no Federal tax incentive enter 0 into cell G71, enter 1 into G72 for years spread. If there is a Federal tax incentive put the percentage of that incentive (e.g., 10) into cell G71 and the years over which that tax incentive is spread out in cell G72 (if there were a 10% Federal tax credit spread over 2 years – it would be included by the *Model* as 5% in year 1 and 5% in year 2, if it is only in the first year it would be included by the *Model* as 10% in year 1).

9. If there is no State tax incentive enter 0 into cell G73, enter 1 into G74 for years spread. If there is a State tax incentive put the percentage of that incentive (e.g., 10) into cell G73 and the years over which that tax incentive is spread out in cell G74 (if there were a 10% State tax credit spread over 2 years – it would be included by the *Model* as 5% in year 1

and 5% in year 2, if it is only in the first year it would be included by the *Model* as 10% in year 1).

10. If there is no rebate enter 0 into cell G75, enter 1 into G76 for years spread. If there is a rebate put the dollar ($) amount of that incentive (e.g., 10) into cell G75 and the years over which that tax incentive is spread out in cell G76 (if there were a $100 rebate spread over 2 years – it would be included by the *Model* as $50 in year 1 and $50 in year 2, if it is only in the first year it would be included by the *Model* as $100 in year 1).

11. Enter the annual repair/maintenance costs related to the project in G77 (in this case we will enter 0 because the premise is that the chemical company is not managing the chemicals. If you have expected $ values every year of process complications from the agreement then you can enter that annual average dollar ($) amount here in G77.

12. Financing – Entering information into the financing-related cells (Loan Fee, Loan Rate, and Loan-to-Value Ratio) is optional. You must have a number greater than zero (we used 10 in the example) in the cell G81 for Loan Term whether you are including a loan or not in order to avoid any errors in the calculations. This will not impact your output unless you enter data into the other 3 financing-related cells.

13. Since we are discussing a chemical management process that does not have an initial fee or capital cost, you would not need to enter any information in the financing cells. But, if you did decide to include a loan in any scenario, here is how to do it. If you have a loan fee enter that into the appropriate cell (G79 for this example). You can then input your loan rate (i.e., the interest rate for your loan on an annual basis) into the Loan Rate cell (G80 for our example). Then you would enter the term of the loan into the Loan Term cell (G81 for us) – this is the number of years you have to pay back the loan. Finally, the Loan-to-Value ratio is the percentage of the initial one-time cost of a project (cell G64 in the example) that your company is taking a loan for (e.g., 75% of the total cost).

14. If there is a change in energy or water usage due to the change in your chemical management strategy you can address that in the "Energy section"; cells G85-G87 in our example. You can include the monthly electricity (in kilowatt hours – kWh), natural gas (thousand cubic feet – tcf), and water usage (hundred cubic feet – HCF) in each of these cells, respectively. See the energy usage and water usage examples for further explanation. We will not record any change in energy or water usage for our example.

15. If there is a change in material usage due to the change in your chemical management strategy you can address that in the "Average Change in Monthly Material Input"; cells G91-G96 in our example. See the Material usage example for related input directions. In our example, we are only looking at the chemical usage in this example, so we will skip to the "Average Monthly Industrial & Organic Chemicals and Fluids" section of the comparison scenario input.

16. In our example we will include the amount of the chemical used on a monthly basis in cell G98 and the new price per unit of chemical based on the new chemical management

agreement with the chemical provider. If you pay a certain amount each year, ask the chemical provider for a rough estimate of the amount of chemicals they would be using annually or monthly in order to provide a price per unit (e.g., lbs. or volume). If they provide you with a monthly amount you can input that into cell G98 for our one chemical example (if you have up to 2 other chemicals you are including in the analysis you would include those numbers in G100 and G102). If they provide you with an annual amount, which is what we are doing in our example, you would divide that number by 12 and input the resulting number in the corresponding cell. For our example we are assuming just over an 18% decrease in usage of the chemical (according to Chemical Strategies Partnership the actual decrease could be up to 30%) so our annual number would be 6,500 lbs. Our input in cell G98 will be 541.6667 lbs. per month (you can also input the following as an equation in that cell "=6500/12"). We will put our new price per volume as $1.20 into cell G99 – indicating a 20% increase for the management of the chemical.

17. If there is a change in solid, hazardous or non-hazardous waste due to the change in your chemical management strategy you can address that in the corresponding cells; in our example cells G104, G105 and G106, respectively. Make sure you are using the same units of measurement for each waste throughout use of the *Model* – "tons". In this example, our company will not have any chemical waste due to the change of ownership to the chemical management company who will take back the chemical at the end of its use and recycle it themselves. This will be taken care of when we indicate Chemical Partnership in a subsequent step.

18. If you have been able to avoid related compliance, litigation, lobbying or clean-up costs enter those cost savings as a negative ANNUAL amount in the appropriate cells; for our example enter them in cells G108, G109, G110, and G111, respectively. Our example assumes 0 for all of them so leave them blank.

Diagram 2: Chemicals Management Example Comparison Inputs

This is what your screen will look like after completing steps 1-18 above.

Equipment 4	Values
Include in Comparison Financials?	No
Cost	$ -
Year of Inclusion in Financials	2010
1st Year of Inclusion of related O&M Values	2011
Units	1
Useful Life (years)	10
Accelerated Depreciation Life (years)	
Useful Life (years) for Depreciation	10
Federal Tax Incentive	0%
Years Spread	1
State Tax Incentive	0%
Years Spread	1
Rebates ($/yr.)	$ -
Years Spread	1

Annual Maintenance and Repair Costs per Unit	
Green Financing? (Yes/No)	
Loan Fee	
Loan Rate	
Loan Term	10
Loan-to-Value Ratio	
Energy	
Average Monthly Electricity Used by Each Unit of Equipment (kWh)	
Average Monthly Natural Gas Used by Each Unit of Equipment (tcf)	
Average Monthly Water Used by Each Unit of Equipment (HCF)	
Chemicals and Materials Used by Equipment	
Average Change in Monthly Material Input	
Iron	
New Price	
Steel	
New Price	
Other	
New Price	
Average Monthly Industrial & Organic Chemicals and Fluids	
Organic Solvents	541.66667
New Price	$ 1.20
Coolant	
New Price	
Other	
New Price	
Average Monthly Solid Waste from Equipment Operation	
Average Monthly Hazardous Waste from Equipment Operation	
Average Monthly non-Hazardous Chemical Waste from Equipment Operation	

Impact on Annual Related Environmental Compliance Costs	
Impact on Annual Related Environment Litigation Costs	
Impact on Annual Environmental-Related Lobbying Costs	
Impact on Annual Related Environmental Clean-Up Costs	

The last step for the comparison case is to go to the baseline scenario input to enter specific information about the management process or equipment you are comparing against. The baseline scenario for comparison is always the module directly above the comparison input (in this case, beginning with cell G16). You will need to put in the baseline amount for any comparison input you have entered (except for the compliance, litigation, lobbying and clean-up

costs). This is important because you MUST have an estimated value in the baseline equipment input to base the comparison analysis off. In this case we will only have to input the following:

1. We will make sure that the answer to "Include in Baseline Financials?" is "No", using the drop-down menu in cell G16, because our original baseline already includes the energy, material, and chemical usage as well as any waste related to this management scheme and we do not want to add to those (which would cause a double counting problem).
2. The price will be $0 in cell G17
3. Year of inclusion, **although not necessary**, is 2010 in G18
4. Year of inclusion of related O&M values, **although not necessary**, is 2011 in G19
5. We will enter "1" into the "Units" cell, G20
6. Enter any positive number into "useful life"; we will enter "10" in G21
7. Enter "1" (or any positive number) into each of the "Years Spread" cells (G25, G27, and G29) to avoid computing errors (although we have 0 as the inputs for the corresponding incentive cells - G24, G26, and G28)
8. Enter a positive number into the Loan Term cell to avoid computing errors – we entered 10 into cell G34
9. Finally, the most important number we need to enter is the amount of the chemical we used in the baseline on a monthly basis. This is important because when calculating the difference between the two scenarios we have to have a monthly comparison value. In our example, this value is 666.66667 lbs. (or you can enter the equation "=8000/12") for cell G48.

