# CANS: INFINITELY RECYCLABLE

An Interdisciplinary Curriculum Module for Grades 10–12

© Aluminum Can Council, 2008. Reproduction may be made only where indicated in this kit, otherwise with written permission from the Aluminum Can Council. Curriculum participants expressly waive all liability for accident or injury from lessons or experiments derived from this kit and accompanying worksheets.

# INTRODUCTION

Welcome to the interdisciplinary curriculum module, **CANS: Infinitely Recyclable**, an easy, informative and fun resource for teaching high school students about building a sustainable future. The term "sustainability" was coined in 1987 in the Brundtland Report titled the *World Commission on Environment and Development*. Sustainable development is defined as: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

The main goal of this curriculum is to help present and future generations approach environmental and scientific dilemmas and social concerns creatively and proactively using the aluminum can as a case study. Through these lessons, students will be equipped with deliberative frameworks, decision-making processes, analytical information and critical-thinking skills to navigate tough problems and develop successful solutions.

Why is aluminum beverage can recycling important? The aluminum beverage can is the most recycled beverage container, one of the most valuable recyclable consumer products, and the only packaging solution that allows for complete recyclability. Americans' recycling efforts and the industry's utilization of aluminum materials reduces the overall energy consumption in the total U.S. aluminum production by 46%. Recycled aluminum cans can be back on the store shelf in as little as 60 days and require 95% less energy, generate 95% less emission and create 97% less water pollution than producing the new metal from ore.

**CANS: Infinitely Recyclable** lessons include background information and in-class and extracurricular activities intended to meet the U.S. Department of Education Project 2061's Benchmarks for Science Literacy. The concepts and learning outcomes adapted in this kit have

been created to ensure that, at the high school level, students are literate in a common set of standards that promote responsible analyses of the world's environmental challenges. It is critical that students learn how to assess and stay current on the environment, inspire public and private organizations to become better stewards, and promote positive economic growth and social objectives.

Designed to act as a whole unit or as stand-alone activities, the interdisciplinary, hands-on lessons allow you to easily determine how much time you want to spend on this topic and choose lessons to meet your students' needs. Thank you for taking the time to teach our future leaders about the many challenges that face decision-makers in balancing environmental protection with social, economic and political considerations.

# TABLE OF CONTENTS

Lesson Overview . . . . . 1

Standards Matrix . . . . . 3

Standards Key . . . . . 4

## LESSONS

Do You Recycle? . . . . . 17

Sustainability in Business . . . . . 37

Be an Executive . . . . . 59

Recycling Plant Woes . . . . . 123

Economic Value of Recycling . . . . . 145

Bibliography . . . . . 173

Resources . . . . . 181

Acknowledgments . . . . . 193

# LESSON OVERVIEW

**Do you Recycle?:** Students explore the reasons why people may or may not recycle aluminum beverage cans. By brainstorming reasons that apply to themselves and peers, they get a better understanding of how the rest of the country may view recycling. Students then conduct a survey on factors that influence recycling rates and compare their results to those of a national poll. Finally, students address the identified challenges to successful recycling programs and higher recycling rates. The lesson provides an introduction to the important consumer-driven step in the life cycle of aluminum beverage cans.

**Sustainability in Business:** Students investigate the concept of sustainability and how different companies prioritize and execute sustainability inside their organizations, among stakeholders, and communities locally and globally. Students start by identifying things in their lives they would like to see last beyond their lifetimes which are then categorized into the 3 Es of Sustainability (Environment, Economics, and Social Equity). Students then select a business from the 100 Most Sustainable Companies and research the company's current sustainability activities including interface with national trade associations, government and other programs, and the added benefits of these associations. While no two businesses or sectors will be identical, students will discover that many practices to achieve continuing economic prosperity, protecting the natural systems of the planet, and proving a high quality of life for its people will be similar, on-going, visionary and require collaboration. Students will develop a definition of sustainability and create a can label depicting sustainable efforts of the company they researched to present to the class. This is a helpful lesson to introduce all aspects of sustainability, prior to students completing the *Be an Executive* lesson.

**Be an Executive:** An extension of *Talkin' Trash with Aluminum Beverage Can's* "Can-o-Nomics" lesson, students participate in a simulation of the beverage can manufacturing industry from mining bauxite to closed-loop recycling of aluminum as part of an international fully integrated corporation. Students become company executives of an aspect of the can-making operation. After learning about their business and those within the conglomerate, the executives present to stakeholders at the "Great Aluminum Can" (GAC) Corporate Conglomerate Annual Meeting their forward thinking business plans, ideas for sustainability, and share successes. Presenters will field probing questions from classmates role-playing as stakeholders. Students will be applying critical thinking skills to

**Through these lessons, students will be equipped with deliberative frameworks, decision-making processes, analytical information and critical-thinking skills to navigate tough problems and develop successful solutions.**

formulate solutions to business and industry challenges as they learn how to make choices based on economics, technology, data, and market dynamics as successful executives do as they drive sustainability.

**Economic Value of Recycling:** Students use national data to calculate full-cost accounting to determine the economic impact of recycling aluminum cans, PET bottles, and glass bottles and jars. Online resources provide current market value for calculations. Students will explore how communities are encouraging recycling and will be able to calculate the impact of higher or lower recycling volumes and how that could impact the environment, a municipal budget, and ultimately the taxpayer and their community. It's fun to brainstorm ideas for possible use of additional revenue generated by recycling. Students also will explore personal action-taking steps to increase recycling in their home, school and town, compare their municipality's recycling rate to others of similar demographics, examine other municipality recycling practices, and their potential applicability to their community. The unit concludes with an optional community activism extension. Students create a report of their recycling findings and present recommendations on ways to increase the community's recycling participation and benefits to the town's recycling coordinator, mayor or council.

**Recycling Plant Woes:** Students discover in a fun, hands-on activity the effects contaminants have on returning commodities such as aluminum into manufacturing feedstock. The stakes are high for the planet and our ability to reduce our carbon footprint. Responsibility lies with consumers and stakeholders for making the recycling process a resounding success. In groups, students draw Fate Cards reflective of real-world scenarios of running a recycling operation. Situations are presented to students and they must actively solve the problem. Students are rewarded or penalized by M&M's® or other tokens for the infraction, good work, or resolution as they learn about preventing contamination. Students also draw Action Fate Cards featuring timed activities simulating multiple daily challenges of running a business. Each group keeps a balance sheet of their net assets. This is an upbeat and engaging way to wrap up a unit on recycling, sustainability, economics, and the environment.

CANS: INFINITELY RECYCLABLE

# STANDARDS MATRIX

Below is a quick reference guide to the National Education Standards that are addressed in each lesson plan. Please refer to the Standards Key for detailed descriptions.

| Lesson Plans | National Education Standards Addressed | Subject Areas | | | |
|---|---|---|---|---|---|
| | | SS | M | S | ENG |
| | | (C,E,G) | (NUM, ALG, DATA, PROB, CONN, REP) | | |
| **Do You Recycle?** | C5, E2, E16, G5, NUM1, DATA1, DATA3, ENG4, ENG7, S1, S5, S6 | X | X | X | X |
| **Sustainability in Business** | C5, E1, E2, E9, G5, S7, ENG1, ENG3, ENG6, ENG7, ENG11, ENG12 | X | | X | X |
| **Be an Executive** | C5, E1, E2, E3, E4, E6, E7, E9, E14, E15, G5, DATA1, DATA3, CONN3, REP3, ENG4, ENG5, ENG6, ENG12, S3, S4, S5, S6 | X | X | X | X |
| **Economic Value of Recycling** | S6, LA4, LA7, LA8, N3, A3, M1, M2, DA1, DA3, PS3, COM2, COM3, CN3, C1, C5, E1, E2, E3, E4, E16, E17, G4, G5 | X | X | X | X |
| **Recycling Plant Woes** | C5, E1, E2, E8, G5, S1, S6, S7 | X | | X | |

# STANDARDS KEY

## National High School Standards Key

**Social Studies**
(Civics, Economics, Geography and U.S. & World History)

**Science**

**Math**

**English**

Please look for these symbols in the upper right hand corner of the lesson plans indicating what subject areas are represented. See the lesson plan sample below. All standards listed are the National Standards for grades 9–12. See individual subject areas for additional standard information.

**Materials:** (For a class of 30)

- Flip chart or butcher paper
- 30 Post-it® notes of one color
- Scissors
- Tape
- Marker
- 15 Post-it® notes of different color
- 1 transparency of *Do You Recycle? Student Survey Teacher Key*
- 1 copy of *Do You Recycle? Teacher Background Information*
- 30 copies of *Do You Recycle? Student Survey*
- 30 copies of *Do You Recycle? Questions for Thought*
- **Optional** Internet access for students or copy of Alcan's *National Survey Recycle Today: The American Consumers' Viewpoint* (http://www.forester.net/mw_electronic/mw0304recycling.pdf)

Symbols show subject area standards represented in lesson plan

Standards are listed by referral code

**Time Required:** Two, 45 minute periods

**Standards Met:** C5, E2, E16, G5, NUM1, DATA1, DATA3, ENG4, ENG7, S1, S5, S6

## National Social Sciences Education Standards Key

**http://www.education-world.com/standards**

### Civics

**C1:** ***Civic Life, Politics and Government***
What is civic life? What is politics? What is government? Why are government and politics necessary? What purposes should government serve? What are the essential characteristics of limited and unlimited government? What are the nature and purposes of constitutions? What are alternative ways of organizing constitutional governments?

**C2:** ***Foundations of the Political System***
What is the American idea of constitutional government? What are the distinctive characteristics of American Society? What is American political culture? What values and principles are basic to American constitutional democracy?

**C3:** ***Principles of Democracy***
How are the power and responsibility distributed, shared, and limited in the government established by the U.S. Constitution? How is the national government organized and what does it do? How are state and local governments organized and what do they do? What is the place of law in the American constitutional system?

**C4:** ***Other Nations and World Affairs***
How is the world organized politically? How do the domestic politics and constitutional principles of the U.S. affect its relations with the world? How has the U.S. influenced other nations, and how have other nations influenced American politics and society?

**C5:** ***Roles of the Citizen***
What is citizenship? What are the rights of citizens? What are the responsibilities of citizens? What civic dispositions or traits of private and public character are important to the preservation and improvement of American constitutional democracy? How can citizens take part in civic life?

### Economics

**E1:** ***Scarcity***
Productive resources are limited. Therefore, people cannot have all the goods and services they want; as a result, they must choose some things and give up others.

**E2:** ***Marginal Cost/Benefit***
Effective decision making requires comparing the additional costs of alternatives with the additional benefits. Most choices involve doing a little more or a little less of something: few choices are "all or nothing" decisions.

**E3:** ***Allocation of Goods and Services***
Different methods can be used to allocate goods and services. People acting individually or collectively through government must choose which methods to use to allocate different kinds of goods and services.

**E4:** ***Role of Incentives***
People respond predictably to positive and negative incentives.

**E5:** ***Gain From Trade***
Voluntary exchange occurs only when all participating parties expect to gain. This is true for trade among individuals or organizations within a nation, and usually among individuals or organizations in different nations.

**E6:** ***Specialization and Trade***
When individuals, regions, and nations specialize in what they can produce at the lowest cost and then trade with others, both production and consumption increase.

**E7:** ***Markets — Price and Quantity Determination***
Markets exist when buyers and sellers interact. This interaction determines market prices and thereby allocates scarce goods and services.

**E8:** ***Role of Price in Market System***
Prices send signals and provide incentives to buyers and sellers. When supply or demand changes, market prices adjust, affecting incentives.

**E9:** ***Role of Competition***
Competition among sellers lowers costs and prices and encourages producers to produce more of what consumers are willing and able to buy. Competition among buyers increases prices and allocates goods and services to those people who are willing and able to pay the most for them.

**E10:** ***Role of Market Institutions***
Institutions evolve in market economies to help individuals and groups accomplish their goals. Banks, labor unions, corporations, legal systems, and not-for-profit organizations are examples of important institutions. A different kind of institution, clearly defined and enforced property rights, is essential to a market economy.

**E11:** ***Role of Money***
Money makes it easier to trade, borrow, save, invest, and compare the value of goods and services.

**E12:** ***Role of Interest Rates***
Interest rates, adjusted for inflation, rise and fall to balance the amount saved with the amount borrowed, which affects the allocation of scarce resources between present and future uses.

**E13:** ***Role of Resources in Determining Income***
Income for most people is determined by the market value of the productive resources they sell. What workers earn depends, primarily, on the market value of what they produce and how productive they are.

**E14:** ***Profit and the Entrepreneur***
Entrepreneurs are people who take the risks of organizing productive resources to make goods and services. Profit is an important incentive that leads entrepreneurs to accept the risks of business failure.

**E15:** ***Growth***
Investment in factories, machinery, new technology, and in the health, education, and training of people can raise future standards of living.

**E16:** ***Role of Government***
There is an economic role for government in a market economy whenever the benefits of a government policy outweigh its costs. Governments often provide for national defense, address environmental concerns, define and protect property rights, and attempt to make markets more competitive. Most government policies also redistribute income.

**E17:** ***Using Cost/Benefit Analysis to Evaluate Government Programs***
Costs of government policies sometimes exceed benefits. This may occur because of incentives facing voters, government officials, and government employees because of actions by special interest groups that can impose costs on the general public, or because social goals other than economic efficiency are being pursued.

**E18:** ***Macroeconomy — Income/Employment Prices***
A nation's overall levels of income, employment, and prices are determined by the interaction of spending and production decisions made by all households, firms,

government agencies, and others in the economy.

**E19:** ***Unemployment and Inflation***
Unemployment imposes costs on individuals and nations. Unexpected inflation imposes costs on many people and benefits some others because it arbitrarily redistributes purchasing power. Inflation can reduce the rate of growth of national living standards because individuals and organizations use resources to protect themselves against the uncertainty of future prices.

**E20:** ***Monetary and Fiscal Policy***
Federal government budgetary policy and the Federal Reserve System's monetary policy influence the overall levels of employment, output, and prices.

## Geography

**G1:** ***The World in Spatial Terms***
- Understand how to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.
- Understand how to use mental maps to organize information about people, places, and environments in a spatial context.
- Understand how to analyze the spatial organization of people, places, and environments on Earth's surface.

**G2:** ***Places and Regions***
- Understand the physical and human characteristics of places.
- Understand that people create regions to interpret Earth's complexity.
- Understand how culture and experience influence people's perceptions of places and regions.

