

## Illustrating the Financial Benefits of Green Chemistry

**Economic Value Added (EVA)** = (ROIC-WACC) \* Capital Employed.

**Levers of Change:** There are three levers which Green Chemistry principles can move to increase EVA (note these may be worked separately or in combination):

1. Increase ROIC - Driven up by increasing revenues from sales or reduced costs<sup>1</sup>
2. Reduce WACC - Driven down by decreasing risk perceived by capital providers
3. Increase Capital Employed – Expand amounts and sources of available capital<sup>2</sup>

**Net Present Value (NPV)** discounts the future, a hard fit with sustainability. Conflict arises, because sustainability asks us to value the future like the present, not discount it with compound interest. Nevertheless, many firms may use NPV in project finance.<sup>3</sup>

Green Chemistry Principle	ROIC increase?	WACC decrease?	NPV Positive?	Positive Externality?
1. Prevent waste rather than treat it after it is formed	<b>Yes</b> Clean-up, Liability, and Insurance Cost Savings	<b>Yes</b> Reduced Firm or Industry Risk Factors	<b>Maybe</b> If discounted future clean-up costs > cost of preventive design	<b>Yes</b> Waste Reduction
2. Maximize the incorporation of all process materials into the final product	<b>Yes</b> Reduced Input & Waste Disposal Costs	<b>Neutral</b>	<b>Yes</b> Reduced Input & Waste Disposal Costs	<b>Yes</b> Waste Reduction
3. Use and generate substances of little or no toxicity	<b>Yes</b> Clean-up, Liability, and Insurance Cost Savings	<b>Yes</b> Reduced Firm or Industry Risk Factors	<b>Maybe</b> If discounted future clean-up costs > cost of non-toxic inputs	<b>Yes</b> Toxic Waste Reduction
4. Preserve efficacy of function while reducing toxicity	<b>Yes</b> Clean-up, Liability, and Insurance Cost Savings	<b>Yes</b> Reduced Firm or Industry Risk Factors	<b>Maybe</b> If discounted future clean-up costs > cost of non-toxic inputs	<b>Yes</b> Toxic Waste Reduction
5. Eliminate or minimize use of or toxicity of auxiliary substances (e.g. solvents)	<b>Yes</b> Clean-up, Liability, and Insurance Cost Savings	<b>Yes</b> Reduced Firm or Industry Risk Factors	<b>Maybe</b> If discounted future clean-up costs > cost of non-toxic inputs	<b>Yes</b> Toxic Waste Reduction

<sup>1</sup> ROIC (Return on Invested Capital) increases if, a) costs decline, revenues stay constant, b) costs stay constant, revenues increase, or c) costs decline *and* revenues grow.

<sup>2</sup> WACC (Weighted Average Cost of Capital) is comprised of opportunity cost of capital for the lender + firm risk + industry risk + project risk. Managers can only control firm and project risk.

<sup>3</sup> ROIC/ROCE/ROA/ROI are similar financial tools that can be adapted to the approach here. This crib sheet is intended for managers to support sustainable decisions regardless of the tools that their firm uses.

<b>Green Chemistry Principle</b>	<b>ROIC increase?</b>	<b>WACC decrease?</b>	<b>NPV Positive?</b>	<b>Positive Externality?</b>
6. Recognize and minimize energy requirements, shoot for room temperature	<b>Maybe</b> If energy cost savings are not offset by new input costs	<b>Neutral</b>	<b>Maybe</b> If energy cost savings are not offset by new input costs	<b>Yes</b> Reduced Energy Demand
7. Use renewable raw material feedstock if economically and technically possible	<b>Neutral</b>	<b>Neutral</b>	<b>Maybe</b> If discounted future costs of renewable feedstocks < cost of non-renewable inputs	<b>Yes</b> Towards Sustainability
8. Avoid unnecessary derivatization (e.g. blocking group, protection/deprotection)	<b>Maybe</b> If input & processing costs do not increase	<b>Neutral</b>	<b>Maybe</b> If energy cost savings are not offset by new input costs	<b>Yes</b> Waste Reduction
9. Consider catalytic reagents superior to stoichiometric reagents	<b>Maybe</b> If input & processing costs do not increase	<b>Neutral</b>	<b>Maybe</b> If energy cost savings are not offset by new input costs	<b>Yes</b> Waste Reduction
10. Design end product to innocuously degrade, not persist	<b>Maybe</b> If ultimate disposal is or becomes the responsibility of the manufacturer	<b>Maybe</b> If ultimate disposal is anticipated to become the responsibility of the manufacturer	<b>Maybe</b> If ultimate disposal is or becomes the responsibility of the manufacturer	<b>Yes</b> Waste Reduction
11. Develop analytical methodologies that facilitate real-time monitoring and control	<b>Maybe</b> If monitoring costs are offset by savings from a lack of errors, work-stoppage & clean-up	<b>Yes</b> Reduced Firm or Industry Risk Factors	<b>Maybe</b> If monitoring costs are offset by savings from a lack of errors, work-stoppage, and clean-ups	<b>Yes</b> Fewer Disasters & Reduced Clean-up Costs
12. Choose substances/forms that minimize potential for accidents, releases and fires	<b>Yes</b> Clean-up, Liability, and Insurance Cost Savings	<b>Yes</b> Reduced Firm or Industry Risk Factors	<b>Yes</b> Clean-up, Liability, and Insurance Cost Savings	<b>Yes</b> Fewer Disasters & lower Clean-up Costs

### FINANCIAL BENEFITS OF GREEN CHEMISTRY

- Principle 12 is a ‘No-Brainer’, offering financial gains to any firm or manager, regardless of the financial evaluation tools they use. Principal 2 is close behind.
- Principles 1,3,4 & 5 are both ROIC increasing and WACC decreasing, suggesting that application of these principles should yield easy financial gains.
- Principles 6, 8-11 hold many conditional gains. Think of a ‘Maybe’ as a conditional ‘Yes.’ Changing conditions demonstrate financial gains here too.