The directions for input are the exact same as for the Comparison Input, the only thing that changes is the cell number.

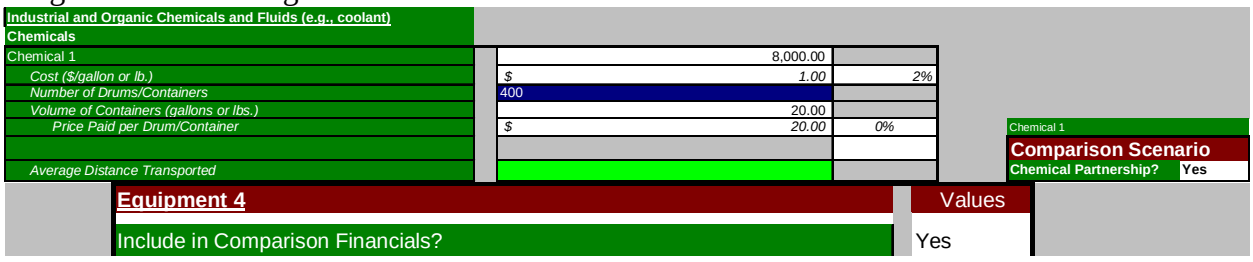
Diagram 3: Chemicals Management Example Baseline Inputs for Comparison
This is what your screen will look like after completing steps 1-9 above.

Baseline 2	Values
Include in Baseline Financials?	No
Cost	$ -
Year of Inclusion in Financials	2010
1st Year of Inclusion of related O&M Values	2011
Units	1
Useful Life (years)	10
Accelerated Depreciation Life (years)	
Useful Life (years) for Depreciation	10
Federal Tax Incentive	0
Years Spread	1
State Tax Incentive	0
Years Spread	1
Rebates ($/yr.)	
Years Spread	1
Annual Maintenance and Repair Costs per Unit	
Green Financing? (Yes/No)	

Loan Fee	
Loan Rate	
Loan Term	10
Loan-to-Value Ratio	
Energy	
Average Monthly Electricity Used by Each Unit of Equipment (kWh)	
Average Monthly Natural Gas Used by Each Unit of Equipment (tcf)	
Average Monthly Water Used by Each Unit of Equipment (HCF)	
Chemicals and Materials Used by Each Unit of Equipment	
Average Change in Monthly Material Input	
Iron	
Steel	
Other	
Average Monthly Industrial & Organic Chemicals and Fluids	
Organic Solvents	666.66667
Coolant	
Other	
Average Monthly Solid Waste from Equipment Operation	
Average Monthly Hazardous Waste from Equipment Operation	
Average Monthly non-Hazardous Chemical Waste from Equipment Operation	
Impact on Annual Related Environmental Compliance Costs	
Impact on Annual Related Environment Litigation Costs	
Impact on Annual Environmental-Related Lobbying Costs	
Impact on Annual Related Environmental Clean-Up Costs	

In order to activate the *Model* and the calculations choose "yes" from the drop-down box in cells G63 on the Surface Finishing Input sheet & H54 on the Manufacturing Process Input sheet to run the calculations.

Diagram 4: Activating the *Model*



RESULTS

This project would save money during its first year of implementation. The company would save $4,860 on just this one chemical in the first year (see cells C52 and/or C60 on the NPV Analysis worksheet) and the project would have a 10 year cumulative Net Present Value of $37,983 (see cells M52 and M60 on the NPV Analysis worksheet and/or cells O13 and O19 on the Project Output Dashboard worksheet). Net Present Value (NPV)[1] is defined as the difference between an initial investment and the present value of all future cash flows from that investment. The present value of the future cash flows is computed by discounting the future cash flows by a required rate of return (the discount factor entered in the General Inputs and Assumptions worksheet described above). If the NPV is zero, this means that the project analyzed pays back the investment plus the required rate of return. If the NPV is positive it pays back more and if it is negative it pays back less than the investment plus the required rate of return. Remember, this is only one chemical. Some companies we worked with used upwards of 50 chemicals. So savings can be much more if you implement this type of strategy with many of the chemicals your company uses. Note: Since there is no upfront capital cost, internal rate of return cannot be calculated.

Before you begin the next example, deactivate the chemical management example. However, make sure you do not delete any of the data because we will combine all of these examples in the end to see what impact combinations of projects can have. In order to deactivate the *Model* and the calculations choose no from the drop-down box in cells G63 on the Surface Finishing Input sheet & H54 on the Manufacturing Process Input sheet.

[1] http://www.businessdictionary.com/definition/net-present-value-NPV.html

Example 2: Metals and Materials – Related Decisions

In this example we will look at a confluence of issues. We will examine energy usage, material usage, and the upstream impacts of the metal material we use.

Here is how the example lays out and the initial data we have:

- Implementing a New Machining Process that Uses More Energy but 80% Less Material
  - Original amount of Al used annually: 80,000 lbs.
    - Monthly: 6,667 lbs.
  - Aluminum Price: $20/lb.
  - Avg. monthly electricity used: 10,000 kWh
  - New equipment cost: $600,000
  - 20% of Aluminum: 1,333 lbs. monthly
  - New Al price (due to volume): $30/lb.
  - New avg. monthly electricity used: 15,000 kWh

BASELINE

Note: The following steps 1-8 are identical to those on pages 1-3, so if you are combining this next example with the first one you need not repeat them & can proceed to page 14. For Baseline Inputs, always start with the **"General INPUT & ASSUMP"** tab. For the sake of this example we will say we are in northeastern Pennsylvania.

1. Go to cell C6, click on the little arrow/drop-down to the right of the cell. When the drop down menu appears click on Pennsylvania. This will automatically fill in the State tax rate and the average electricity rate and natural gas rate from 2008 throughout the *Model*. If you have a more specific rate to input, we will show you how to do that on the "Manufacturing Process Input" sheet.

2. Enter your Federal Tax Rate in cell C7 as a percentage; if you don't know it assume 35%. In this example we will use 35%.

3. In C9 enter the beginning year of the financials – this refers to the first year of purchase of any equipment. Any equipment purchase or initial cost will be considered to occur at the end of the year entered here. For this example we will assume the equipment and initial costs will occur at the end of 2010, so we enter 2010 in this cell.

4. In cell C13 click on the drop-down menu and select whether you would like to use eGRID Emissions Factors or State-Specific Emissions Factors for calculating some of the emissions related to the electricity you purchase and use in your location. We highly suggest using the eGRID Emissions Factors as they are the factors used by EPA.

5. After you select eGRID Emissions Factors in C13 click on the drop-down menu in C14 to select the grid you get your electricity from. You can determine that grid by looking at the map to the right. Since we are using northeastern Pennsylvania as our location, we can see that according to the map to the right northeastern PA is part of the RFCE grid. So we select RFCE in the drop-down menu in C14.

6. Then enter a cost of funds number (the opportunity cost you place on your funds) in C34. A good estimate would be 3% if you do not know how your company values this.

7. Next is the discount rate for projects in your company. You can go about this two different ways. 1) If you have a company-specific discount rate skip straight to step #8 (Note: This is the easiest and quickest method if you have a discount rate to enter). Or, 2) if you decide you would like to calculate a Weighted Average Cost of Capital (WACC) based on financial indicators then follow the directions in the *Model* Manual on page 5 for "Cost of Capital". C45 will automatically populate with the WACC if you have entered the proper inputs for the WACC calculation process, so do **NOT** change this cell if you are using this method.