**G3:** ***Physical Systems***
- Understand the physical processes that shape the patterns of Earth's surface.
- Understand the characteristics and spatial distribution of ecosystems on Earth's surface.

**G4:** ***Human Systems***
- Understand the characteristics, distribution, and migration of human populations on Earth's surface.
- Understand the characteristics, distribution, and complexity of Earth's cultural mosaics.
- Understand the patterns and networks of economic interdependence on Earth's surface.
- Understand the processes, patterns, and functions of human settlement.
- Understand how the forces of cooperation and conflict among people influence the division and control of Earth's surface.

**G5:** ***Environment and Society***
- Understand how human actions modify the physical environment.
- Understand how physical systems affect human systems.
- Understand the changes that occur in the meaning, use, distribution, and importance of resources.

**G6:** ***The Uses of Geography***
- Understand how to apply geography to interpret the past.
- Understand how to apply geography to interpret the present and plan for the future.

## U.S. History

**USH1:** ***Three Worlds Meet (Beginnings to 1620)***
- Understand comparative characteristics of societies in the Americas, Western Europe, and Western Africa that increasingly interacted after 1450.
- Understand how early European exploration and colonization resulted in cultural and ecological interactions

among previously unconnected peoples.

**USH2:** ***Colonization and Settlement (1585–1763)***

- Understand why the Americas attracted Europeans, why they brought enslaved Africans to their colonies, and how Europeans struggled for control of North America and the Caribbean.
- Understand how political, religious, and social institutions emerged in the English colonies.
- Understand how the values and institutions of European economic life took root in the colonies and how slavery reshaped European and African life in the Americas.

**USH3:** ***Revolution and The New Nation (1754–1820s)***

- Understand the causes of the American Revolution, the ideas and interests involved in forging the revolutionary movement, and the reasons for the American victory.
- Understand the impact of the American Revolution on politics, economy, and society.
- Understand the institutions and practices of government created during the Revolution and how they were revised between 1787 and 1815 to create the foundation of the American political system based on the U.S. Constitution and the Bill of Rights.

**USH4:** ***Expansion and Reform***

- Understand United States territorial expansion between 1801 and 1861 and how it affected relations with external powers and Native Americans.
- Understand how the industrial revolution, increasing immigration, the rapid expansion of slavery, and the westward movement changed the lives of Americans and led toward regional tensions.
- Understand the extension, restriction, and reorganization of political democracy after 1800.
- Understand the sources and character of cultural, religious, and social reform movements in the antebellum period.

**USH5:** ***Civil War and Reconstruction (1850–1877)***

- Understand the causes of the Civil War.
- Understand the course and character of the Civil War and its effects on the American people.
- Understand how various reconstruction plans succeeded or failed.

**USH6:** ***The Development of the Industrial United States***

- Understand how the rise of corporations, heavy industry, and mechanized farming transformed the American people.
- Understand massive immigration after 1870 and how new social patterns, conflicts, and ideas of national unity developed amid growing cultural diversity.
- Understand the rise of the American labor movement and how political issues reflected social and economic changes.
- Understand Federal Indian policy and United States foreign policy after the Civil War.

**USH7:** ***The Emergence of Modern America (1890–1930)***

- Understand how Progressives and others addressed problems of industrial capitalism, urbanization, and political corruption.
- Understand the changing role of the United States in world affairs through World War I.

- Understand how the United States changed from the end of World War I to the eve of the Great Depression.

**USH8:** ***The Great Depression and WWII (1929–1945)***

- Understand the causes of the Great Depression and how it affected American society.
- Understand how the New Deal addressed the Great Depression, transformed American federalism, and initiated the welfare state.
- Understand the causes and course of World War II, the character of the war at home and abroad, and its reshaping of the U.S. role in world affairs.

**USH9:** ***Postwar United States (1945 to early 1970s)***

- Understand the economic boom and social transformation of postwar United States.
- Understand how the Cold War and conflicts in Korea and Vietnam influenced domestic and international politics.
- Understand domestic policies after World War II.
- Understand the struggle for racial and gender equality and the extension of civil liberties.

**USH10:** ***Contemporary United States (1968 to present)***

- Understand recent developments in foreign and domestic politics.
- Understand economic, social, and cultural developments in contemporary United States.

## World History

**WH1:** ***The Beginnings of Human Society***

- The biological and cultural processes that gave rise to the earliest human communities.
- The processes that led to the emergence of agricultural societies around the world.

**WH2:** ***Early Civilizations and the Emergence of Pastoral Peoples, 4000–1000 BCE***

- The major characteristics of civilization and how civilizations emerged in Mesopotamia, Egypt, and the Indus valley.
- How agrarian societies spread and new states emerged in the third and second millennia BCE.
- The political, social, and cultural consequences of population movements and militarization in Eurasia in the second millennium BCE.
- Major trends in Eurasia and Africa from 4000 to 1000 BCE.

**WH3:** ***Classical Traditions, Major Religions, and Giant Empires, 1000 BCE–300 CE***

- Innovation and change from 1000–600 BCE: horses, ships, iron, and monotheistic faith.
- The emergence of Aegean civilization and how interrelations developed among peoples of the eastern Mediterranean and Southwest Asia, 600–200 BCE.
- How major religions and large-scale empires arose in the Mediterranean basin, China, and India, 500 BCE–300 CE.
- The development of early agrarian civilizations in Mesoamerica.
- Major global trends from 1000 BCE–300 CE.

**WH4:** ***Expanding Zones of Exchange and Encounter, 300–1000 CE***

- Imperial crises and their aftermath, 300–700 CE.
- Causes and consequences of the rise of Islamic civilization in the 7th–10th centuries.
- Major developments in East Asia in the era of the Tang dynasty, 600–900 CE.
- The search for political, social, and cultural redefinition in Europe, 500–1000 CE.

- The development of agricultural societies and new states in tropical Africa and Oceania.
- The rise of centers of civilization in Mesoamerica and Andean South America in the first millennium CE.
- Major global trends from 300–1000 CE.

**WH5:** ***Intensified Hemispheric Interactions, 1000–1500 CE***

- The maturing of an interregional system of communication, trade, and cultural exchange in an era of Chinese economic power and Islamic expansion.
- The redefining of European society and culture, 1000–1300 CE.
- The rise of the Mongol empire and its consequences for Eurasian peoples, 1200–1350 CE.
- The growth of states, towns, and trade in Sub-Saharan Africa between the 11th and 15th centuries.
- Patterns of crisis and recovery in Afro-Eurasia, 1300–1450 CE.
- The expansion of states and civilizations in the Americas, 1000–1500 CE.
- Major global trends from 1000–1500 CE.

**WH6:** ***The Emergence of the First Global Age, 1450–1770***

- How the transoceanic interlinking of all major regions of the world from 1450 to 1600 led to global transformations.
- How European society experienced political, economic, and cultural transformations in an age of global intercommunication, 1450–1750.
- How large territorial empires dominated much of Eurasia between the 16th and 18th centuries.
- Economic, political, and cultural interrelations among peoples of Africa, Europe, and the Americas, 1500–1750.
- Transformations in Asian societies in the era of European expansion.
- Major global trends from 1450 to 1770.

**WH7:** ***An Age of Revolutions, 1750–1914***

- The causes and consequences of political revolutions in the late 18th and early 19th centuries.
- The causes and consequences of the agricultural and industrial revolutions, 1700–1850.
- The transformation of Eurasian societies in an era of global trade and rising European power, 1750–1850.
- Patterns of nationalism, state-building, and social reform in Europe and the Americas, 1830–1914.
- Patterns of global change in the era of Western military and economic domination, 1850–1914.
- Major global trends from 1750 to 1914.

**WH8:** ***A Half-Century of Crisis and Achievement, 1900–1945***

- Reform, revolution, and social change in the world economy of the early century.
- The causes and global consequences of World War I.
- The search for peace and stability in the 1920s and 1930s.
- The causes and global consequences of World War II.
- Major global trends from 1900 to the end of World War II.

**WH9:** ***The 20th Century since 1945: Promises and Paradoxes***

- How post-World War II reconstruction occurred, new international power relations took shape, and colonial empires broke up.
- The search for community, stability, and peace in an interdependent world.
- Major global trends since World War II.

## National Science Education Standards Key

**http://www.educationworld.com/standards/national/science/9_12.shtml**

### Standards

**S1:** ***Science as Inquiry***
Abilities necessary to do scientific inquiry; understandings about scientific inquiry.

**S2:** ***Physical Science***
Structure of atoms; structure and properties of matter; chemical reactions; motions and forces; conservation of energy and increase in disorder; interactions of energy and matter.

**S3:** ***Life Science***
The cell; molecular basis of heredity; biological evolution; interdependence of organisms; matter, energy, and organization in living systems; behavior of organisms.

**S4:** ***Earth and Space Science***
Energy in the earth system; geochemical cycles; origin and evolution of the earth system; origin and evolution of the universe.

**S5:** ***Science and Technology***
Abilities of technological design; understandings about science and technology.

**S6:** ***Personal and Social Perspectives***
Personal and community health; population growth; natural resources; environmental quality; natural and human-induced hazards; science and technology in local, national, and global challenges.

**S7:** ***History and Nature of Science***
Science as a human endeavor; nature of scientific knowledge; historical perspective.

## National Mathematics Education Standards Key

**http://www.nctm.org/standards/**

### Number and Operations

**NUM1:** ***Understand numbers, ways of representing numbers, relationships among numbers, and number systems***

- develop a deeper understanding of very large and very small numbers and of various representations of them;
- compare and contrast the properties of numbers and number systems;
- understand vectors and matrices as systems that have some of the properties of the real-number system; and
- use number-theory arguments to justify relationships involving whole numbers.

**NUM2:** ***Understand meanings of operations and how they relate to one another***

- judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities;
- develop an understanding of properties of, and representations for, the addition and multiplication of vectors and matrices; and

- develop an understanding of permutations and combinations as counting techniques.

**NUM3:** ***Compute fluently and make reasonable estimates***

- develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more complicated cases; and
- judge the reasonableness of numerical computations and their result.

## Algebra

**ALG1:** ***Understand patterns, relations, and functions***

- generalize patterns using explicitly defined and recursively defined functions;
- understand relations and functions and select, convert flexibly among, and use various representations for them;
- analyze functions of one variable by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior;
- understand and perform transformations such as arithmetically combining, composing, and inverting commonly used functions, using technology to perform such operations on more complicated symbolic expressions;
- understand and compare the properties of classes of functions, including exponential, polynomial, rational, logarithmic, and periodic functions; and
- interpret representations of functions of two variables.

**ALG2:** ***Represent and analyze mathematical situations and structures using algebraic symbols***

- understand the meaning of equivalent forms of expressions, equations, inequalities, and relations;
- write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency — mentally or with paper and pencil in simple cases and using technology in all cases;
- use symbolic algebra to represent and explain mathematical relationships;
- use a variety of symbolic representations, including recursive and parametric equations, for functions and relations; and
- judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology.

**ALG3:** ***Use mathematical models to represent and understand quantitative relationships***

- identify essential quantitative relationships in a situation and determine the class or classes of functions that might model the relationships;
- use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts; and
- draw reasonable conclusions about a situation being modeled.

**ALG4:** ***Analyze change in various contexts***

- approximate and interpret rates of change from graphical and numerical data.

## Geometry

**GEO1:** ***Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships***

- analyze properties and determine attributes of two- and three-dimensional objects;
- explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them;

- establish the validity of geometric conjectures using deduction, prove theorems, and critique arguments made by others; and
- use trigonometric relationships to determine lengths and angle measures.

**GEO2:** ***Specify locations and describe spatial relationships using coordinate geometry and other representational systems***

- use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations;
- investigate conjectures and solve problems involving two- and three-dimensional objects represented with Cartesian coordinates.

**GEO3:** ***Apply transformations and use symmetry to analyze mathematical situations***

- understand and represent translations, reflections, rotations, and dilations of objects in the plane by using sketches, coordinates, vectors, function notation, and matrices; and
- use various representations to help understand the effects of simple transformations and their compositions.

**GEO4:** ***Use visualization, spatial reasoning, and geometric modeling to solve problems***

- draw and construct representations of two- and three-dimensional geometric objects using a variety of tools;
- visualize three-dimensional objects and spaces from different perspectives and analyze their cross sections;
- use vertex-edge graphs to model and solve problems;
- use geometric models to gain insights into, and answer questions in, other areas of mathematics; and
- use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture.

## Measurement

**MEA1:** ***Understand measurable attributes of objects and the units, systems, and processes of measurement***

- make decisions about units and scales that are appropriate for problem situations involving measurement.

**MEA2:** ***Apply appropriate techniques, tools, and formulas to determine measurements***

- analyze precision, accuracy, and approximate error in measurement situations;
- understand and use formulas for the area, surface area, and volume of geometric figures, including cones, spheres, and cylinders;
- apply informal concepts of successive approximation, upper and lower bounds, and limit in measurement situations;
- use unit analysis to check measurement computations.

## Data Analysis and Probability

**DATA1:** ***Formulate questions that can be addressed with data, and collect, organize, and display relevant data to answer***

- understand the differences among various kinds of studies and which types of inferences can legitimately be drawn from each;
- know the characteristics of well-designed studies, including the role of randomization in surveys and experiments;
- understand the meaning of measurement data and categorical data, of univariate and bivariate data, and of the term variable;
- understand histograms, parallel box plots, and scatterplots and use them to display data; and

- compute basic statistics and understand the distinction between a statistic and a parameter.

**DATA2:** ***Select and use appropriate statistical methods to analyze data***

- for univariate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics;
- for bivariate measurement data, be able to display a scatterplot, describe its shape, and determine regression coefficients, regression equations, and correlation coefficients using technological tools;
- display and discuss bivariate data where at least one variable is categorical;
- recognize how linear transformations of univariate data affect shape, center, and spread; and
- identify trends in bivariate data and find functions that model the data or transform the data so that they can be modeled.

**DATA3:** ***Develop and evaluate inferences and predictions that are based on data***

- use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions;
- understand how sample statistics reflect the values of population parameters and use sampling distributions as the basis for informal inference;
- evaluate published reports that are based on data by examining the design of the study, the appropriateness of the data analysis, and the validity of conclusions; and
- understand how basic statistical techniques are used to monitor process characteristics in the workplace.