8. If you have decided to enter a company-specific discount rate, enter that into cell C46. For our example, we will use 6%. Then, select which discount rate you would like to use for the *Model* from the drop down menu in C47 (IMPORTANT: This box MUST have a non-zero number in it for calculations to work!). For this example, we will select the 6% discount rate from the drop-down menu.

To continue with the Baseline Inputs (whether facility or product-related) go to the "**Manufacturing Process Input**" tab.

1. Enter the annual energy usage for the facility or the manufacture of the specific product you are addressing in cell C14. For our example we will enter 4,000,000 (4 million) kWh as our annual energy usage.

2. Enter the percentage of the annual electricity usage that your company gets from the grid in cell C15. In our example, 100% comes from the grid. If that percentage is less than 100% you would then enter what percentage comes from renewable energy in cell C17 and what percentage comes from on-site non-renewable energy in cell C19.

3. The electricity price will automatically fill in cell C16 based on the average 2008 electricity price in your State. You can override this with a specific electricity price for your company by typing in your price in $/kWh in Cell C16. ***BUT***, remember to save the original *Model* as a separate name so you do not lose the *Model* as it was originally set up. If you override the price you want to save it as a separate file so you can go back to the original *Model* and still have the ability to have the price fill in automatically. In our example we will use the average 2008 electricity price for Pennsylvania that automatically fills in, which is $0.0701.

4. If the percentage of electricity from the grid in cell C15 is less than 100% you would also enter the price per kWh of any renewable energy used in cell C18 and the price per kWh of any on-site non-renewable energy in cell C20. Again, in our example 100% of the electricity we use is coming from the grid so we will leave these two cells blank.

5. Enter an appropriate growth factor in cell D16 to represent the percent of annual growth in the price of electricity. Many use 3% as a growth factor and we will use 3% in our example.

6. The following addresses natural gas usage, which is not used in this example. But, it's important to explain how this step would be completed. Cells C21 and C22 are essential to facilitating the calculation of N2O, other nitrogen oxides (NOx) and carbon monoxide (CO) emissions.

    a. In cell C21 click the drop-down menu to choose the natural gas combustor type. You can find out the natural gas combustor type by asking your natural gas provider. However, if you do not know this you can also simply make a guess or pick a conservative estimate to begin with (by conservative we mean the estimate that assumes the least amount of emissions – but we stress that we would never condone this from a policy or regulatory standpoint, only as a starting point for a user to provide an initial comparison of business options without a lot of data). We will choose a large wall-fired boiler controlled with flue gas recirculation because it is the most conservative large boiler option. The most conservative choice overall would be a small boiler controlled with flue gas recirculation, but we are going to assume here that the natural gas utility would use larger wall-fired boilers.

    b. In cell C22 click the drop-down menu to choose whether the natural gas burner is controlled or uncontrolled. For the purpose of this example we will use, again, the most conservative estimate and assume that the burner is controlled. Again, we stress that we would never condone this from a policy or regulatory standpoint, only as a starting point for a user to provide an initial comparison of business options without a lot of data.

7. In cell C23 enter the average annual amount of natural gas used by the facility, process, or manufacturing of the product of concern in mmBtu (this is the normal

reporting method). This number will be converted to million cubic feet in cell C24 – never type in cell C24 – which will then be converted to thousand cubic feet in cell C26 – never type in cell C26 either. However, if you know your average annual natural gas usage in thousand cubic feet enter that in cell C25 instead and this will be used in any calculations. If you do not know your usage in thousand cubic feet MAKE SURE that C25 is empty. We are not addressing in natural gas in this example.

8. The natural gas price will automatically fill in cell C27 based on the average 2008 natural gas price in your State. You can override this with a specific natural gas price for your company by typing in your price in $/thousand cubic feet in Cell C27. ***BUT***, remember to save the original *Model* as a separate name so you do not lose the *Model* as it was originally set up. If you override the price you want to save it as a separate file so you can go back to the original *Model* and still have the ability to have the average State price fill in automatically. In our example we will use the average 2008 natural gas price for Pennsylvania that automatically fills in, which is $15.21.

9. Enter an appropriate growth factor in cell D27 to represent the percent of annual growth in the price of natural gas. Many use 3% as a growth factor and we will use 3% in our example.

10. You can also include your average annual water usage in hundred cubic feet (HCF) in cell C28. In this example we will not address water usage.

    a. Enter the price per HCF of your water in cell C29. In this example we will not address water usage.

    b. Enter an appropriate growth factor in cell D29 to represent the percent of annual growth in the price of water. In this example we will not address water usage.

11. Finally, in order to make sure there are no division errors throughout the model we simply need to make sure that all of the cells that ask for a volume of a container have a number in them. We will enter "1" into cells C61, C71, C88, C91, C94, and C103.

Next, we will continue with the Baseline Inputs in the "**Manufacturing Process Input**" tab by moving on to the "Material" section beginning in row 31. There are 3 groups of input cells – so you can include up to 3 metals. For the purpose of this example we will only look at one metal. We will use the 3rd group of inputs starting in cell A41. The following process can be repeated for the group of input cells starting in cell A33 and cell A37 as well.

1. In order to calculate the upstream impacts (emissions and solid waste related to extraction, refining and smelting of metals before the metal gets to the entry gate of the manufacturing company) we need to pick from a list of metals based on their refining and smelting methods. In order to do this click on the drop-down menu in

A41. In this example we will use Aluminum and assume that the most common processes are used: Bayer refining, Halle-Herroult smelting conventional.

2. In cell C41 enter the average annual amount of the metal you use in lbs. In this case we are going to enter 80,000.

3. In cell C42 enter the price per lb. for the metal you are analyzing. In our example we will use $20/lb.

4. Enter an appropriate growth factor in cell D42 to represent the percent of annual growth in the price of electricity. In this example we will use 2% as the growth rate.

5. If you have another piece of baseline equipment that uses a different form of the same metal (e.g. plates vs. powder) that you will include in the analysis in one of the other input tabs, enter the price for that in cell C44. NOTE: This price would only be used for the additional equipment in addition to the baseline. The overall manufacturing process baseline will use the value from C42. More often than not, C44 will be left blank because it can make the analysis more complicated. We will leave it blank in our example.

Diagram 5: Metals Example Manufacturing Process Input

The following is what your screen will look like after completing the steps 1-5 above and 1-11 on the previous pages.

Expenses		
Baseline	Baseline	Growth Factors
Energy & Water		
Average Annual Electricity Use (kWh)	4,000,000	
Percentage from grid	100%	
Electricity price ($/kWh)	$ 0.0701	3%
Percentage from Renewable Energy		
Electricity price ($/kWh)		
Percentage from Onsite non-Renewable Energy		
Electricity price ($/kWh)		
Combustor Type	Large Wall-Fired Boilers Controlled - Flue gas recirculation	
Natural Gas Controlled or Uncontrolled Burner	N2O (pounds) Controlled low NOx burner	
Average Annual Natural Gas Use (mmBtu) if known in mmBtu		
Average Annual Natural Gas Use (million cubic feet)	-	
Average Annual Natural Gas Use (thousand cubic feet) only if known		
Average Annual Natural Gas Use (thousand cubic feet)	-	
Natural gas price ($/thousand cubic feet)	$ 15.21	3%
Average Annual Water Use (HCF)		
Price of Water ($/HCF)		
Material		
Annual Material Input		
Iron (lbs.)		
Price ($/lb.)		
Average Distance Transported		
Cost for alternative form of metal purchased ($/lb.)		
Aluminium: Bayer refining, Halle-Heroult smelting conventional		
Price ($/lb.)		
Average Distance Transported		
Cost for alternative form of metal purchased ($/lb.)		
Aluminium: Bayer refining, Halle-Heroult smelting conventional	80,000	
Price ($/lb.)	$ 20.00	2%
Average Distance Transported		
Cost for alternative form of metal purchased ($/lb.)		