**DATA4:** ***Understand and apply basic concepts of probability***

- understand the concepts of sample space and probability distribution and construct sample spaces and distributions in simple cases;
- use simulations to construct empirical probability distributions;
- compute and interpret the expected value of random variables in simple cases;
- understand the concepts of conditional probability and independent events; and
- understand how to compute the probability of a compound event.

## Problem Solving

**PROB1:** ***Build new mathematical knowledge through problem solving***

**PROB2:** ***Solve problems that arise in mathematics and in other contexts***

**PROB3:** ***Apply and adapt a variety of appropriate strategies to solve problems***

**PROB4:** ***Monitor and reflect on the process of mathematical problem solving***

## Reasoning and Proof

**REA1:** ***Recognize reasoning and proof as fundamental aspects of mathematics***

**REA2:** ***Make and investigate mathematical conjectures***

**REA3:** ***Develop and evaluate mathematical arguments and proofs***

**REA4:** ***Select and use various types of reasoning and methods of proof***

## Communication

**COMM1:** ***Organize and consolidate mathematical thinking through communication***

**COMM2:** ***Communicate mathematical thinking coherently and clearly to peers, teachers, and others***

**COMM3:** ***Analyze and evaluate the mathematical thinking and strategies of others***

**COMM4:** ***Use the language of mathematics to express mathematical ideas***

## Connections

**CONN1:** ***Recognize and use connections among mathematical ideas***

**CONN2:** ***Understand how mathematical ideas interconnect and build on one another to produce a coherent whole***

**CONN3:** ***Recognize and apply mathematics in contexts outside of mathematics***

## Representation

**REP1:** ***Create and use representations to organize, record, and communicate mathematical ideas***

**REP2:** ***Select, apply, and translate among mathematical representations to solve problems***

**REP3:** ***Use representations to model and interpret physical, social, and mathematical phenomena***

## National Language Arts Education Standards Key

**http://www.ncte.org/about/over/standards/110846.htm**

## Standards

**ENG1:** ***Reading for Perspective***
Students read a wide range of print and non-print texts to build an understanding of texts, of themselves, and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works.

**ENG2:** ***Understanding the Human Experience***
Students read a wide range of literature from many periods in many genres to build an understanding of the many dimensions (e.g., philosophical, ethical, aesthetic) of human experience.

**ENG3:** ***Evaluation Strategies***
Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics).

**ENG4:** ***Communication Skills***
Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.

**ENG5:** ***Communication Strategies***
Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.

**ENG6:** ***Applying Knowledge***
Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and non-print texts.

**ENG7:** ***Evaluating Data***
Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.

**ENG8:** ***Developing Research Skills***
Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

**ENG9:** ***Multicultural Understanding***
Students develop an understanding of and respect for diversity in language use, patterns, and dialects across cultures, ethnic groups, geographic regions, and social roles.

**ENG10:** ***Applying Non-English Perspectives***
Students whose first language is not English make use of their first language to develop competency in the English language arts and to develop understanding of content across the curriculum.

**ENG11:** ***Participating in Society***
Students participate as knowledgeable, reflective, creative, and critical members of a variety of literacy communities.

**ENG12:** ***Applying Language Skills***
Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

# LESSON 1
# DO YOU RECYCLE?

**Goal:** To explore trends in recycling, determine local recycling impediments, and facilitate solutions to increase recycling

**Objectives:** Students will…

- Determine the factors influencing personal recycling decisions
- Conduct and analyze results from their area survey on recycling
- Compare and contrast local results with national data
- Investigate action-taking measures to increase recycling in their municipality

**Materials:** (For a class of 30)

- Flip chart or butcher paper
- 30 Post-it® notes of one color
- Scissors
- Tape
- Marker
- 15 Post-it® notes of different colors
- 1 transparency of *Do You Recycle? Student Survey Teacher Key*
- 1 copy of *Do You Recycle? Teacher Background Information*
- 30 copies of *Do You Recycle? Student Survey*
- 30 copies of *Do You Recycle? Questions for Thought*
- 1 copy of *Do You Recycle? Questions for Thought Teacher Answer Key*
- **Optional** calculators
- **Optional** Internet access for students or copy of Alcan's *National Survey Recycle Today: The American Consumers' Viewpoint* (**http://www.forester.net/mw_electronic/mw0304recycling.pdf**)

**Time Required:** Two, 45 minute periods

**Standards Met:** C5, E2, E16, G5, NUM1, DATA1, DATA3, ENG4, ENG7, S1, S5, S6

## Procedure

**Prep**

- Review *Teacher Background Information*.
- Using flip chart paper or butcher paper, divide the paper into two sections. Label one side "Why I Recycle" and label the other side "Why I Don't Recycle."

**Day One**

- Start the class by explaining that, as a class, you will be examining something that most people are familiar with — recycling, in particular, aluminum cans.
- Have a brief discussion exploring the different products that aluminum metal is used to make, where aluminum metal comes from, if it is from a renewable source, if it can be recycled, and what is true closed-loop recycling.
- Tape the flip chart paper in the front of the room.
- Group students into pairs and hand out two Post-it® notes to each pair.
- Each pair should come up with one or two reasons why they might recycle aluminum beverage cans and one or two reasons they may not recycle them. If two reasons are given, students should cut their Post-it® in half.
- Have students place their Post-it® notes on the flip chart paper on the appropriate side.
- Students should not put their names on the Post-it® notes.
- Once all the reasons have been posted, discuss together as a class each of the reasons why they recycle and why they don't recycle. If any reasons are duplicates, arrange the most popular responses at the top of the flip chart. Have them start thinking about potential solutions to the reasons why they don't recycle.
- Following this discussion, pass out the *Student Survey* to each student and review the questions together. The questions and results are from a national survey of about 1,000 American consumers on aluminum beverage can recycling issues conducted by Alcan.
- Each student should survey 10 people from within the class and 10 people from outside of the class, including at least two adults. They should calculate the percentages for each answer for all 4 questions before returning the next class period.
- Allow time for students to survey 10 students in the classroom.

**Day Two**

- Students should have their survey completed, including their percentages.
- Now they can compare their results with the results that were reported in the Alcan National Survey *Recycle Today: The American Consumers' Viewpoint*.
- Place the *Student Survey Teacher Key* transparency on overhead and reveal the national results.
- Note that on Question 3, the national survey results combine the percentages for "Very Important" and "Somewhat Important" to get one percentage. Students can do that with their results for comparison.
- Discuss the similarities and differences between their personal surveys and the national survey.

- Have students get back together with their partner and give each pair one Post-it® note. This Post-it® note should be a different color than the original one.
- Students should brainstorm, with their partner, a solution to the reason(s) they placed on the list previously "Why I Don't Recycle."
- Have students place the new Post-it® note over their original Post-it® note. If two reasons were provided, students should cut the Post-it® in half to accommodate answers for both reasons.
- Hand out one *Questions for Thought* student sheet to each student.
- To facilitate a classroom debrief, assign each pair one of the *Questions for Thought* (Questions #1–4) and all students should answer Question #5. Have each pair present their answer to the class. Pairs that answered the same question should present together. As students listen to the other groups, they can fill out their answers on the *Questions for Thought* student sheet.
- Discuss with all students Question #5 and brainstorm ideas together for potential actions.

## Assessment

- Class participation
- Completion of *Student Survey*
- Completion and presentation of *Questions for Thought*

## Extensions

- Students graph results for comparison of their surveys to the results of the Alcan national survey *Recycle Today: The American Consumers' Viewpoint*.
- Have students write a letter to their local recycling coordinator with ideas to generate increased recycling based on your research and knowledge of the local area.
- Have students read the *General Accountability Office (GAO) Report to Congressional Requesters: Recycling — Additional Efforts Could Increase Municipal Recycling*, December 2006 (GAO-07-37) at **www.gao.gov/new.items/d0737.pdf**, and, if time permits, research other articles and websites such as **www.recyclecurbside.org** to gain a further perspective and understanding of managing the municipal solid waste stream.
  - Students can then create a table summary of their local government's recycling program characteristics using *Your City's Recycling Program Characteristics Compared to Other Cities Extension Sheet*. Then select two cities to compare from "Appendix II: Recycling Program Characteristics of Selected U.S. Cities" (Atlanta, Georgia; Austin, Texas; Chicago, Illinois; Denver, Colorado; Jacksonville, Florida; Minneapolis, Minnesota; New York, New York; Philadelphia, Pennsylvania; Portland, Oregon; San Francisco, California; and Seattle, Washington) from the *GAO Report to Congressional Requesters: Recycling – Additional Efforts Could Increase Municipal Recycling*.
  - Host a debate regarding different methods other cities are using to increase recycling and why these techniques would be advantageous in improving recycling efforts and processes locally. This debate would be conducted in the form of an exploratory hearing on recycling to the town council comprised of four students. The student town council is welcome to ask questions of the presenters. Following the student debate, the student town council will vote for the best action plan presented or defer action because 1) more research is needed or 2) the present system is working.

## Extra Credit

- How many and what type of recycling or municipal solid waste (MSW) legislation has been introduced this legislative session in your state (**http://www.llsdc.org/org;sourcebook/state-leg.htm or http://thomas.loc.gov/**)? Are any bills similar? Any bills reintroduced or is there a new legislative solid waste focus? Which bills have companion bills (identical legislation) introduced in the other chamber? Select a current recycling or MSW bill and discuss its chances of becoming a state law.

## Your City's Recycling Program Characteristics Compared to Other Cities

Name: _____ Date: _____

| **Category**<br>Local Program Characteristics | _____(city)<br>Characteristics | _____(city)<br>Characteristics |
|---|---|---|
| **Residential recycling** | | |
| Collection point | | |
| Materials collected | | |
| Single-unit dwellings | | |
| Multi-unit dwellings | | |
| Curbside collection frequency | | |
| Single-stream curbside collection | | |
| State legal recycling requirements | | |
| Local legal recycling requirements | | |
| **Commercial recycling** | | |
| City recycling program | | |
| Materials collected | | |
| Construction and demolition | | |
| State legal recycling requirements | | |
| Local legal recycling requirements | | |
| **Other recycling program features** | | |
| City financial incentives to recycle | | |
| Public outreach effort/education component | | |
| Recycling in public places (e.g., streets, parks, etc.) | | |
| Recycling goals | | |

*From Appendix II: Recycling Program Characteristics of Selected U.S. Cities, GAO Report to Congressional Requesters: Recycling — Additional Efforts Could Increase Municipal Recycling (GAO-07-37), December 2006, page 30 (www.gao.gov/new.items/d0737.pdf.*

## Teacher Background Information

In 2006, the United States generated 251 million tons of municipal solid waste, or over 1,600 pounds per person. Americans recovered 61 million tons through recycling, more than 31 million tons (12.5%) of materials were combusted with energy recovery and composting recovered almost 21 million tons of waste. This left about 138 million tons (55%) discarded in landfills according to the U.S. Environmental Protection Agency's *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures* for 2006. Americans recycle 1.5 pounds of our individual waste for a 32.5% national recycling rate. However, since 1960, the amount of daily waste created per person has doubled from 2.7 to 4.6 pounds. Sadly, Americans did not achieve EPA's 2002 Resource Conservation Challenge to meet or beat a 35% national recycling rate by 2005, the goal has been extended to 2008.

The goal has been a recycling culture generating less waste. Recycling is not disposal and can lower the amount of waste that is incinerated or sent to landfills, reduce cities' waste disposal costs, and has potentially significant environmental benefits, such as decreasing waste, water and air pollution, greenhouse gas emissions, effluent discharges, and conserving raw materials. In addition, manufacturing products from recycled material can provide economic benefits including using less electricity, fuel, and water, leading to lower production costs and consumer savings. According to EPA, "recycling 82 million tons of MSW saved the energy equivalent of more than 10 billion gallons of gasoline."

The aluminum beverage can is the most recycled (nearly 55%) consumer beverage package on the market today; it is designed for recycling and is the number one beverage container for recycled content, with almost half of each can made from used recycled beverage cans. In 1968, when the nation's first Earth Day celebration was being planned, a brand new industry was getting its start — aluminum can recycling. This 40-year-old industry has become a billion-dollar business, one of the world's most successful environmental enterprises, and the all-aluminum can has come to be known as America's most recycled beverage container. According to Allen Hershkowitz, a solid waste disposal expert for the Natural Resources Defense Council, "the aluminum industry might be described as a yardstick for success compared to other industries nationally."

Aluminum ore is mined, refined, and smelted to produce virgin aluminum metal. Used cans and manufacturing aluminum scrap

**The aluminum beverage can is the most recycled consumer beverage package on the market today.**

are added to the smelted virgin aluminum, saving 95% of the energy required to produce aluminum from ore. The melted aluminum is cast into large ingots and then rolled into coils for beverage can sheet. These coils weigh around 25,000 pounds and are distributed to aluminum can manufacturing plants. Today's beverage can is lighter in weight with 34 cans to a pound. This means around 20% more cans can be produced for each ton of aluminum compared to 15 years ago. More detailed information on the processes and production of aluminum beverage cans can be found in *Talkin' Trash with ABCs* available for free at **www.cancentral.com** or upon request at 202.232.4677.

Aluminum beverage cans are made from a non-renewable natural resource, but aluminum is actually the third most abundant element in the Earth's crust, after oxygen and silicon. The element Aluminum, (Al), makes up 10% of the Earth's crust. Aluminum is non-renewable because it cannot be grown or replaced in a useful amount of time the way that wood from trees or soybeans can be grown. As common as the element aluminum is, the form of aluminum we are so familiar with was not isolated and identified as a metal until 1827. At one time, aluminum metal was more valuable than gold, because aluminum was so rare — a perfect example of supply dictating value. Aluminum remained a precious metal valued at approximately $1200 per kilogram in 1982. Thanks to Charles Martin Hall's processing methods, in 1924, aluminum price fell to 18 cents per pound.[1] The reason for this late discovery is that aluminum does not exist naturally in its pure metallic state due to its highly reactive nature. This means aluminum reacts with oxygen and other elements to form aluminum oxides and hydroxides. Aluminum does not exist naturally, but with other mineral compounds (silicate and oxide) that are very stable, and it took many years of research to find a way to remove the metal from the ore minerals in which it is found. The most economically important form of an aluminum hydroxide is the aluminum ore, called bauxite.[1]

Aluminum is one of the most reusable sources available and can be used over and over and over again indefinitely. Two very commonly recycled materials, paper (because of the fibers) and plastic (because of its molecular structure), are limited in the number of times they can be recycled, and the quality eventually degrades to a non-reusable state. Every time an aluminum product is thrown away instead of being recycled, a useable resource is wasted. The economies of the aluminum can are incredibly valuable; the industry estimates that, in the United States, nearly 50 billion aluminum cans are thrown away annually; that's $800 million annually being buried in American landfills. This equates to nearly 2 billion pounds of aluminum or less than one percent (0.6%) of MSW.[2]

[1] Bellis, Mary. About, Inc., A part of the NY Times Company. April 12, 2008 retrieved http://inventors.about.com/libary/inventors/blalminum.htm

[2] Anonymous. America's Recycling "Perception Gap" Leaves Millions in Landfill (2003). Alcan. April 12, 2008 retrieved from http://www.recycle.alcan.com/NR/rdonlyres/ECB89725-DBA1-4643-B1A1-6AA8CA17295D/0/WasteAgeArticle.pdf

American consumers are vitally important to recycling and keeping the can as the most environmentally efficient beverage package. There are many reasons and theories about the motivating factors affecting our population's recycling habits.

- perception that it is too much work or inconvenient
- people may not think about the value of aluminum when disposing of their cans
- skepticism about the aluminum actually getting recycled
- no personal reward, doesn't save me any money
- used cans can be messy, sticky or smelly
- don't believe in saving the environment
- not sure what is recyclable or where to recycle
- what's one or two cans trashed
- had no idea that used cans are needed to make new cans and that recycling saves energy, reduces emissions, and conserves resources

- reduce waste sent to landfill
- minimize pollution
- get money back
- pays for the cost of collection and re-processing for itself and subsidizes other containers including plastic and glass
- it's easy
- feels good
- helps the environment
- conserves natural resources
- saves energy (processing new virgin aluminum vs. recycling scrap aluminum)
- it's convenient (gets picked up curbside)
- lowers production costs that can be passed on to the consumer
- provides jobs (employs more than 1.1 million workers with an annual payroll of $37 billion)
- raises money for school, charity or a special project
- family recycles
- school recycles
- friends all recycle
- like crushing and piling cans

## Benefits of Aluminum Can Recycling

- Reduces the amount of waste going to the landfill
- Extends life of landfills
- Lowers waste-hauling fees and landfill disposal fees
- Cost avoidance can minimize expense
- Demand for used beverage cans exceeds supply
- Creates jobs
- Saves energy and resources
- Provides valuable feed stock to can manufacturers
- Builds civic pride and acceptance of recycling as a community norm

## More Cans for Recycling — Is This True in Your Locale?

According to the **U.S. Census Bureau**, of the 126.3 million housing units in the United States, 84.8 million (70.0%) are single-family; 5.1 million (4.2%) are duplexes; and 27.6 million (21.8%) contain three or more units. (The remaining units consist of mobile homes, boats, RVs, and the like.)

According to Waste News' latest *Municipal Recycling Survey*, about half of the nation's 30 largest cities don't provide recycling collection for multi-family dwellings.

It's clear there are a lot of apartment-dwelling Americans who are still being underserved when it comes to recycling services.

*Source: Fchrenbach, Peter, Editor. Waste News Daily E-Mail, "Inbox." April 29, 2008. Retrieved from news@wastenews.com.*

## Recycling Calculator

### What if everyone in your neighborhood recycled all their aluminum cans?

**Number of people in your city or neighborhood:** 304,319,066 GO

These statistics are based on US data, assuming 100% recycling rate.

| | |
|---|---|
| **Total Cans Recycled:** | 90,991,400,734 |
| **Total Weight Recycled:** | 2,659,789,557 LBS |
| **Amount of Greenhouse Gases ($C0_2e$) Saved vs Using New Aluminum:** | 10,880,957 Metric Tons |
| **Energy Saved:** | 169,259,335 MBTUs |
| **Barrels of Oil with Equivalent Energy:** | 29,182,644 Barrels |
| **Equivalent GHG Emissions from Cars Not Driven in One Year:** | 1,992,849 Cars |
| **Length of Cans if Stacked End to End:** | 6,910,564 Miles |
| **Value of Aluminum:** | $1,994,842,168 |
| **Water Saved:** | 6,649,474 Cubic Meters |

Based on United States population at 8:07 a.m. on June 12, 2008.
Source: Novelis retrieved from
http://www.novelis.com/Internet/recyclingcalculator/recycleCalculator.aspx

# LESSON 1 DO YOU RECYCLE?

## Student Survey

Name: _____ Date: _____

**Directions:** Survey 10 students from your class and 10 people outside of your class, including at least two adults such as parents, grandparents and teachers, on aluminum beverage can recycling issues. When all 20 people have been surveyed, calculate the percentage for each answer in all four questions. Leave the National Survey percentages blank for now and your teacher will discuss these with you at a later time.

### Question 1:

| **Compare your aluminum beverage can recycling today to your recycling of 5 years ago, are you recycling:** | My survey | | National survey |
|---|---|---|---|
| | Tally | Percent | |
| More than you did 5 years ago? | | % | % |
| About the same? | | % | % |
| Less? | | % | % |
| Don't know | | % | % |
| Additional Feedback: | | 100% | 100% |

**Question 2:**

| **What do you believe is the main obstacle to increased aluminum beverage can recycling?** | My survey | | National survey |
|---|---|---|---|
| | Tally | Percent | |
| Simple laziness? | | % | % |
| Inconvenience? | | % | % |
| Lack of recycling programs and facilities? | | % | % |
| "Other" or Don't know | | % | % |
| Additional Feedback: | | 100% | 100% |

**Question 3:**

| **Rate how important the ability to recycle the container is in deciding whether to purchase a certain type of beverage container.** | My survey | | National survey |
|---|---|---|---|
| | Tally | Percent | |
| Very important? | | % | *See Below* |
| Somewhat important? | | % | % (Sum of Very and Somewhat Important) |
| Not an important factor? | | % | % |
| Don't know | | % | % |
| Additional Feedback: | | 100% | 100% |

**Question 4:**

| **What do you believe is the best way to increase the aluminum beverage can recycling rate?** | My survey | | National survey |
|---|---|---|---|
| | Tally | Percent | |
| Increasing the number of recycling centers? | | % | % |
| Increased support for government-sponsored recycling programs? | | % | % |
| More education on the monetary benefits of recycling? | | % | % |
| More education on the environmental benefits of recycling? | | % | % |
| "Other" or Don't know | | % | % |
| Additional Feedback: | | 100% | 100% |

*Survey questions and results from: Alcan, America's Recycling Perception Gap" Leaves Millions in Landfill (2003). April 14, 2008 retrieved from http://www.recycle.alcan.com/NR/rdonlyres/ECB89725-DBA1-4643-B1A1-6AA8CA17295D/0/WasteAgeArticle.pdf*

## Student Survey Teacher Key

Name: _____ Date: _____

**Directions:** Survey 10 students from your class and 10 people outside of your class, including at least two adults such as parents, grandparents and teachers, on aluminum beverage can recycling issues. When all 20 people have been surveyed, calculate the percentage for each answer in all four questions. Leave the National Survey percentages blank for now and your teacher will discuss these with you at a later time.

**Question 1:**

| **Compare your aluminum beverage can recycling today to your recycling of 5 years ago, are you recycling:** | My survey | | National survey |
|---|---|---|---|
| | Tally | Percent | |
| More than you did 5 years ago? | | % | 49% |
| About the same? | | % | 32% |
| Less? | | % | 17% |
| Don't know | | % | 2% |
| Additional Feedback: | | 100% | 100% |

**Question 2:**

| **What do you believe is the main obstacle to increased aluminum beverage can recycling?** | My survey | | National survey |
|---|---|---|---|
| | Tally | Percent | |
| Simple laziness? | | % | 33% |
| Inconvenience? | | % | 21% |
| Lack of recycling programs and facilities? | | % | 11% |
| "Other" or Don't know | | % | 35% |
| Additional Feedback: | | 100% | 100% |

**Question 3:**

| **Rate how important the ability to recycle the container is in deciding whether to purchase a certain type of beverage container.** | My survey | | National survey |
|---|---|---|---|
| | Tally | Percent | |
| Very important? | | % | *See Below* |
| Somewhat important? | | % | 64% (Sum of Very and Somewhat Important) |
| Not an important factor? | | % | 12% |
| Don't know | | % | 24% |
| Additional Feedback: | | 100% | 100% |

**Question 4:**

| **What do you believe is the best way to increase the aluminum beverage can recycling rate?** | My survey | | National survey |
|---|---|---|---|
| | Tally | Percent | |
| Increasing the number of recycling centers? | | % | 22% |
| Increased support for government-sponsored recycling programs? | | % | 18% |
| More education on the monetary benefits of recycling? | | % | 17% |
| More education on the environmental benefits of recycling? | | % | 17% |
| "Other" or Don't know | | % | 26% |
| Additional Feedback: | | 100% | 100% |



*Survey questions and results from: Alcan, America's Recycling Perception Gap" Leaves Millions in Landfill (2003). April 14, 2008 retrieved from http://www.recycle.alcan.com/NR/rdonlyres/ECB89725-DBA1-4643-B1A1-6AA8CA17295D/0/WasteAgeArticle.pdf*

# LESSON 1 DO YOU RECYCLE?

## Questions for Thought Student Sheet

Name: _____ Date: _____

1. Which question had the largest difference in percentage between your personal survey and the national survey?

   What are some reasons for this difference?

2. What do you believe is the largest obstacle to increased aluminum can recycling and how would you overcome this obstacle?

3. Based on the results of this survey, predict the trend in five years and ten years for aluminum cans and other recyclable commodities.
   A. Recycling in five years:

   B. Recycling in ten years:

4. Which two solutions, presented on the Post-it® notes, do you think have the best potential to be put into action and why?

5. What are some actions you could do as an individual, class, school, city, or nationally to promote increased aluminum beverage can recycling?

   Individual:

   Class:

   School:

   City:

   Nationally:

## Questions for Thought Teacher Answer Key

Name: _____ Date: _____

1. Which question and answers on your survey have the largest difference in percentage between your personal survey and the national survey?
   *Answers will vary.*

   What are some reasons for this difference?
   *Possible answers might include: age, multi-family dwelling vs. residence or rural/urban, gender, proclaimed environmentalist, want to make a difference, etc.*

2. What do you believe is the largest obstacle to increased aluminum beverage can recycling and what are some ideas to overcome this obstacle?
   *Answers will vary.*

3. Based on the results of this survey, predict what the trend will look like in five years and ten years regarding aluminum beverage can recycling and other recyclable commodities.
   A. Recycling in five years:
   B. Recycling in ten years:
   *Answers will vary. Students will probably provide a percentage figure for recycling rates and then brief comments as to why. Possible answers may include:*
   *• Recycling of one commodity such as aluminum may help to encourage greater recycling of other commodities such as paper, plastic, steel, glass.*
   *• Commonly collected curbside or drop-off commodities would be expanded to include recovery of materials from demolition or dismantling of white goods, computers, etc.*
   *• Rewards of engineering and technological advances providing even cleaner commodities ready for immediate use by industry.*
   *• A society so moved by sustainability that zero waste is achieved.*

4. Which two solutions, presented on the Post-it® notes, do you think have the best potential to be put into action and why?
   *Answers will vary.*

5. What are some actions you could do as an individual, class, school, city or nationally to promote increased aluminum beverage can recycling?
   *Answers will vary. Possible answers might include the following:*

**Individual:** Join the environmental club; participate in town's recycling program; make purchase decisions with the environment in mind, such as buying products in recycled and recyclable containers, aluminum beverage cans that cover the cost of collection and re-processing for itself and subsidizes the recycling of other containers; encourage my family and friends to recycle as much as possible; check to make sure all our family's used aluminum cans are being recycled and educate them about the benefits; at recreational fields and parks when no recycling barrels are available, contact the owner or manager and ask why they are not present; help spread the word that recycling bins or barrels should be used for recyclables only; volunteer to teach students in lower grades with the *ABCs of Environmental Education* and *Talkin' Trash* curriculums; and set up an aluminum can recycling program in the lower school and earn community service hours.

**Class:** Inform the Mayor and the local recycling coordinator about the U.S. Conference of Mayors and Novelis Cans for Cash City Recycling Challenge for cash awards based on size of population and the "Most Cans Collected," "Most Innovative Ideas Category," and local "Keep America Beautiful Affiliate Most Innovative and Sustainable Recycling Initiative" to promote aluminum can recycling (http://www.usmayors.org/mwma/novelis/deadlines.html); write an Op-Ed to the newspaper regarding the benefits of aluminum can recycling and how our school is helping the environment and community; conduct neighborhood meetings on how, when and where to recycle; etc.

**School:** Establish a recycling team or environmental club to turn aluminum cans into cash for the school as well as educate and motivate — promoting and collecting of aluminum cans for recycling throughout the facility including sports activities; learn what your state is doing for Environmental Education Week (www.eeweek.org), Earth Day (www.earthday.org) and America Recycles Day (www.americarecyclesday.org) and coordinate with aluminum can recycling event.

**City:** Include what items are acceptable on recycling bins; use larger curbside bins for residential recycling (www.recyclecurbside.org); launch an education/public outreach recycling campaign (website, mailings, PSAs, ads on public transit, school education programs); extend recycling programs to commercial sector — food establishments and office buildings; make recycling mandatory; host school recycling contest for aluminum can collection drives; offer grant money for recycling projects; target multi-unit dwellings for recycling; create financial incentive to recycle (fees based on size of garbage can used, reduction in garbage bill for source-separating recyclables, offer retailer coupons based on weight of resident's curbside recyclable material); create brochures in appropriate language for diverse populations; hold neighborhood meetings on how, when and where to recycle.

**Nationally:** Have EPA facilitate the sharing of recycling best practices success stories; encourage with grants and partnerships technology development to reduce contamination of collected recyclables; expand research on the economic and environmental benefits of recycling; provide additional grant money for recycling projects, form voluntary partnerships between government and industry with agreed-upon recycling goals by commodity type.

# LESSON 2
# SUSTAINABILITY IN BUSINESS

**Goal:** Students will develop their own definitions of sustainability — a term whose definition continues to evolve — and investigate how different companies prioritize and execute sustainability inside their organizations, among stakeholders, and local communities for a global world.