COMPARISON

1. Pick a module to enter the new equipment and metals information. It can be any comparison module on any of the manufacturing stage input tabs (Metal Working, Surface Finishing, Component Assembly, Final Assembly, Equipment-Scale Input: General Onsite Waste Management/Treatment Equipment and Waste Water Treatment/Management Equipment).

2. For the sake of our example we will input our new equipment and metals data in the Metal Working Input tab under "Equipment 1" for the comparison (cell A62).

3. If there is any up-front one-time cost involved in the comparison case enter it into cell C65. If there is no initial cost to take into account simply enter 0. In this example we will assume that the new piece of equipment that uses slightly more energy but a lot less material input will cost $600,000.

4. Choose the year of inclusion of any initial cost, even if it is $0. In this case we will choose 2010 from the drop-down menu for cell C66. This initial cost will be treated as if it were to occur at the end of 2010.

5. Choose the year of inclusion of any operation and maintenance costs – this refers to your ongoing costs related to the new equipment. For this example we will say that the new operations costs will begin at the beginning of 2011 so the first year that will realize the related costs will be 2011. Choose 2011 from the drop-down menu for cell C67.

6. Enter 1 into the cell for units – this is a place holder used to calculate overall impacts if you were to purchase any number of units of the same equipment. In this case we will enter "1" in cell C68 because we are buying one unit of this new equipment. If we were buying two units you would enter "2", but all of the subsequent inputs for the new equipment would still be related to only 1 unit and then multiplied by whatever number is in this cell.

7. Use a default number of "10" in cell C69 in order to avoid errors in calculations (this number does not matter if you do not have an input for an original equipment cost in cell C65). Since we do have an input, we want to pick the appropriate useful life. Many of the companies we have worked with use 10 here, so we will input "10" into cell C69 for this example. If accelerated depreciation is available for the equipment for tax purposes you can enter that in cell C70. In this example we will assume there is no accelerated depreciation and leave it blank. It must be left blank otherwise it would override the number in C69.

8. If there is no Federal tax incentive enter 0 into cell C72 (for this example we will enter "0"), enter 1 into C73 for years spread. If there is a Federal tax incentive put

the percentage of that incentive (e.g., 10) into cell C72 and the years over which that tax incentive is spread out in cell C73 (if there were a 10% Federal tax credit spread over 2 years – it would be included by the *Model* as 5% in year 1 and 5% in year 2, if it is only in the first year it would be included by the *Model* as 10% in year 1).

9. If there is no State tax incentive enter 0 into cell C74 (for this example we will enter "0"), enter 1 into C75 for years spread. If there is a State tax incentive put the percentage of that incentive (e.g., 10) into cell C74 and the years over which that tax incentive is spread out in cell C75 (if there were a 10% State tax credit spread over 2 years – it would be included by the *Model* as 5% in year 1 and 5% in year 2, if it is only in the first year it would be included by the *Model* as 10% in year 1).

10. If there is no rebate enter 0 into cell C76 (for this example we will enter "0"), enter 1 into C77 for years spread. If there is a rebate put the dollar ($) amount of that incentive (e.g., 10) into cell C76 and the years over which that tax incentive is spread out in cell C77 (if there were a $100 rebate spread over 2 years – it would be included by the *Model* as $50 in year 1 and $50 in year 2, if it is only in the first year it would be included by the *Model* as $100 in year 1).

11. Enter the annual repair/maintenance costs related to the project in C78 (in this case we will enter 0 because the premise is that the new equipment does not add to current repair/maintenance costs. If you have expected $ values every year of increased repair/maintenance costs due to the new equipment then you can enter that annual average dollar ($) amount here in C78.

12. Financing – Entering information into the financing-related cells (Loan Fee, Loan Rate, and Loan-to-Value Ratio) is optional. You must have a number greater than zero (we used 10 in the example) in the cell C82 for Loan Term whether you are including a loan or not in order to avoid any errors in the calculations. This will not impact your output unless you enter data into the other 3 financing-related cells. To begin with, we will not enter any financing information.

13. Since our example is looking at using a new piece of equipment, we will have an initial capital cost ($600,000). For our example we will not have a loan, but if you did decide to include a loan in any scenario, here is how to do it. If you have a loan fee enter that into the appropriate cell (C80 for this example). You can then input your loan rate (i.e., the interest rate for your loan on an annual basis) into the Loan Rate cell (C81 for our example). Then you would enter the term of the loan into the Loan Term cell (C82 for us) – this is the number of years you have to pay back the loan. Finally, the Loan-to-Value ratio is the percentage of the initial one-time cost of a project (cell C65 in the example) that your company is taking a loan for (e.g., 75% of the total cost). We will address this type of scenario at the end of this example.

14. To address the change in energy usage due to the new manufacturing process/equipment in this example we move on to the "Energy section"; cells C86-C88 in our example. You can include the monthly electricity (in kilowatt hours –

kWh), natural gas (thousand cubic feet – tcf), and water usage (hundred cubic feet – HCF) in each of these cells, respectively. For this example we are going to include an average monthly electricity use of 15,000 kWh. So enter 15,000 in cell C86.

15. To address the change in material usage due to the new manufacturing process/equipment you can address that in the "Average Change in Monthly Material Input"; cells C92-C97 in our example. Here we will add 1,333.33 in cell C96 as our monthly lbs. of Aluminum used with the new manufacturing process/equipment. You can also type in the equation "=0.2*(80000/12)" since we are assuming 20% of the baseline amount of aluminum will be used with the new process/equipment. Our annual amount is 80,000, so we need to divide that by 12 to get the monthly amount.

16. In cell C97 we will enter the new price of aluminum per lb. We will assume in our example that the price will go up to $30/lb. due to the large decrease in volume purchased (this may be a little high, but we want to have a conservative estimate). So enter 30 into cell C97.

17. If there is a change in chemical usage due to the new manufacturing process/equipment you can address that in the "Average Monthly Industrial & Organic Chemicals and Fluids" portion; cells C99-C104 in our example. See the Chemical Management usage example for related input directions. In our example, we are only looking at the energy and material (metal) usage, so we will skip the "Average Monthly Industrial & Organic Chemicals and Fluids" section of the comparison scenario input.

18. If there is a change in solid, hazardous or non-hazardous waste due to the new equipment you can address that in the corresponding cells; in our example cells C105, C106 and C107, respectively. Make sure you are using the same units of measurement for each waste throughout use of the *Model* – "tons". In this example, we will assume our company will not have any change in waste due to the new manufacturing process/equipment. While this likely would change, we are going to keep this example simple by not introducing this portion.

19. If you have been able to avoid related compliance, litigation, lobbying or clean-up costs enter those cost savings as a negative ANNUAL amount in the appropriate cells; i.e. C109, C110, C111, and C112, respectively. For our example we will skip this section.