**Background:** This lesson is based on the concept of sustainability. According to the Environmental Protection Agency (EPA), "Sustainability is the ability to achieve continuing economic prosperity by protecting the natural systems of the planet and providing a high quality of life for its people." In order to determine if something is sustainable, three elements must be considered: economics, environment, and social equity. These are known as the "3 Es."

- **Economic** factors or criteria might be, but are not limited to: jobs, cost, human hours, health and safety, performance, supplier training and development programs, product certification, patents, worker training and knowledge, transportation, health care, recovery value, market criteria for performance and cost, policy on using local suppliers/contractors, recognition awards, wages, teamwork across all boundaries — sharing ideas, expertise and best practices, investment in research and development, upgrading equipment and management systems for peak performance and reduced environmental impact, etc.

- **Environment** factors or criteria might be, but are not limited to: air quality, water quality, open space, energy, replenishment of renewable resources, recycling, use of renewable or recycled materials, clean production technologies and best practices, products designed to optimize material and energy, caring for our environment, etc.

- **Social Equity** factors or criteria might be, but are not limited to: diverse populations, number of people positively impacted, increased lifestyle efficiency, empowering workers, equal opportunities, human rights, community involvement, sharing of knowledge, social responsibility toward co-workers, the environment and the communities where we operate, striving for excellence, etc.

**Objectives:** Students will…

- Identify the concepts of sustainability
- Write enlightened definitions of sustainability
- Gain insight regarding sustainability challenges and opportunities
- Brainstorm and prioritize short- and long-term sustainability goals
- Weigh evidence and draw conclusions
- Better understand individual responsibility to sustain our environment

**Materials:** (For a class of 30)

- 3 pieces of easel paper or dry erase boards
- Markers
- 30 copies of *Sustainability in Business – Novelis Joins EPA Climate Leaders Program*
- 30 copies of *Sustainability in Business – Measuring the Challenge to Aluminum*
- 30 copies of *Sustainability in Business – ARCO Aluminum: Health, Safety, Security and Environment*
- 30 copies of *Sustainability in Business – Three Challenges to Leadership in Moving Toward Sustainable Development*
- 15 copies of *Sustainability in Business – Blank 12-ounce Beverage Can Labels*
- 30 copies of *Sustainability in Business – Student Sheet*
- 10 copies of *Sustainability in Business – 100 Most Sustainable Companies*
- Internet access for students or 10 copies of sustainability reports from 3 U.S. companies representing three different sectors currently on the Global List of top 100 (**www.global100.org**) and an overhead of the Global List
- 15 pieces of 12" x 18" construction paper
- 10 copies of *Sustainability in Business – Label Guidelines*
- Assorted magazines destined for the recycling bin
- 60 Assorted color pencils/color felt-tip pens
- 10 Pair of scissors
- 10 Glue sticks
- Several rolls of transparent tape
- An assorted sample of 12-ounce beverage cans for examples
- 15 aluminum beverage cans to display the created labels (these can be unopened or clean, dry used beverage cans)

**Time Required:** Two, 45–60 minute periods

**Standards Met:** C5, E1, E2, E9, G5, S7, ENG1, ENG3, ENG6, ENG7, ENG11, ENG12

## Procedure:

**Day One**

- Have students brainstorm a list of things that have impacted their lives and previous generations that they would like to see last beyond their lifetimes. Examples might include: a strong education system, books available to your grandchildren, NY Subway, Statue of Liberty, Mt. Everest, American Red Cross, Gettysburg Battlefields, etc.
- Have three paper easels or white boards ready to record their lists according to categories (environment, social equity, or economics), that will be later added to the top of each list. Categories should not be written at the top of each list at this point. After the lists are complete, ask the students to identify the headings for each of the three categories. Paraphrase the headings so that the class has identified the 3 Es of sustainability: Environment, Social Equity, and Economics.
- Allow students to work in groups of two to develop their own definitions of sustainability. Have them write their definitions on a large piece of construction paper. The sheets can be posted around the room after everyone is finished. Students can then refer back to their definitions and revise throughout the unit.
- Group students into groups of 3.
- Pass out the *100 Most Sustainable Companies* handout to each group to discuss what companies and businesses are doing in relation to sustainability.
- Distribute the *Sustainability in Business – Student Sheet* to each student.
- Students should go to **www.global100.org** and pick one company from the list they would like to learn more about. They will use this information to fill out the *Sustainability in Business – Student Sheet*. Once they select a company, they will need to research on the business' website to look for specific actions they are taking in relation to sustainability. Suggest to students that they review the company's current annual report and press releases for added insight. Some companies will have a direct link to "sustainability" within their organization. For those students desiring to delve into their company and its industry further, they should go to the industry's national trade association's website. Students will then categorize those actions according to the 3 Es and list these actions on the chart.
- For those students without access to a personal computer, create an overhead of the *100 Most Sustainable Companies* available at **www.global100.org**. Either you choose or invite the class to select three different United States sector companies, i.e. consumer discretionary, industry, health care, or information technology. Then download the sustainability section from the company's website for handouts. Students can choose the industry they want to explore and complete the *Sustainability in Business – Student Sheet* as above. Encourage students to visit the library and research business/investment publications and use the library's computer to round out their research.

- After the groups are finished with their research, have them share with the class what business they chose to research and why, as well as the specific actions the business has taken in an effort to be sustainable.
- Distribute *Novelis Joins EPA Climate Leaders Program, Three Challenges to Leadership in Moving Toward Sustainable Development, ARCO Aluminum: Health, Safety, Security and Environment* and *Measuring the Challenge to Aluminum* articles to each student. They should read the articles before the next class and visit the Aluminum Association's website at **www.aluminum.org** for current developments as well as aluminum supplier (ALCOA, ARCO Aluminum, Novelis) websites which can be linked to from **www.cancentral.com**.

**Day Two**

- Discuss the aluminum industry articles and what they learned from the Aluminum Association and aluminum supplier websites linked from **www.cancentral.com**. Students should use this information to complete their *Sustainability in Business – Student Sheet*.
- Discuss the similarities and differences students found regarding the business they researched versus the aluminum industry's sustainability efforts.
- Briefly explore the notion that taking care of our environment is the responsibility of each individual. In what ways does the corporate culture encourage employees to contribute to the business' sustainability?
- Ask students to return to their group to design three 12-ounce beverage can labels highlighting the actions taken by aluminum can industry with regard to sustainability. This 360˚ "billboard" should appeal to student's age group.
- Have assorted magazines, scissors, glue sticks, color pencils/felt tip pens available for artwork and assorted 12-ounce beverage cans for ideas.
- Hand out *Label Guidelines*, *Blank 12-ounce Beverage Can Labels*, and beverage cans on which to display their label to each group and discuss.
- Allow time for students to complete their can label, select their best label conveying sustainability efforts, and present to the class. After the presentation, labels should be removed from the cans and the cans recycled. All labels should be turned in with the names of the designers on the backside.
- Teacher Presentation Discussion Questions:
  - Are there other promotional opportunities for the aluminum industry to use the ideas from can labels you have created?
  - If given an opportunity for a second phase to communicate the aluminum industry's sustainability success, what promotional strategies and messages would you propose? This could be your group's opportunity to earn extra business from the trade association.

## Assessment:

- Participation in class activity
- Completion of definition of sustainability
- Completion of *Student Sheet*
- Completion of sustainability beverage can label
- Successful participation in group presentation to class

## TEACHER TIP

- **Short on time?** Jump from student's developing their own definition of sustainability to Day Two — the reading and discussion of the four articles (1) *Three Challenges to Leadership in Moving Toward Sustainable Development*, (2) *ARCO Aluminum: Health, Safety, Security and Environment*, (3) *Measuring the Challenge to Aluminum* and (4) *Novelis Joins EPA Climate Leaders Program* portion of this exercise.

**Sustainability is the ability to achieve continuing economic prosperity protecting the natural systems of the planet and proving a high quality of life for its people.**

*Source: United States Environmental Protection Agency*

## Extensions:

- Visit websites for current aluminum can suppliers and manufacturers for the latest information on sustainability activities at **www.cancentral.com**. Record and be ready to discuss at least three interesting, innovative ways that companies are investing in the future through the 3 Es. **Hint:** News releases, annual reports, speeches/presentations, visiting their trade associations, and the U.S. Environmental Protection Agency and U.S. Department of Energy websites are good sources for the latest developments.
- Write a 30 second public service announcement (PSA) to showcase the aluminum beverage can industry and at least two specific actions it is taking in relation to sustainability. If time and tools are available, encourage students to add music, music with lyrics or other sound effects to take their message to the next level. By ballot, students should select the best "Canniest Can" sustainability PSA. If several classes are creating beverage industry PSAs, roll out the red carpet for a schoolwide competition. Winners receive prestige and bragging rights. As a starting point, and to view current public service radio spots, go to **www.adcouncil.org**. Share the winners with the Aluminum Can Council at jday@cancentral.com. Ask about prizes.
- Explore the diverse opportunities awaiting those in the packaging field by visiting colleges and universities offering packaging schools and exploring semester course offerings to learn more. With the packaging industry's economic impact estimated at about $100 billion worth of materials, list some of the possibilities that are available in the packaging sector for packaging majors. Star those areas of most interest to you and explain why. Visit **http://www.packaging.msu.edu/UniversityCollegeProgramswithaPackagingInterest.php**

## An Ultimate Vision in a Perfect World…

- There is no waste
- All materials are completely recyclable and/or everlasting
- Recycling is highly valued and the norm.

*Source: Maryland Recyclers Coalition*

## Label Guidelines

### Challenge!

The president of the aluminum industry trade organization has just hired your company to design three 12-ounce beverage can labels (8 3/16" x 3 3/4") highlighting the various actions taken by the aluminum beverage can industry in relation to sustainability. The labels will be used for a soft drink trade show promotional giveaway. Use the companies from your *Sustainability in Business – Student Sheet* as a springboard for design ideas.

**Label Guidelines:**

1. Your final product should include three labels utilizing the beverage can's unique 360° "billboard" surface to convey the sustainability message. Labels should be creative, colorful and appeal to students your age — the trade show audience.

2. Your labels need to showcase the aluminum industry, including a minimum of three specific actions reflective of their sustainability efforts.

3. Creatively present your best label design as determined by the group to the class. For the presentation, place the group's selected label around a 12-ounce beverage can, securing with tape. All members of your group must participate in the group presentation. Be sure to put the name of each artist on the back of their label before turning them in.

*Reminder: A can's label represents a 360° surface that forms a cylinder rather than flat artwork. Design your labels for continuity at the seam line as well.*

Your label and presentation will be graded on the following:

- Does it include a minimum of at least three specific sustainability actions?
- Does it include information on sustainability (3 Es)?
- Is it creative, colorful, informative, and professional?
- Did all group members participate in the presentation?
- Is it appealing to students your age — the target audience?
- Was the group presentation interesting?

## Blank 12-ounce Beverage Can Labels

## Student Sheet

Name: _____ Date: _____

**Instructions:** Go to **www.global100.org** or work with your teacher to choose one business that you would like to research. Once you select a company, go to their particular website to look for specific actions they are taking in relation to sustainability. Some companies may have a link to sustainability activities, but be sure to explore their annual reports, press releases and presentations/speeches for the most current sustainability activities. To delve into your company and industry further, go to the company's national trade association's website. Categorize those actions by the 3 Es and list below. In the last column, describe one issue that has local impact and global implications. Be sure to list what business you selected as well as their web address in the chart below. Your teacher will provide you the information regarding the aluminum industry and their specific actions.

| | **Environment** | **Economic** | **Social Equity** | **Global Implications** |
|---|---|---|---|---|
| **Specific Actions:** | Example: *Concerned with the environment, Co. X donated $1M to rain forest conservation.* | Example: *Concerned with economics, Co. Y switched to low-energy and long-lasting fluorescent light bulbs.* | Example: *Concerned with social equity, Co. Z gives its employees one week a year of paid volunteer time off to help Habitat for Humanity.* | Example: *Concerned with fossil fuels, Co. A adopts renewable energy policy, invests in efficiency innovations resulting in less energy use, fewer greenhouse emissions leading to cleaner air and reduced environmental impact.* |
| Selected Business: _____<br>Web Address: _____<br>National Trade Assn. Web Address: _____ | | | | |
| Aluminum Industry **www.aluminum.org** **www.cancentral.com** for links to aluminum can industry suppliers | | | | |

## 100 Most Sustainable Companies

Feb. 2, 2005
**List of Global 100 Most Sustainable Companies Highlights Alcoa, BP and Toyota**
**http://www.socialfunds.com/news/article.cgi/article1628.html**
*By William Baue*

SOCIALFUNDS.COM — Last week at the World Economic Forum (WEF) in Davos, Switzerland, a list of the "Global 100 Most Sustainable Corporations in the World" was unveiled by *Corporate Knights*, a Canadian publication focusing on corporate social responsibility (CSR). The list constitutes the 100 companies with the highest Intangible Values Assessment (IVA) scores from Innovest Strategic Value Advisors, a socially responsible investment (SRI) research firm.

"How companies perform on environmental, social, and strategic governance issues is having a rapidly growing impact on their competitiveness, profitability, and share price performance," said Dr. Matthew Kiernan, founder and CEO of Innovest, which rates the sustainability performance of 2,000 companies from such indexes as the S&P 500, MCSI World, FTSE 350, and Eurostoxx.

Due to the proprietary nature of Innovest's sustainability ratings, the list is not ordered according to IVA scores, which assess 80 social, environmental, and governance indicators. The Global 100 list, which covers five percent of Innovest's universe and hence draws on the top five percent of sectors rated by Innovest, does however highlight three companies for farsighted sustainability practice: UK-based BP (ticker: BP), U.S.-based Alcoa (AA), and Japan-based Toyota (TM).

"Toyota, BP, and Alcoa are not rated 1, 2, 3 — they were chosen because they represent the best examples of companies using strategic profit opportunities in the area of sustainability," Michelle McCulloch, Innovest's director of research operations, told SocialFunds.com. "It's impossible to rate companies like this from 1 to 100 because one simply cannot compare across sectors — the issues for each sector Innovest looks at are inherently different."

The Global 100 website details specific sustainability best practices at each of the three companies highlighted. "BP has demonstrated leadership in resource and energy efficiency, climate change risk abatement, waste reduction and recycling, and overall environmental impact minimization," according to Global 100. "Some relevant initiatives include participation in emissions trading, development of a world-leading solar power business, a shift toward natural gas from oil, a goal of zero impact in upstream operations, and the provision of clean/low emissions vehicle fuels at retail outlets."