Diagram 6: Metals Example Comparison Inputs

Here is what the screen will look like after you have done steps 1-19 above:

Equipment 1		Values
Include in Comparison Financials?		No
Cost		$ 600,000.00
Year of Inclusion in Financials		2010

1st Year of Inclusion of related O&M Values	2011
Units	1
Useful Life (years)	10
Accelerated Depreciation Life if Applicable (years)	
Useful Life (years) for Depreciation	10
Federal Tax Incentive	0
Years Spread	1
State Tax Incentive	0
Years Spread	1
Rebates ($/yr.)	
Years Spread	1
Annual Increase in Maintenance and Repair Costs per Unit	
Green Financing? (Yes/No)	
Loan Fee	
Loan Rate	
Loan Term	10
Loan-to-Value Ratio	
Energy	
Average Monthly Electricity Used by Each Unit of Equipment (kWh)	15000
Average Monthly Natural Gas Used by Each Unit of Equipment (tcf)	
Average Monthly Water Used by Each Unit of Equipment (HCF)	
Chemicals and Materials Used by Equipment	
Average Change in Monthly Material Input	
Iron	
New Price	
Steel	
New Price	
Other	1333.333333
New Price	30
Average Monthly Industrial & Organic Chemicals and Fluids	
Organic Solvents	
New Price	
Coolant	
New Price	
Other	
New Price	
Average Monthly Solid Waste from Equipment Operation	
Average Monthly Hazardous Waste from Equipment Operation	
Average Monthly non-Hazardous Chemical Waste from Equipment Operation	
Impact on Annual Related Environmental Compliance Costs	

Impact on Annual Related Environment Litigation Costs	
Impact on Annual Environmental-Related Lobbying Costs	
Impact on Annual Related Environmental Clean-Up Costs	

The last step for the comparison case is to go to the baseline scenario input to enter specific information about the management process or equipment you are comparing against. The baseline scenario for comparison is always the module directly above the comparison input (in this case, beginning with cell C17). You will need to put in the baseline amount for any comparison input you have entered (except for the compliance, litigation, lobbying and clean-up costs). This is important because you MUST have an estimated value in the baseline equipment input to base the comparison analysis off. In this case we will only have to input the following:

1. We will make sure that the answer to "Include in Baseline Financials?" is "No" in cell C17 because our original baseline inputs in the "Manufacturing Process Input" worksheet already includes the energy, material, and chemical usage as well as any waste related to this piece of equipment, we do not want to add to these numbers into our baseline AGAIN (which would cause us to double-count the energy, material and chemical usage and the waste related to the piece of equipment we already account for in our "Manufacturing Process Input"). If we were comparing replacing the existing equipment with the same type of equipment versus the new more material efficient and less energy efficient equipment we could indicate "Yes" and include all the same information we included in the comparison scenario for "Equipment 1". In this example we are not doing that so choose "No" from the drop-down menu in cell C17.
2. The price will be $0 in cell C18
3. Year of inclusion, **although not necessary**, is 2010 in C19
4. Year of inclusion of related O&M values, **although not necessary**, is 2011 in C20
5. We will enter "1" into the "Units" cell, C21
6. Enter any positive number into "useful life"; we will enter "10" in C22
7. Enter "1" (or any positive number) into each of the "Years Spread" cells (C26, C28, and C30) to avoid computing errors (although we have 0 as the inputs for the corresponding incentive cells - C25, C27, and C29)
8. Enter a positive number into the Loan Term cell to avoid computing errors – we entered 10 into cell C35
9. Finally, the most important numbers we need to enter are the amount of energy and the amount of the material (aluminum in our example) we used in the baseline on a monthly basis. This is important because when calculating the difference between the two scenarios we have to have a monthly comparison value for the baseline manufacturing process/equipment and the comparison manufacturing process/equipment. In our example, the energy is 10,000 kWh per month to cell C39 and the material value is 6,666.66667 lbs. (or you can enter the equation "=80000/12") to cell C47.

The directions for input are the exact same as for the Comparison Input, the only thing that changes is the cell number.

Diagram 7: Metals Example Baseline Inputs for Comparison

This is what your screen will look like after completing steps 1-9 above:

Baseline	Values
Include in Baseline Financials?	No
Cost	
Year of Inclusion in Financials	2010
1st Year of Inclusion of related O&M Values	2011
Units	1
Useful Life (years)	10
Accelerated Depreciation Life if Applicable (years)	
Useful Life (years) for Depreciation	10
Federal Tax Incentive	
Years Spread	1
State Tax Incentive	
Years Spread	1
Rebates ($/yr.)	
Years Spread	1
Annual Maintenance and Repair Costs per Unit	
Green Financing? (Yes/No)	
Loan Fee	
Loan Rate	
Loan Term	10
Loan-to-Value Ratio	
Energy	
Average Monthly Electricity Used by Each Unit of Equipment (kWh)	10000
Average Monthly Natural Gas Used by Each Unit of Equipment (tcf)	
Average Monthly Water Used by Each Unit of Equipment (HCF)	
Chemicals and Materials Used by Each Unit of Equipment	
Average Monthly Material Input	
Iron	
Steel	
Other	6666.666667
Average Monthly Industrial & Organic Chemicals and Fluids	
Organic Solvents	
Coolant	
Other	
Average Monthly Solid Waste from Equipment Operation	
Average Monthly Hazardous Waste from Equipment Operation	
Average Monthly non-Hazardous Chemical Waste from Equipment Operation	

In order to activate the *Model* and the calculations choose "yes" from the drop-down box in cell C64 on the Metal Working Input sheet to run the calculations

Diagram 8: Activating the *Model*

RESULTS

This project would pay back in its 4th year after implementation. The project would have a 10 year cumulative Net Present Value of $1,048,918 (see cells M52 and M60 on the NPV Analysis worksheet and/or cells O13 and O19 on the Project Output Dashboard worksheet) and an Internal Rate of Return of 27% (see cells C51 and C59 on the NPV Analysis worksheet and/or cells O14 and O20 on the Project Output Dashboard worksheet). "IRR is the average annual return earned through the life of an investment."[2]

From an environmental perspective the reduction in the materials used has a far larger impact than the manufacturing of the product. We know this because while energy use during manufacturing increased, thus increasing related emissions (Total Ten year increase in greenhouse gas emissions of 343.65 tons – cell I5, SOx emissions of 2.34 tons – cell I6, and NOx emissions of 0.49 tons – cell I 7 of the Project Output Dashboard), the energy use and other upstream indicators decreased dramatically due to the much lower amount of material used. The upstream environmental output data reveals far larger decreases in energy consumption of over 17 million kWh (D7 of the Project Output Dashboard), greenhouse gas emissions of over 7,000 tons (D8 of the Project Output Dashboard), SOx emissions of almost 42 tons (D9 of the Project Output Dashboard) and solid waste of 1,440 tons (D10 of the Project Output Dashboard).

Before you begin the next example, deactivate the materials example. However, make sure you do not delete any of the data because we will combine all of these examples in the end to see what impact combinations of projects can have. In order to deactivate the *Model* and the calculations choose "no" from the drop-down box in cells C64 on the Metal Working Input sheet.

Adding in a Loan Scenario

Let's look at how getting a loan will impact the financial outputs. If you have a loan fee enter that into the appropriate cell (C80 for this example). You can then input your loan rate (i.e., the interest rate for your loan on an annual basis) into the Loan Rate cell (enter 5% in C81 for our example). Then you would enter the term of the loan into the Loan Term cell (enter 20 in C82 for us) – this is the number of years you have to pay back the loan. Finally, the Loan-to-Value

[2] http://www.businessdictionary.com/definition/internal-rate-of-return-IRR.html

ratio is the percentage of the initial one-time cost of a project (cell C65 in the example) that your company is taking a loan for (e.g., enter 75% of the total cost into C83 in this example).

Now, re-activate the materials example by choosing "yes" in cell C64 of the Metal Working Input sheet. Now, this project would pay back in its 2nd year after implementation (2012). The project would have a 10 year cumulative Net Present Value of $1,096,492 (see cells M52 and M60 on the NPV Analysis worksheet and/or cells O13 and O19 on the Project Output Dashboard worksheet) and an Internal Rate of Return of 96% (see cells C51 and C59 on the NPV Analysis worksheet and/or cells O14 and O20 on the Project Output Dashboard worksheet). This is because your cash flow does not take the full $600,000 hit in year 1; instead it spreads it out over time. This is a preferable financial situation. In a lot of cases your company can go to a bank and provide this illustration of definite savings from purchasing less materials to be attractive to the lending institution. Since you can provide the environmental data from this model, you may be able to get a better rate since it is environmentally-friendly AND guarantees savings that can be used to pay off the loan.

Before you begin the next example, deactivate the materials example. However, make sure you do not delete any of the data because we will combine all of these examples in the end to see what impact combinations of projects can have. In order to deactivate the *Model* and the calculations choose "no" from the drop-down box in cells C64 on the Metal Working Input sheet.