Global 100 applauds Alcoa's ability to meld sustainability and profitability: for example, the company expects to create environmental

and energy saving of $100 million by 2006. "Importantly, Alcoa's approach to sustainability is firmly rooted in the idea that sustainability programs can indeed add financial value," states Global 100. "This approach is perhaps best evidenced by the company's efforts to promote the use of aluminum in transportation applications, where aluminum — by nature of its excellent strength-to-weight ratio — is making inroads as a material of choice that allows automakers to build low-weight, fuel efficient vehicles that produce fewer tailpipe emissions."

Toyota's hybrid technology distinguishes the company as a sustainability leader, according to Global 100. "Its Prius [hybrid] model was the fastest selling car in America in 2004 and the company is doubling production in 2005 due to strong demand," states Global 100. "Toyota is also licensing some of the technology to Ford Motor for its hybrid vehicles, thereby vastly expanding the positive impact this technology has made on the automotive sector."

An April 11, 2005 supplement to the *International Herald Tribune* focusing on the Global 100 list will publish the three companies with the top IVA scores in each sector rated by Innovest. The supplement will also include an article documenting the correlation between corporate sustainability performance and corporate financial performance, according to *Corporate Knights* Editor Toby Heaps. *Corporate Knights* itself reaches a circulation of 100,000 as an insert magazine in Canada's national newspaper, *The Globe and Mail*, making it the only mainstream magazine devoted to CSR.

The Canadian publisher decided to launch a list publicly recognizing the top global corporate sustainability performers "because nobody else was," Mr. Heaps told SocialFunds.com.

"Canada as a middle power with no colonial baggage to bog it down has a long history of brokering consensus on thorny global issues, like the Montreal Protocol or Suez Canal crisis," Mr. Heaps said. "CSR is pretty thorny, so it seemed like a natural fit."

Indeed, the last edition of the UK business magazine *The Economist* features a diatribe against CSR as its cover story, and CSR critics routinely point out instances of poor social and environmental performance at companies with high sustainability ratings.

"Our current economic system makes it difficult for a large company to be truly sustainable without going bankrupt," said Mr. Heaps. "Within our flawed system — which early corporate sustainability leaders should be trying to change — there is still considerable latitude to cut back on unsustainable behavior, sometimes in ways that are quite profitable."

"The goal of the Global 100 is to spur and recognize those companies willing to pioneer less damaging ways of doing business because if nobody knows who is making progress in this area, it is going to be difficult to maintain the momentum," he concluded.

To learn more visit **www.global100.org**.

## Novelis Joins EPA Climate Leaders Program

August 9, 2006
**Novelis Joins EPA Climate Leaders Program**
**http://www.novelis.com/Internet/en-US/Sustainability**

As a part of its continued commitment to sustainable practices, Novelis Inc. announced today that its North American organization is participating in the U.S. Environmental Protection Agency's (EPA's) Climate Leaders program. "Climate Leaders presents an opportunity for Novelis to continue its voluntary efforts to conserve energy and reduce its greenhouse gas emissions, share best practices and promote cooperation between industry and government," said Kevin Greenawalt, President, Novelis North America.

Launched in 2002, Climate Leaders is an industry-government partnership that works with companies to develop long-term, comprehensive climate change strategies. Partners set a greenhouse gas reduction goal and inventory their emissions to measure progress. "Novelis' voluntary participation in the Climate Leaders program demonstrates a serious commitment to corporate social responsibility," said Kathleen Hogan, Director of EPA's Climate Protection Partnerships Division. "We look forward to working with Novelis in developing their aggressive greenhouse gas reduction goals." Novelis believes that global climate change should be managed through involvement of industry, government and consumers throughout the product life cycle. The use of clean technologies coupled with conservation efforts and recycling initiatives are essential elements of a successful climate change program.

Novelis is committed to minimizing its environmental footprint by optimizing raw material usage through process improvements, implementation of energy efficient technologies and promoting recycling and other conservation practices. In addition, Novelis is working to reduce emissions throughout the product life cycle by:

- Creating products that take full advantage of aluminum's weight savings potential. For example, every pound of aluminum used in place of steel in an automobile can save up to 20 pounds of greenhouse gases from being emitted over the average lifetime of the vehicle.
- Working with our customers and suppliers to drive energy efficiency improvements and increase recycling rates for aluminum products. Recycling aluminum saves 95% of the energy required to produce primary aluminum, which means that up to 95% of related greenhouse gas emissions are avoided.

"Achieving leading environmental, health and safety performance is a guiding principle for Novelis," stated Greenawalt. "We are dedicated to working with our supplier and customer

partners on innovative environmental solutions to improve the efficiency of our products and their impact on the environment." (For more information about Climate Leaders, visit **www.epa.gov/climateleaders**.) Novelis Inc. is the global leader in aluminum rolled products and aluminum can recycling. The company operates in 11 countries and has approximately 13,000 employees. Novelis offers the unrivaled capability to provide its customers with a regional supply of technologically sophisticated rolled aluminum products throughout Asia, Europe, North America and South America. Through its advanced production capabilities, the company supplies aluminum sheet and foil to the automotive and transportation, beverage and food packaging, construction and industrial, and printing markets. For more information, visit **www.novelis.com**.

**Overview of Novelis and Sustainability**

Sustainability, or sustainable development, is often defined as acting in a manner that meets the needs of today without hampering the ability of future generations to meet their needs as well. At Novelis, it means much more than that. We seek to create a distinct brand that will motivate customers, employees, suppliers and communities to partner with us for the long term. We operate with a mind-set that integrates the many parts of our business activities and links the social and environmental aspects to our key economic business objectives. By doing this, we will continually find new ways of creating greater value for all of Novelis' stakeholders and society as a whole.

Novelis has the technology, economic strength, commitment, and skills in the financial, environmental and social dimensions to excel as a sustainable corporation. Our integrated management system that incorporates rigorous environment, health and safety standards, and lean six sigma-based continuous improvement programs coupled with a focus on value-based management, will enable our success. In 2005, Novelis established a set of performance metrics and stretch targets that go beyond compliance. We strive to exceed stakeholder expectations and improve the quality of life through our products and actions. We will partner with our supply chain partners and communities on the voyage toward sustainability and we will communicate transparently our vision, objectives and performance.

**Novelis Sustainability Objectives**

- Reduce land-fill waste generation by 25% by 2010
- Improve energy efficiency by 16% by 2012
- Reduce specific greenhouse gas emissions by 16% by 2012

**Overview of Environment, Health, Safety & Quality**

At Novelis, we are dedicated to supporting the success of our stakeholders, especially our customers, employees, shareholders and communities through excellence in environmental management, health, safety and quality (EHS&Q). In particular, we strive for continual improvement in our operations and business practices to:

- Achieve zero injuries and illnesses through prevention and risk reduction;
- Minimize our impact on the environment by reducing the use of natural resources and preventing pollution; and
- Enhance the quality and benefits of our products and services throughout their life cycle, especially through increased recycling.

At Novelis, we are passionate about the following guiding principles and hold every employee accountable and personally responsible to support this policy.

We will:

- Commit to customer satisfaction by anticipating and understanding their needs;
- Create an atmosphere that motivates each of us, our contractors and visitors to attend to our own health and safety and that of those around us;
- Comply with all EHS regulatory requirements, Novelis' own high standards and other applicable requirements;
- Proactively seek to increase aluminum recycling wherever we do business;
- Challenge each other to question the status quo to foster innovation and improvement;
- Measure our performance, procedures and equipment, and establish challenging objectives and targets to continually improve the effectiveness of our management systems;
- Build collaborative relationships with our key suppliers and customers for the sharing of best practices;
- Celebrate our successes and accomplishments.

**Novelis and Recycling**

This policy is based on our values. Our focused actions will bring sustainable results and high performance.

Novelis is a leader in establishing industry programs to promote aluminum collection and recycling in many of the countries where it operates. Many Novelis plants have the facilities to recycle post-consumer aluminum as well as scrap aluminum generated during the manufacturing process. This recycled metal is then primarily utilized by Novelis' own rolling facilities to produce can sheet.

With developments in legislation and the increasing number of end-use markets (notably packaging, automotive and building products), recyclable aluminum continues to play an important and growing role in the industry.

# LESSON 2 SUSTAINABILITY IN BUSINESS

## Measuring the Challenge to Aluminum

**Excerpts from**
**"Measuring the Challenge to Aluminum"**
**http://www.aluminum.org/AM/Template.cfm?Section=Press_Room&CONTENTID=19410&TEMPLATE=/CM/ContentDisplay.cfm**
*By Brian Sturgell, Executive Vice President Alcan, Inc., Chairman, The Aluminum Association*

**Conveying the Sustainability Message**

If we believe the concept of sustainable development will grow year after year, then as an industry we have a significant leverage point. And we know that a little knowledge goes a long way in persuading people of the many attributes of aluminum. Among these proven attributes are: far less waste, energy savings, reduced environmental impact, and the conservation of natural resources — all attributes associated with sustainability.

If aluminum is to become favored as a truly sustainable resource, then the recycling attribute is likely to be the basis for that conviction. It provides us with that rarest of advantages: the opening to make a credible case about the benefits of using aluminum for the benefit of current and future generations.

For example: What if consumers knew that the 54 billion cans recycled in 2002 constituted a $750 million value? Or that recycling those cans saved energy equivalent to 15 million barrels of crude oil? Think of the relevance that such energy savings has to the sustainability issue.

Think of the impression on auto engineers, dealers, and buyers if we can raise awareness that every ton of aluminum replacing two tons of steel in automobiles reduces carbon dioxide emissions by up to 20 tons over the life of a vehicle. Or that aluminum offers substantial opportunity to reduce greenhouse gas emissions in the auto fleet.

Beyond its value to the environment and consumers, recycling is also good for our business. Scrap is 32 percent of total metal consumption. It would take 23 smelters the size of a modern-day 400,000-ton smelter to equal our industry's consumption of aluminum scrap. That amounts to a $30 to $40 billion investment, not including the corresponding costs of bauxite and alumina facilities.

After all is said and done, recycling is an appeal to intelligence, resourcefulness, and good business sense. These are the same reasons why people the world over are embracing sustainability. And no better illustration of sustainability exists than recycling aluminum.

The task we have now as an industry is to tie it all together for consumers. Aluminum alone is infinitely recyclable, provides the highest value, and its recyclability promotes sustainable development through energy and environmental advantages. This is true for the aluminum can as it is for aluminum automobile parts, aluminum

building materials, and aluminum consumer goods.

Let's not forget that recycling ties our product to a value important to almost everybody — their communities. In short, it is our brand. But, we are in danger of losing our brand. This is something our industry cannot afford!

**Action Taken**

They say that a mind is a terrible thing to waste. But so too is the loss of the value of a brand that, due to neglect, may lose its power to persuade people about what is most distinctive about our metal.

This would be especially regrettable now as the world begins to focus on sustainability. The linkage is incredibly strong with our products! With this in mind, the Aluminum Association has launched an initiative to take our industry's sustainability message to consumers, so that they can make a fully informed decision about the materials they purchase. An executive committee has formed for the express purpose of:

1. Turning recently completed consumer research into actionable recommendations;
2. Developing core messages we can use with maximum impact that will perhaps broaden our recycling message into a new communications platform for talking more comprehensively about a sustainable aluminum industry; and
3. Producing the marketing tools to carry this theme forward.

Future issues of *Aluminum Now* will report on the progress and recommendations.

The intrinsic value of aluminum is the heart of our competitive advantage … and at the heart of how we provide sustainable development. For the benefit of both our industry, and the planet we all inhabit, it is our obligation to bring aluminum's sustainability message to the marketplace.

## Arco Aluminum: Health, Safety, Security and Environment

ARCO Aluminum, Inc.

**Health, Safety, Security and Environment: Commitment to conducting its business in an ethical and environmentally responsible manner**
**www.arcoaluminum.com/sectiongenericarticle.do?categoryId=9004057&contentId=7008374**

ARCO Aluminum's HSSE principles are closely aligned with those of our parent company, BP, and with our manufacturing facility, Logan Aluminum, Inc. Each shares the same base goals of — no accidents, no harm to people, and no damage to the environment.

**Policies and guidelines**

All the activities and assets of ARCO Aluminum and Logan Aluminum are expected to…

- Comply with all legal and regulatory requirements and, where appropriate, meet or exceed more stringent internal HSSE standards.
- Provide a secure and safe working environment for our employees, contractors, and visitors, and protect our operations and assets from criminal or hostile acts.
- Ensure that all employees, contractors and visitors are well-informed about our HSSE expectations, and are properly trained and equipped to perform their activities safely in our facilities.
- Continually refine and improve our HSSE processes, and to incorporate the best practices, technologies, and behavioral culture in achieving expected levels of HSSE performance.
- Provide assurance that HSSE standards and regulatory requirements are being met through regularly scheduled audits and process assessments.
- Identify the risks and hazards in our operations, and have plans in place to proactively manage them.
- Maintain public confidence in the integrity of our operations by maintaining open and honest relationships at the local, state, and federal levels.
- Ensure that all contractors working on our behalf are compliant with our HSSE standards and satisfy our expectations for HSSE performance.
- Continually improve our operations and processes to maximize efficiencies, minimize waste, and conserve resources.
- Promote environmental awareness among our employees and our host communities.

## Three Challenges to Leadership in Moving Toward Sustainable Development

June 18, 2007
**Tools for Action:**
**International Forum on Applied Sustainable Development**
Université de Sherbrooke
**http://www.alcoa.com/global/en/about_alcoa/commitment_to_sustain/pdfs/Gilardeau_Sustainability_Challenges_07_17-07.pdf**
*Address by Jean-Pierre Gilardeau, President, Alcoa Canada*

Ladies, Gentlemen, Good day.

I am very happy to be with you today, and I thank the organizers of this International Forum on Applied Sustainable Development for inviting me. This talk, and the work I did in preparing it, allowed me to define more clearly the issue and to deepen my understanding of the subject. I thank you for this opportunity.

I would like to use these few minutes to share with you my feelings about the challenges that await us if we want to make sustainable development the solution to the problems we face.

1. **But to understand these challenge better, I propose starting with a rapid assessment of the current situation.**

On the **environmental front**, often the most visible aspect of sustainable development, the media have extensively covered alarming reports of the problems of climate change, of water shortages which now affect 1 in every 3 persons, waste management, deforestation, soil erosion, and more.