Example 3: Packaging and Pallets – Related Decisions

In this example we will look at packaging and pallet choices. This part of the *Model* is based on the Use Reusables model at http://www.usereusables.org/cost/cctool.html#, the Reusable Packaging Association and the StopWaste Partnership.

Here is how the example lays out and the initial data we have (the input numbers will be provided during the steps for this example and not in the summary box below):

- Savings by moving from disposable corrugated cardboard containers to reusable plastic containers
- Data needed:
  - Purchase price per container and other shipping materials
  - # of products per container
  - Total # of products shipped
  - Tons of container waste disposed of
  - Number of pulls (waste pick-ups)
  - Tipping Fee
  - Transportation charges

BASELINE

Note: The following steps 1-8 are identical to those on pages 1-3, so if you are combining this next example with the first one you need not repeat them & can proceed to the "Packaging" tab steps on page 26.

For Baseline Inputs, always start with the **"General INPUT & ASSUMP"** tab. For the sake of this example we will say we are in Pennsylvania.

1. Go to cell C6, click on the little arrow/drop-down to the right of the cell. When the drop down menu appears click on Pennsylvania. This will automatically fill in the State tax rate and the average electricity rate and natural gas rate from 2008 throughout the *Model*. If you have a more specific rate to input, we will show you how to do that on the "Manufacturing Process Input" sheet.

2. Enter your Federal Tax Rate in cell C7 as a percentage; if you don't know it assume 35%. In this example we will use 35%.

3. In C9 enter the beginning year of the financials – this refers to the first year of purchase of any equipment. Any equipment purchase or initial cost will be considered to occur at the end of the year entered here. For this example we will assume the equipment and initial costs will occur at the end of 2010, so we enter 2010 in this cell.

4. In cell C13 click on the drop-down menu and select whether you would like to use eGRID Emissions Factors or State-Specific Emissions Factors for calculating some of the emissions related to the electricity you purchase and use in your location. We highly suggest using the eGRID Emissions Factors as they are the factors used by EPA.

5. After you select eGRID Emissions Factors in C13 click on the drop-down menu in C14 to select the grid you get your electricity from. You can determine that grid by looking at the map to the right. Since we are using northeastern Pennsylvania as our location, we can see that according to the map to the right northeastern PA is part of the RFCE grid. So we select RFCE in the drop-down menu in C14.

6. Then enter a cost of funds number (the opportunity cost you place on your funds) in C34. A good estimate would be 3% if you do not know how your company values this.

7. Next is the discount rate for projects in your company. You can go about this two different ways. 1) If you have a company-specific discount rate skip straight to step #8 (Note: This is the easiest and quickest method if you have a discount rate to enter). Or, 2) if you decide you would like to calculate a Weighted Average Cost of Capital (WACC) based on financial indicators then follow the directions in the *Model* Manual on page 5 for "Cost of Capital". C45 will automatically populate with the WACC if you have entered the proper inputs for the WACC calculation process, so do **NOT** change this cell if you are using this method.

8. If you have decided to enter a company-specific discount rate, enter that into cell C46. For our example, we will use 6%. Then, select which discount rate you would like to use for the *Model* from the drop down menu in C47 (IMPORTANT: This box MUST have a non-zero number in it for calculations to work!). For this example, we will select the 6% discount rate from the drop-down menu.

To continue with the Baseline and Comparison Inputs go to the "Packaging" tab. This tab is based on the Use Reusables model at http://www.usereusables.org/cost/cctool.html#, the Reusable Packaging Association and the StopWaste Partnership.

1. Begin by picking a container type from the drop-down box in B11. This cell is not necessary for any calculations in its current state. We will choose corrugated one-way to indicate a disposable corrugated cardboard container

2. In cells B12 through L12 enter the purchase price per container. In our example we will enter $1.00 per container with no change in cost over the 11 years. You must enter the cost for each year in the 11 year period in order to make calculations over that period of time.

3. In cells B13 through L13 enter the cost of sealing materials (such as tape) per container per use. In our example we are only indicating $0.02 per container per use for each of the 11 years.

4. In cells B14 through L14 enter the cost of shrink wrap per container per use. We are not including a price (e.g. $0) for this category.

5. In cells B15 through L15 enter the cost of other peripheral packaging (e.g. corner boards) per container per use. We are not including a price (e.g. $0) for this category.

6. The next section is about timing of use and only has to be entered for the first year. This section will calculate the number of turns (or uses) per container per year. ONLY utilize this section if you use the containers or packaging MORE than once before replacing it. The relevant input cells are B18 through B27. We are going to assume that we only use the containers in our example once each, so we will enter 0 in each of these cells.

    a. In cell B18 enter the amount of time (in days) the container spends at your facility before used again.
    b. In cell B19 enter the number of days worth of "safety stock" you keep on site at any given moment
    c. In cell B20 enter the number of days of transit of the container to the first location to which it is sent
    d. In cell B21 enter the number of days the container spends at this first location
    e. In cell B22 enter the number of days of transit of the container to the second location to which it is sent
    f. In cell B23 enter the number of days the container spends at this second location
    g. In cell B24 enter the number of days of transit of the container to the final location to which it is sent
    h. In cell B25 enter the number of days the container spends at this final location
    i. In cell B26 enter the number of days of transit of the container back to the original location/facility
    j. In cell B27 enter the number of days the container spends in processing (preparation for reuse)
    k. Do NOT enter anything in cells B28 or B29 through L29
    l. B28 will calculate the number of turns (or uses of a container) each year.
    m. B29 through L29 simply lay out the number of turns per year for the 11 years based on the calculation in B28.

7. In cells B31 through L31 enter the number of products per container for each year. In our example we will say that we ship 30 products per container each year.

8. In cells B32 through L32 enter the total number of products shipped each year. In this example we will assume we ship 100,000 products per year with no increase or decrease in products shipped each year.

9. Do NOT enter anything in cells B33 through L33. These cells automatically calculate the total number of containers shipped each year.

10. Do NOT enter anything in cells B35 through L35. These cells automatically calculate the total number of containers owned each year based on the number of turns and the number of shipments.

11. In cell B36 enter the replacement rate of the containers. This determines how many you buy each year after the original year. Enter the percentage of the needed containers that will be replaced each year with purchases of new containers. In our example we are going to say we replace every corrugated cardboard container so we enter 100%.

12. Do NOT enter anything in cells B37 through L37. These cells automatically calculate the total investment in containers each year.

13. Do NOT enter anything in cells B38 through L38. These cells automatically calculate the total investment per container shipped each year.

14. In cells B40 through L40 enter the cost of getting EACH container returned for subsequent use. In this example this cost will be $0 since we are not getting them returned.

15. Do NOT enter anything in cells B41 through L41. These cells automatically calculate the total cost of having ALL containers returned each year.

16. In cells B42 through L42 enter the processing cost to clean and prepare ALL of the containers returned for subsequent use. In this example this cost will be $0 since we are not getting them returned.

17. Do NOT enter anything in cells B43 through L43. These cells automatically calculate the total disposal cost of having ALL containers disposed of each year. It will utilize the subsequent cells to make these calculations. IF you do not have the details for the subsequent cells you can override these cells by entering a known or estimated overall cost of disposal of ALL used containers and skip to step 18. Remember, whenever you override a calculation cell you should save it as a different document with a different document name so you always have a copy of the original *Model* with all of the original calculations. If you do have more details follow these steps:

a. Enter the tonnage of container waste disposed of each year in cells B44 through L44. In this example we will say we have 32 tons of container waste each year
b. Enter number of pulls per year in cells B45 through L45 – number of pulls is the number of waste pickups for container waste. This example will use 24 pulls – 2 container waste pickups per month.
c. Enter the tipping fee for container waste each year in cells B46 through L46. In our example, we will use $70/ton as our tipping fee for each year.
d. Do NOT enter anything in cells B47 through L47. These cells automatically calculate the total transportation charge per pull based on the subsequent cells to make these calculations – the regular charge per pickup and any fuel surcharge. IF you do not have the details for the subsequent cells you can override these cells by entering a known or estimated overall charge per pull (or pickup). Remember, whenever you override a calculation cell you should save it as a different document with a different document name so you always have a copy of the original *Model* with all of the original calculations.
e. If you have the details enter the estimated fuel surcharge per pull (or pickup) for each year in cells B48 through L48. In this example we'll use $30 per pull.
f. Enter the general charge per pull before fuel surcharge in cells B49 through L49. We will use $30 for these cells in our example.