I will not say more about this aspect, other than noting that it is clear that few people take it seriously enough to change their way of life.

It is more difficult to report on the **social front**. There are certain general positive tendencies: average incomes have increased by 22% in the world and the number of people living in extreme poverty has decreased by 130 million.

But there remain disturbing phenomena such as poverty, the unacceptably large number of young children in the world who are still working, AIDS, and closer to home, work-related stress and ill health, which is increasingly costly in Québec and Canadian society.[1] Not to speak of the problem of workforce succession management, which is beginning to affect a number of industrialized countries.

The report on the **economic front** bears the two-faced stamp of globalization: half angel, half devil.

There are now some 70,000 international companies on the planet, with some 700,000 subsidiaries and millions of suppliers. Together, they constitute a formidable network which, as well as creating jobs and transferring technology, has contributed a great deal to spreading awareness of environmental issues and of

struggles against discrimination and for human rights.[2] The repercussions of this on transport and on the flow of information has allowed many small- and medium-sized companies to access markets on the far side of the world, as some of our suppliers can testify!

There is, however, a flip side to this coin.

For example, governance capability is weak in certain countries, and the protection of human rights and application of environmental regulations are often ineffective if not nonexistent. Companies that operate in these countries must strengthen their internal controls and their own governance capability.

In drawing up this brief balance sheet, I may have given the impression that it was possible to separate environmental, social, and economic problems. This is where the fundamental difficulty lies, for most of these problems are, in fact, interrelated!

Suddenly, the basic question becomes: How do we solve all these environmental, social, and economic problems, knowing that we have to tackle them simultaneously and from all sides?

Today, we're in quite a paradoxical situation with, on the one hand, alarm calls about our future growing ever louder, and on the other, the apparent multiplication of applications of sustainable development principles.

What lessons should we draw from this? It seems to me that we could sum it up by saying that we're on the right road, but that we set off quite late, and that we have to pick up the pace if were are to avoid ending up like the hare in the fable.

**2. I would like to illustrate these remarks by describing Alcoa's current situation.**

We are fortunate in having a good product, aluminum, which can be part of the long-term solution of many programs. It is sustainable, and can be almost indefinitely recycled: more than 70% of the aluminum produced in the world since the industry began a century ago is still in use. Recycling aluminum saves 95% of the energy needed to make new metal. Aluminum, being lighter than certain traditional materials, reduces the weight of vehicles and reduces the emission of greenhouse gases (GHGs). In fact, replacing traditional materials in transport by 1 kg of aluminum is equivalent to reducing GHG emissions by 20 kg over the life of a vehicle.

Moreover, for a long time now, we have been active on environmental and social questions.

- We are concerned about Health and Safety and, thanks to the programs we have set up and which are now integral to our culture, we have significantly reduced our rate of time-loss accidents. In fact, it has been more than a year and a half since we have had any accident involving loss of time in any of our aluminum smelters in Québec with their more than 3,500 employees.
- Turning to GHGs, in 2002 we became the first company in Québec to sign a voluntary agreement with the Government of Québec to reduce emissions. We have reached our target for the period 2002–2005, and are well on the way to reaching our 2006–2007 target. If all goes as we think it will, we will have reduced our total emissions by 10% relative to 2001.
- All our plants are certified ISO 14 001, and they have all been certified by the Ici on recycle[3] program of Recyc-Québec.
- We have numerous social partners and programs, such as the programs of the Alcoa Foundation, which encourage our employees to participate as volunteers in their community; the Ten Million Trees project; the actions carried out during Earth Day and the National Waste Reduction Week.

- We have set up local advisory committees in each of the regions in which we operate, and in 2006, we created an advisory committee on sustainable development to advise us on integrating the expectations of Québec society into our business practices.

But we know this is not enough. We remain a major energy consumer. We are among the major industrial emitters in Québec. We have a major stake in renewing our workforce in the regions in which we operate. And we can have a major influence on the quality of life of the local communities where our facilities have been implemented.

We are well aware that to respond to these issues, we must go further and do more. But to succeed in this, we must rise to at least three challenges of leadership that I believe are pretty universal. I shall now describe them to you.

***1st challenge: thinking and working in the long term.***

This notion of duration is an essential condition for getting results in a number of fields:

- Major technological advances require considerable sums, years of investment, research and testing, before being applied industrially;
- Changes in behavior require a lot of sensitization, time, and attention to be effective. Québecers needed a generation to accept the use of seat belts;[4]
- The renewing and regeneration of natural resources, of wood for instance, goes in cycles that sometimes extend over several decades; and
- Adapting our processes must be done through dialogue, but this approach sometimes takes longer to make a real change.

And it seems to me that to meet this challenge of duration, we will have to:

1) Forget the duration, which is often short, or our mandates, and dare to take actions whose benefits we will not always see;
2) Have a long-term vision, supported by a structured approach; and
3) Balance the pressure for short-term results with our long-term objectives and not make choices that compromise our long-term vision.

***2nd challenge: mobilize to a greater extent our internal and external stakeholders.***

The problems that face us also involve numerous agents, who sometimes differ as widely as possible from each other: governments, municipalities, non-governmental organizations, our employees, citizens, financiers, suppliers, and finally, our clients. Each of these stakeholders often implements one-sided solutions instead of consulting with all the others. This can lead to disagreements, delays or blockages, and can get in the way of obtaining good results. Current management of the reduction of GHG emissions is a good example.

Mobilizing our stakeholders in a more systematic way thus becomes critical. There are many advantages to doing this: credibility; reduction in resistance and conflict; input of new information and ideas; a more effective sharing of responsibilities. However, this requires adapting our mode of leadership and applying the new rules of the game. We must:

1) Recognize the value added by all stakeholders, whoever they are;
2) Be more transparent in our exchanges of information;
3) Accept enlarging decision-making processes; and
4) Surmount cultural barriers associated with our role, functions, or organization.

***3rd challenge: move on to take concrete actions.***

Engaging concretely in sustainable development is no longer one possibility among others; it has become a necessity.

In the first place, this is because there are urgent issues such as the struggle against poverty or climate change.

Secondly, it's because it's always less costly to act now than to delay. The Stern report estimates that the global cost of mitigating the effects of climate change would be 5 to 20 time greater for actions taken 10 year hence compared with taking them now.[5]

Finally, it's because we know that the great majority of changes that are effective are those that leaders initiate or support. Their involvement also assures coherence in bringing about these changes, from the decision-making processes through the systems for information, measurement and reconnaissance.

So, if we want to rise with success to the three challenges I have mentioned, namely:

1) Working on the long-term;
2) Mobilizing our stakeholders; and
3) Moving on to action; quite significant changes are needed in our leadership and our way of doing things.

In conclusion, I'd like to propose to you — to propose to us — a fourth challenge. At the end of these three days, why not all and each of us make an engagement to apply the principles of sustainable development, and record this engagement in the Forum's book, which is located at the entrance to the cultural center? The organizers of this Forum will, in a few months, measure the concrete application of our engagements.

Let's set a date, and see if we are able to rise to these challenges, for our own sake and for the sake of the generations to come.

Thank you.

*Sources*

[1] Univesité Laval, 2005
[2] World Investment Report, 2005
[3] Conseil économique et social, 2006
[4] Ministére du Transport du Québec, 2002
[5] Stern Report, 2006

# LESSON 3
# BE AN EXECUTIVE

**Goal:** To provide students the opportunity to use data and background material in practical, real-life applications that reflect the business world, its challenges and rewards.

**Background:** Refer to the *Teacher Background Information Sheet* for additional information.

**Objectives:** Students will

- Participate in a stakeholder annual meeting simulation illustrating the fully-integrated businesses involved in the aluminum beverage can industry from mining bauxite to selling the cans to the bottler and recycling.
- Learn how to make choices based on economics, technology, data and market dynamics as executives do while considering the 3 Es (economic, environment, and social equity) of sustainability resulting in quality, customer-desired products.
- Communicate in groups effectively exploring the art of negotiation and teamwork through listening, writing, feedback, data (provided) analysis, support material, and cognitive knowledge.
- Participate interactively in stakeholders meeting by presenting the company's forward thinking business plan, then fielding probing questions from classmates role-playing as stockholders, environmentalists, investment brokers, reporters, and the community.
- Apply critical thinking skills to formulate solutions to business and industry challenges.

**Materials:** (For a class of 32)

- 32 copies of *Be an Executive – Student Executive Assignment*
- 32 copies of *Be an Executive – Student Backgrounder*
- 32 copies of *Be an Executive – Company Profile Worksheet*
- 32 copies of *Be an Executive – Great Aluminum Can (GAC) Corporate Conglomerate Annual Meeting Schedule*
- 32 copies of *Be an Executive – Running a Successful Company: Ten Rules that Worked for Me – Sam Walton*
- 32 copies of *Be an Executive – Round Table Discussion Notes*
- 8 copies (one for each company) of *Be an Executive – Three Questions Your Company Anticipates after the GAC Corporate Annual Meeting Presentation*
- 32 copies of *Be an Executive – GAC Corporate Conglomerate Annual Meeting Guidelines*
- 32 copies of *Be an Executive – Student Recommendations Sheet*
- 2 copies (one for Corporate Conglomerate and one for The Waste Place – Landfill & Incinerate) of *Be an Executive – Landfill Methane Partners and Projects Receive EPA Awards*
- Overhead of *Life Cycle of the Aluminum Can*
- 4 copies of each *Be an Executive – Company Profile* set:
  - Mining Co.
  - Boxed Up Bauxite Co.
  - Coils R Us
  - Cannery Row, Inc.
  - Can Endos
  - The Waste Place – Landfill & Incinerate
  - Al's Recycling Center
  - Corporate Conglomerate
- Access to research sources (library, computers with Internet access, or hard copies of information from the Can Manufacturers Institute at **www.cancentral.com**, *Talkin' Trash lessons Five: Bauxite Beginnings* and *Six: Can-O-Nomics*, and the Aluminum Association at **www.aluminum.org** and **www.cancentral.com** for aluminum supplier and can manufacturers links, current industry trends, and news)
- 1 copy of *Landfill Methane Partners and Projects Receive EPA Awards* to accompany *Be an Executive – Company Profile* for *The Waste Place – Landfill & Incinerate* or website address: **www.gradingandexcavation.com/mw_0705_methane.html**
- 1 copy of your *Be an Executive – Company Profile Teacher Key*
- **Optional** Completed *Do You Recycle?* and/or *Sustainability in Business* lesson
- Overhead of *Be an Executive – Aluminum Processing Diagram*
- **Optional** Background from *Talkin' Trash* curriculum, "How Aluminum Beverage Cans (ABCs) are Made," pages 92–99
- **Optional** A fun prize. (Free Al the Can awards are available by contacting the Aluminum Can Council at 202.232.4677 or emailing requests to jday@cancentral.com)

**Time Required:** Three, 45–60 minute periods

**Standards Met:** C5, E1, E2, E3, E4, E6, E7, E9, E14, E15, G5, DATA1, DATA3, CONN3, REP3, ENG4, ENG5, ENG6, ENG12, S3, S4, S5, S6

# LESSON 3 BE AN EXECUTIVE

## Procedure:

**Prep**

- Make overhead of *Life Cycle of the Aluminum Can*.
- Make overhead of *Aluminum Processing Diagram*.
- Briefly review the concepts of sustainability through the *Sustainability in Business* lesson plan, if new to this lesson plan.
- If you would like, invite guests from the community who are connected to recycling or the can industry for class GAC Corporate Conglomerate Annual Meeting presentations. Contact these volunteers ahead with the time, date, and location of that class. Suggestions for invitees include: local human resource office of a recycling plant, can manufacturer or aluminum supplier, city or municipality Department of Public Works solid waste employee, local college or university recycling coordinator, and other state recycling/ environmental organizations such as Keep America Beautiful affiliates.

**Day One**

- Explain to students that they will represent a successful company that makes up a large, international Great Aluminum Can (GAC) Corporate Conglomerate in this simulation of the aluminum can manufacturing industry.
- Distribute *Be an Executive – Student Executive Assignment* and explain that this is a basic syllabus leading up to your presentation at the GAC Annual Corporate Conglomerate Annual Meeting.
- First, have a brief discussion using the *Life Cycle of the Aluminum Can* and *Aluminum Processing Diagram* overheads to explore the aluminum can closed-loop recycling process, where aluminum metal comes from, if it is from a renewable source, benefits of recycling, the role of recycling, etc.
- Review the concepts of sustainability. The lesson plan *Sustainability in Business* goes into detail about these concepts. Recap this lesson plan with students, if you haven't already done so.
- Ask students to get into groups of 4. These became the 8 business groups of the corporate conglomerate.
- Assign each group one of the eight GAC companies within the Corporate Conglomerate. Explain that students will attend the GAC Corporation Conglormerate Annual Meeting as executives of their respected companies and summarize their business' forward-thinking business plan, how the company will interface with others in a corporate conglomerate, share successes, discuss choices based on economics, technology, data and market dynamics while considering the 3 Es (economic, environment, and social equity) of sustainability resulting in quality, customer-desired products.
- Inform students that because of the number of processes required in the production of aluminum and class time constraints, alumina refining, primary smelting, re-melting of UBC and ingot-casting steps in the production of aluminum have been combined within Boxed

Up Bauxite Co. Students will be running their company within one large industrial complex owned by corporate. Each Boxed Up Bauxite Co. executive should become familiar with the entire company's process, but specialize in a particular stage of the process for the GAC Corporate Conglomerate Annual Meeting presentation.

- Distribute the *Be an Executive – Student Backgrounder* and review.
- Hand-out the appropriate *Be an Executive – Company Profile* for each business entity along with *Be an Executive – Company Profile Worksheet*. The Waste Place – Landfill & Incinerate Company also should receive a copy of *Landfill Methane Partners and Projects Received EPA Awards* or the website link. **www.gradingandexcavation.com/mw_0705_methane.html**.
- All students should become familiar with their company's business. Students should take the information from their *Be an Executive – Company Profile* and *Be an Executive – Student Backgrounder* and summarize it on the *Be an Executive – Company Profile Worksheet*.
- Hand out the *GAC Corporate Conglomerate Annual Meeting Schedule* to each student and explain that there will be three parts to the conference:
    1. **Introduction:** Evaluate each company's sustainability practices and opportunities to reduce its carbon footprint.
    2. **Round Table Discussions:** Get to know your corporate partners and identify synergies to minimize impact on the world around us and empower responsibility.
    3. **Presentations:** Present with visuals to the annual meeting on your company's future 3 Es sustainability endeavors, synergies with other corporate companies, successes and forward-thinking business plans.
- If you have completed any lessons prior to this lesson, encourage students to use the information and ideas from previous hand-outs and activities — especially on what makes companies sustainable and successful.
- Distribute copies of *Running a Successful Company: Ten Rules that Worked for Me* for executive business management insight.