18. Enter an annual labor cost associated with managing the containers and managing the used container disposal process in cells B50 through L50. In our example we'll use ½ or 1/3 of a Full Time Employee and value that at $20,000 per year.

19. Finally, in cells B51 through L51 you can enter any ergonomic benefits related to the containers or pallets you are analyzing. This value will be subtracted from the overall costs since it is a valued benefit by the company. In this example we will not include any ergonomic benefits.

Diagram 9: Baseline Packaging Inputs

The following is the way the screen will look after you do steps 1-19 above:

Product Type for Container Use												
Include in Baseline Expenses?	No											
Baseline	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Container Type	Corrugated one-way											
Purchase Price per container	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	
Cost of sealing materials (e.g., tape) per container per use	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	
Cost of shrink wrap per container per use	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
cost of other peripheral packaging (e.g., corner boards) per container per use	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Timing Inputs												
Time at your site/facility (days)	0											
"Safety Stock" (days)	0											
Days of transit to first location	0											
Days at first location	0											
Days of transit to second location	0											
Days at second location	0											
Days of transit to final location	0											
Days at final location	0											
Days of transit back to facility	0											
Processing time	0											
Turns per Year	#DIV/0!											
Usable turns per year	1	1	1	1	1	1	1	1	1	1	1	
Number of products per container	30	30	30	30	30	30	30	30	30	30	30	
Total number of products shipped	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	
Total number of containers shipped each year	3334	3334	3334	3334	3334	3334	3334	3334	3334	3334	3334	
Total number of containers Owned	3334	3334	3334	3334	3334	3334	3334	3334	3334	3334	3334	
Replacement rate	100%											
Total Investment	$ 3,400.68	$ 3,400.68	$ 3,400.68	$ 3,400.68	$ 3,400.68	$ 3,400.68	$ 3,400.68	$ 3,400.68	$ 3,400.68	$ 3,400.68	$ 3,400.68	
Total investement per container shipped	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	
Return cost per container	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Total annual return costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Processing cost (clean and prepare)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Disposal Cost	$ 3,680.00	$ 3,680.00	$ 3,680.00	$ 3,680.00	$ 3,680.00	$ 3,680.00	$ 3,680.00	$ 3,680.00	$ 3,680.00	$ 3,680.00	$ 3,680.00	
Tons of container waste disposed of	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	
Number of pulls	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	
Tipping fee ($/ton)	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	
Transportation charge per pull	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	
Fuel surcharge per pull	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	
Charge per pull	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	
Labor Cost	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	
Ergonomic benefits	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Total Related Costs	$ 27,080.68	$ 27,080.68	$ 27,080.68	$ 27,080.68	$ 27,080.68	$ 27,080.68	$ 27,080.68	$ 27,080.68	$ 27,080.68	$ 27,080.68	$ 27,080.68	
Cost per container shipped	8.122579484	8.122579484	8.122579484	8.122579484	8.122579484	8.122579484	8.122579484	8.122579484	8.122579484	8.122579484	8.12257948	

COMPARISON

For the comparison case below the baseline case the directions are the same. However, our inputs for the example will be different. Follow these steps for the comparison inputs.

1. Begin by picking a container type from the drop-down box in B59. This cell is not necessary for any calculations. We will choose plastic reusable to indicate a reusable plastic container.

2. In cells B60 through L60 enter the purchase price per container. In our example we will enter $7.50 per container with no change in cost over the 11 years. You must enter the cost for each year in the 11 year period in order to make calculations over that period of time.

3. In cells B61 through L61 enter the cost of sealing materials (such as tape) per container per use. In our example we will us $0 per container per use for each of the 11 years because we will assume the plastic containers seal/close themselves.

4. In cells B62 through L62 enter the cost of shrink wrap per container per use. We are not including a price (i.e. $0) for this category.

5. In cells B63 through L63 enter the cost of other peripheral packaging (e.g. corner boards) per container per use. We are not including a price (i.e. $0) for this category.

6. The next section is about timing of use and only has to be entered for the first year. This section will calculate the number of turns (or uses) per container per year. ONLY utilize this section if you use the containers or packaging MORE than once before replacing it. The relevant input cells are B66 through B75. We are going to assume that we reuse these containers in our example, so we will enter the following in each of these cells.

    a. In cell B66 enter the amount of time (in days) the container spends at your facility before used again. Example – 5 days.
    b. In cell B67 enter the number of day's worth of "safety stock" you keep on site at any given moment. Example – 2 days.
    c. In cell B68 enter the number of days of transit of the container to the first location to which it is sent. Example – 2 days.
    d. In cell B69 enter the number of days the container spends at this first location. Example – 5 days.
    e. In cell B70 enter the number of days of transit of the container to the second location to which it is sent. Example – 0 days.
    f. In cell B71 enter the number of days the container spends at this second location. Example – 0 days.
    g. In cell B72 enter the number of days of transit of the container to the final location to which it is sent. Example – 2 days.
    h. In cell B73 enter the number of days the container spends at this final location. Example – 5 days.
    i. In cell B74 enter the number of days of transit of the container back to the original location/facility. Example – 2 days.
    j. In cell B75 enter the number of days the container spends in processing (preparation for reuse). Example – 5 days.
    k. Do NOT enter anything in cells B76 or B77 through L77
    l. B76 will calculate the number of turns (or uses of a container) each year.
    m. B77 through L77 simply lay out the number of turns per year for the 11 years based on the calculation in B75.

7. In cells B79 through L79 enter the number of products per container for each year. In our example we will say that we ship 30 products per container each year.

8. In cells B80 through L80 enter the total number of products shipped each year. In this example we will assume we ship 100,000 products per year with no increase or decrease in products shipped each year.

9. Do NOT enter anything in cells B81 through L81. These cells automatically calculate the total number of containers shipped each year.

10. Do NOT enter anything in cells B83 through L83. These cells automatically calculate the total number of containers owned each year based on the number of turns and the number of shipments.

11. In cell B84 enter the replacement rate of the containers. This determines how many you buy each year after the original year. Enter the percentage of the needed containers that will be replaced each year with purchases of new containers. In our example we are going to say we replace 3% of our plastic reusable containers each year.

12. Do NOT enter anything in cells B85 through L85. These cells automatically calculate the total investment in containers each year.

13. Do NOT enter anything in cells B86 through L86. These cells automatically calculate the total investment per container shipped each year.

14. In cells B88 through L88 enter the cost of getting EACH container returned for subsequent use. In this example this cost will be $0.50 to have each container returned.

15. Do NOT enter anything in cells B89 through L89. These cells automatically calculate the total cost of having ALL containers returned each year.

16. In cells B90 through L90 enter the processing cost to clean and prepare ALL of the containers returned for subsequent use. In this example we will say it costs $2,000 per year.

17. Do NOT enter anything in cells B91 through L91. These cells automatically calculate the total disposal cost of having ALL containers disposed of each year. It will utilize the subsequent cells to make these calculations. IF you do not have the details for the subsequent cells you can override these cells by entering a known or estimated overall cost of disposal of ALL used containers and skip to step 18. Remember, whenever you override a calculation cell you should save it as a different document with a different document name so you always have a copy of the original *Model* with all of the original calculations. If you do have more details follow these steps:

    a. Enter the tonnage of container waste disposed of each year in cells B92 through L92. In this example we will say we have 1 ton of container waste each year.
    b. Enter number of pulls per year in cells B93 through L93 – number of pulls is the number of waste pickups for container waste. This example will use 1 pull per year.

c. Enter the tipping fee for container waste each year in cells B94 through L94. In our example, we will use $70/ton as our tipping fee for each year.
d. Do NOT enter anything in cells B95 through L95. These cells automatically calculate the total transportation charge per pull based on the subsequent cells to make these calculations – the regular charge per pickup and any fuel surcharge. IF you do not have the details for the subsequent cells you can override these cells by entering a known or estimated overall charge per pull (or pickup). Remember, whenever you override a calculation cell you should save it as a different document with a different document name so you always have a copy of the original *Model* with all of the original calculations.
e. If you have the details enter the estimated fuel surcharge per pull (or pickup) for each year in cells B96 through L96. In this example we'll use $30 per pull.
f. Enter the general charge per pull before fuel surcharge in cells B97 through L97. We will use $30 for these cells in our example.

18. Enter an annual labor cost associated with managing the containers and managing the used container disposal process in cells B98 through L98. In our example we'll use $5,000 per year.

19. Finally, in cells B99 through L99 you can enter any ergonomic benefits related to the containers or pallets you are analyzing. This value will be subtracted from the overall costs since it is a valued benefit by the company. In this example we will not include any ergonomic benefits, although ergonomic benefit values are often used for these types of containers because moving them around the plant often involves demanding physical human work.

Diagram 10: Comparison Packaging Inputs

The following is the way the screen will look after you do steps 1-19 above:

Include in Comparison Expenses?	No										
Comparison	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Container Type	Plastic reusable										
Purchase Price per container	$ 7.50	$ 7.50	$ 7.50	$ 7.50	$ 7.50	$ 7.50	$ 7.50	$ 7.50	$ 7.50	$ 7.50	$ 7.50
Cost of sealing materials (e.g., tape) per container per use	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cost of shrink wrap per container per use	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
cost of other peripheral packaging (e.g., corner boards) per container per use	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Timing Inputs											
Time at your site/facility (days)	5										
"Safety Stock" (days)	2										
Days of transit to first location	2										
Days at first location	5										
Days of transit to second location	0										
Days at second location	0										
Days of transit to final location	2										
Days at final location	5										
Days of transit back to facility	2										
Processing time	5										
Turns per Year	13.03571429										
Usable turns per year	13.03571429	1	1	1	1	1	1	1	1	1	1
Number of products per container	30	30	30	30	30	30	30	30	30	30	30
Total number of products shipped	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000
Total number of containers shipped each year	3334	3334	3334	3334	3334	3334	3334	3334	3334	3334	3334
Total number of containers Owned	256	8	8	8	8	8	8	8	8	8	8
Replacement rate	3%										
Total Investment	$ 1,920.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00
Total investement per container shipped	0.575884823	0.017996401	0.017996401	0.017996401	0.017996401	0.017996401	0.017996401	0.017996401	0.017996401	0.017996401	0.0179964
Return cost per container	$ 0.50	$ 0.50	$ 0.50	$ 0.50	$ 0.50	$ 0.50	$ 0.50	$ 0.50	$ 0.50	$ 0.50	$ 0.50
Total annual return costs	$ 128.00	$ 128.00	$ 128.00	$ 128.00	$ 128.00	$ 128.00	$ 128.00	$ 128.00	$ 128.00	$ 128.00	$ 128.00
Processing cost (clean and prepare)	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00
Disposal Cost	$ 130.00	$ 130.00	$ 130.00	$ 130.00	$ 130.00	$ 130.00	$ 130.00	$ 130.00	$ 130.00	$ 130.00	$ 130.00
Tons of container waste disposed of	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of pulls	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Tipping fee ($/ton)	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ 70.00
Transportation charge per pull	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00	$ 60.00
Fuel surcharge per pull	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Charge per pull	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Labor Cost	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00
Ergonomic benefits											
Total Related Costs	$ 9,178.00	$ 7,318.00	$ 7,318.00	$ 7,318.00	$ 7,318.00	$ 7,318.00	$ 7,318.00	$ 7,318.00	$ 7,318.00	$ 7,318.00	$ 7,318.00
Cost per container shipped	2.75284943	2.194961008	2.194961008	2.194961008	2.194961008	2.194961008	2.194961008	2.194961008	2.194961008	2.194961008	2.19496101
Difference Between Base Case and Comparison Case	$ 17,902.68	$ 19,762.68	$ 19,762.68	$ 19,762.68	$ 19,762.68	$ 19,762.68	$ 19,762.68	$ 19,762.68	$ 19,762.68	$ 19,762.68	$ 19,762.68
Difference Between Base Case and Comparison Case per container shipped	5.369730054	5.927618476	5.927618476	5.927618476	5.927618476	5.927618476	5.927618476	5.927618476	5.927618476	5.927618476	5.92761848

In order to activate the *Model* and the calculations choose "yes" from the drop-down box in cells B9 and B57 on the Packaging sheet to run the calculations.

Diagram 11: Activating the *Model*

Product Type for Container Use			
Include in Baseline Expenses?	Yes		
Baseline	2010	2011	
Container Type	Corrugated one-way		
Include in Comparison Expenses?	Yes		
Comparison	2010	2011	
Container Type	Plastic reusable		

RESULTS

This project would pay back in its 1st year of implementation. The project would have a savings of $9,848 in its first year and a 10 year cumulative Net Present Value of $89,863 (see cells M52 and M60 on the NPV Analysis worksheet and/or cells O13 and O19 on the Project Output Dashboard worksheet). There is no IRR because there is no capital investment, the purchasing of the containers for this example is considered an operations and maintenance expense.

Now, deactivate the packaging example. However, make sure you do not delete any of the data because we will combine all of these examples in the end to see what impact combinations of projects can have. In order to deactivate the *Model* and the calculations choose "no" from the drop-down box in cells B9 and B57 on the Packaging worksheet.

RESULTS and INTERPRETATION

In this last section we will discuss another way to use this model beyond the individual project comparisons discussed thus far. Since we have kept all of the data for each of the three project scenarios above in the model, we can now address different combinations of the projects to assess how utilizing multiple projects can help make a single project look more attractive from a financial perspective. This is important because combining projects can provide a quicker payback, yet greatly increase the environmental benefits of sustainable manufacturing initiatives.

The following is a great example of the impact combining two sustainability projects can have when modeling financial and environmental impacts of these potential decisions. If a company combines the material use scenario without a loan above with the packaging scenario the pay back period moves from the 4th year after implementation to the 3rd year after implementation. In fact, the internal rate of return rises to 30% and the cumulative net present value becomes $1,138,781. This is done by choosing "yes" in cells C64 (of the Metal Working Input worksheet) and C57 (of the Packaging worksheet) and finding the results in O20 and 019, respectively, of the Project Output Dashboard.

Further, if a company adds the loan into the material use scenario and then combines it with the packaging scenario the pay back period moves from the 2nd year after implementation with the loan to the 1st year after implementation. The internal rate of return rises to 111% and the cumulative net present value becomes $1,186,355. This is done by adding the loan values to the Metal Working Input worksheet per the explanation in the results section of the Materials example earlier and choosing "yes" in cells C64 (of the Metal Working Input worksheet) and C57 (of the Packaging worksheet) and finding the results in O20 and 019, respectively, of the Project Output Dashboard.

This illustrates the modeling capabilities and how this model can be used to better inform business decision-making from strategy development to project development. A company can model combinations of different possible projects in order to determine a strategy for a company to become more sustainable in a manner that fits with its financial and environmental goals. It also allows a company to maximize both the financial and environmental returns of its business decision-making at multiple levels of the organization with very limited data and estimated inputs, or with a lot of precise data at different points in the planning and implementation processes.