**Day Two**

- Welcome students to the second day of the GAC Corporate Conglomerate Preparation for the Annual Meeting and tell them that they will participate in Round Table Discussions today. The goal is to learn about other companies within the corporate conglomerate and their contribution to the creation of the aluminum beverage can.
- Ask students to take their *Be an Executive – Company Profile Worksheets* with them as they participate in the Round Table Discussions for reference.
- Set the classroom up so that there will be four meeting areas, each large enough for eight students.
- Hand out a copy of the *Be an Executive – Round Table Discussion Notes* to each student. Explain that this is to be a dynamic exchange where each of the companies in the GAC Corporate Conglomerate will provide a brief overview of what their company does prior to exchanging ideas and successes on implemented innovative environmental initiatives. Remind them to note ideas their company can glean to help lessen its environmental footprint and how to implement throughout the entire corporation. Identify synergies (where companies may overlap and could possibly save time, money, and help the environment by collaborating). Work to find possible corporate partnerships and plausible other environmental initiatives that would be worthy of testing or purchasing to increase sustainability within their company, the corporation, the community, and globally.

- Tell students they will have 15 minutes for their Round Table Discussions before reconvening with their own company for a brief 10-minute recap. Before the class ends, they will meet for a final class wrap up.
- Ask students if there are any questions and then instruct them to split up into four groups, with at least one representative from each company.
- After 10 minutes, tell students to begin wrapping up, to gather their materials, and to move seats so that they are now with the rest of the members of their own company.
- Inform students they will have 10 minutes to share with their company the information they learned about the other corporate companies and future sustainable (the 3 Es) endeavors, including possible partner synergies, ideas for their company, corporate, community, and global environmental stewardship.
- Then briefly review the company profiles and information as a class, asking students to share what they learned, ideas they had about partnerships as well as sustainability.
- Use the *Be an Executive – Company Profiles Teacher Key* to make sure all key points are addressed and add any new ideas the students suggest.
- Before class ends, pass out the *Student Executive Assignment* to each student and tell students that they have one more part to complete, a 4-minute professional class presentation with display board visuals from the information they have gathered. This will be their company's presentation to the GAC Corporate Conglomerate's Annual Meeting of stakeholders. The report should include a brief company profile, the company's current expectations, forward-thinking projections, success stories, assumptions, and analyses based on economics, technology, data and market dynamics, experience, historical trends, current conditions, future developments, and sustainability goals resulting in quality, customer-desired products.
- Students should be prepared for a 4-minute follow-up question-and-answer session by fellow classmates who will be role playing as environmentalists, stockholders, media, investment brokers, and the community.
- Hand out the *Be an Executive – Three Questions Your Company Anticipates after the GAC Corporate Annual Meeting Presentation*. Each company is to submit three questions they think they will be asked at the beginning of the next class. You may want to ask the students to mark the question that they hope will not be asked of the ones submitted.
- Distribute the *Be an Executive – GAC Corporate Conglomerate Annual Meeting Presentation Guidelines*. Review the assignment and presentation expectations with the class. Once the guidelines have been reviewed and any student questions have been answered, give the students the remaining class time to begin their preparations.

**Day Three**

- Start the class by setting the scene for the presentations and introduce those likely to be in attendance at the GAC Corporate Annual Meeting. Attendees will include reporters, industry investment analysts, stockholders, environmentalists, community leaders, and other stakeholders. The teacher, Conglomerate CEO, is expecting professional and informative presentations. If you invited guests from the community, introduce and welcome them at this point.
- Collect each company's *Be an Executive – Three Questions Your Company Anticipates after the GAC Corporate Conglomerate Annual Meeting Presentation* and review before the student's annual meeting presentation.

## TEACHER TIP

Have the students mark the question that they hope will not be asked and see if the student presentation addresses the issue. If not, then you may want to ask or use for discussion later.

- Pass out the *Be an Executive – Student Recommendations Sheets* and instruct students to take notes during the presentations. Students should record any questions, ideas, and differences of opinion generated by the presenters in their respective presentations.
- Have student companies and the Corporate Conglomerate present one at a time. Remind them to keep their presentations to 4 minutes, and that they should be sure to turn in their visual display, with their names on the back, after their presentation.
- Students not involved in the current company's presentation are to role play as reporters, investment analysts, stockholders, environmentalists, or members of the community during the 4-minute question-and-answer period to the presenters after the company's presentation. Students are to identify the role they are playing before asking their questions. Warning: hecklers may be present.
- At the completion of all presentations, allow students to discuss the options suggested by each company and see if they can identify any similar themes throughout the presentations, and what other sustainable development ideas should be integrated at the corporate level or piloted among corporate entities.
- Invite guests to comment on the presentations or provide industry insight.
- If you choose, you may then award one company the GAC Corporate Conglomerate Company of the Year Award for an exceptional job. Guests could determine the winner. (Free Al the Can awards are available by contacting the Aluminum Can Council at 202.232.4677 or emailing requests to jday@cancentral.com.)

## Assessment:

- Completion of required student sheets and assignments
- Completed professional presentation adhering to guidelines
- Insightful or probing sustainability questions posed to presenters verbally or recorded on *Be an Executive – Student Recommendations Sheet*
- Visual display
- Three questions the group anticipates will be asked by the audience during the presentation question-and-answer session
- Interactive participation and negotiation, evaluate data including market dynamics, communication skills, understanding of subject area, and leadership

### TEACHER TIP
### Add Another Day

Extend this lesson to a four-day activity. On Day 2, increase the Round Table discussions and business entity meeting by 5 minutes and conduct your recap of what they have learned about the other corporate companies and future sustainable endeavors. Distribute the *Be an Executive – Student Executive Assignment* for students read before the next class.

On Day 3, open with a discussion of the annual meeting presentation, its format, presentation expectations, and answer any questions. Distribute the *Be an Executive – Three Questions Your Company Anticipates after the GAC Corporate Annual Meeting Presentation*. Students would then have the remainder of the class to team and create a dynamic, polished presentation including colorful, professional-looking visual aids. Encourage executives to collaborate sustainable practices for their business plans among corporate conglomerate companies. Day 4 will be reserved for presentation activities from what was to have been Day 3 in this lesson.

## Extensions:

- **Be an Executive** has encouraged students to gain valuable information regarding the can industry and its suppliers. Have students join their respective Corporate Conglomerate companies and select a New York Stock Exchange (NYSE) traded company that represents their industry segment for a class investment activity. During the next two weeks, students are to follow the stock, national and international news, and monitor the company's website for leads or insight regarding their stock's performance. The Corporate Conglomerate will be responsible for calculating the transaction value of each of its company's 100 shares of common stock, its sale price, and any additional (value of stock splits or dividends) events that occurred during the two-week period. Each company and the Corporate Conglomerate is to report to the class regarding stock selection and performance.

  The New York Stock Exchange and Lifetime Learning Systems offer free *Stock Market Savvy: Investing for Your Future* lesson plans and classroom charts that would complement this extension at **http://www.nyse.com/pdfs/TG_Mech.pdf**.
- Research ways bauxite and alumina refining, aluminum production, and packaging are investing in the future with plants, new technology, energy, and GHG efficiency. Can manufacturers and aluminum suppliers website links are available at **www.cancentral.com** and at **www.aluminum.org**. Both websites offer resource links to government, publications, and international websites. A **Resources** section can be found at the conclusion of this curriculum.

# LESSON 3 BE AN EXECUTIVE

## Teacher Background Information

In 1965, aluminum cans were first introduced and by 1985, the aluminum can was the most popular beverage package in any market. The aluminum can was easily integrated into the package market because of its ductility (ability to be molded), its support of carbonated pressure, its light weight and its resistance to corrosion. Perhaps the most critical element in the aluminum can's success was its recycling value. Aluminum can recycling excelled economically in its competition with steel because of the efficiencies aluminum cans realized by using recycled materials instead of costly and non-renewable virgin aluminum ore. Aluminum can recycling became common and responded to the growing concerns of environmentally-conscious consumers about the depletion of natural resources and the consequences of what was being called "a throwaway society." The opportunity to market the all-aluminum can as recyclable and environmentally friendly led to its growing acceptance as a product package. In late 1960s and early 1970s, both the steel and aluminum industry came to realize the importance of recycling their impact on the environment. As environmental awareness developed, manufacturers began to recognize the economics of recycling — namely lower costs from using less material and energy.

**As Americans celebrated their first Earth Day in 1970, aluminum companies and can makers began to create a nationwide recycling infrastructure of buy-back centers.** In 1972, 1.2 billion aluminum cans were recycled as recycling became a way of life. In 1997, aluminum can collection topped 66.8 billion aluminum cans. Over the years, the aluminum can has come to be known as the most recyclable, valuable, and recycled beverage package with over 50% of cans recycled annually for the past 20 years, diverting 1.5 billion pounds of aluminum annually from landfills. Aluminum can recycling is a billion-dollar business, employing thousands in one of the world's most successful environmental enterprises. Consumers have earned more than 10 billion dollars by recycling aluminum cans. Cans are easy to recycle via 8,659 curbside recycling programs.

**Aluminum ore, called bauxite, is mined, then refined and smelted to produce virgin aluminum metal.** After this processing, the melted aluminum is cast into large ingots and rolled into coils. These coils weigh around 25,000 pounds and are distributed to various manufacturing plants worldwide. The coils then go into the production phase to become aluminum beverage cans. From the can manufacturer, the cans are

**The opportunity to market the all-aluminum can as recyclable and environmentally friendly led to its growing acceptance as a product package.**

shipped to the bottler who fills the can with beverage, seals the can with the lid, packages the cans, and ships to retailers for sale to consumers. More detailed information on the processes and production of aluminum beverage cans is provided in the Teacher Background Information found on page 75 of *Talkin' Trash with ABCs Curriculum* found at **www.cancentral.com**.

**Environmental awareness, economics, and social equity are the 3 Es of sustainability that are used to help businesses evaluate practices and products.** Corporate sustainability is not new to can manufacturers and aluminum suppliers in their business systems. The industry has proactively found ways and remains committed to reducing our environmental footprint while providing a safe and healthy environment for a diverse workforce.

For example:

- Metal lightweighting programs have reduced the weight of an aluminum beverage can and end by more than 40% since 1970.
- Recycling aluminum cans, manufacturing scrap, and other materials has been practiced for decades.
- Improved energy efficiency, weight reduction, and recycling have reduced the greenhouse gas production to Kyoto Protocol levels or better.

Today, the can industry is energetically embracing sustainability as part of its local and global strategy.

**Aluminum beverage cans are made from a non-renewable natural resource, but aluminum is actually the third most abundant element in the Earth's crust, after oxygen and silicon.** The element Aluminum (Al) makes up 10% of the Earth's crust. Aluminum is non-renewable because it cannot be grown or replaced in an economically useful amount of time the way that wood from trees or soybeans can be grown. As common as the element aluminum is, the form of aluminum we are so familiar with was not isolated and identified as a metal until 1808 by Sir Humphry Davy. At one time, aluminum metal was more valuable than gold because aluminum was so rare, making it a perfect example of supply dictating value. The reason for this late discovery is that aluminum does not exist naturally in its pure metallic state, due to its highly reactive nature. This means aluminum reacts with oxygen and other elements to form aluminum oxides and hydroxides. The most economically important form of an aluminum hydroxide is the aluminum ore, called bauxite.[1]

**Aluminum is one of the most reusable commodities available, particularly when recycled.** That is because aluminum is 100% recyclable and can be recycled endlessly with no inherent degradation in properties. Two very commonly recycled materials, paper and plastic, are limited in the number of times they can be recycled. In paper, the fibers and quality eventually degrade to a non-reusable degree. The molecular structure of the PET polymer changes, which is why PET is recycled into other products, such as fiber fill rather than a true closed-loop recycling process of the aluminum can. In the seconds it takes to throw a can away instead of recycling, a useable resource is going to waste, along with the opportunity to save 95% of the energy, effluents and emissions by recycling it, rather than creating the aluminum from raw materials. The economies of the aluminum can

[1] http://www.world-aluminum.org/production/mining/geology.html

**Improved energy efficiency, weight reduction, and recycling have reduced the greenhouse gas production to Kyoto Protocol levels or better**

are incredibly valuable; the industry estimates that, in the United States, nearly 50 billion aluminum cans are thrown away annually; that's $800 million annually being buried in American landfills or incinerated.[2] There are many reasons and theories about the motivating factors affecting our population's recycling habits. Some reasons to recycle include to reduce waste, get money back, it's easy, feel good, help the environment, conserve natural resources, save energy, it's convenient (gets picked up curbside), provides jobs to local recyclers, raises money for school, charity or a special project, family recycles, school recycles, and my friends all recycle. Some reasons professed for not recycling include: the perception that it is too much work or inconvenient; people may not think about it when disposing of their cans; skepticism on the aluminum actually getting recycled; don't get any money for it; old cans can be messy, sticky, smelly, and sharp; people don't believe in saving the environment or lessening their carbon footprint; consumers don't believe there's a shortage of aluminum; citizens don't think energy or natural resources are saved or need to be saved; and individuals do not believe recycling saves them any money or derive any personal benefit. (See *Do You Recycle? – Student Survey* in this curriculum.)

**Businesses use different methods to examine motivating factors of their consumers when they are developing and marketing products, and these same factors can be helpful in evaluating other behavior-determining factors.** One analysis method is by type of incentive. Incentives are an economic concept that helps determine how and why consumers make decisions on purchases and behaviors based on motivating rewards for their actions. Incentives may be divided into two categories: monetary incentives and non-monetary incentives. Examples of monetary incentives include getting paid for something, getting something of value in return, and to reduce cost and/or taxes. Examples of non-monetary incentives include it's a popular or trendy thing to do or have, peer pressure, to feel good, or to help someone or something, like the environment.

**Exciting advanced technology is being teamed with collaborative research and development between industry, government, and academia transforming the way aluminum is made and boosting U.S. competitiveness.** In 1996, the U.S. aluminum industry formed a partnership with the U.S. Department of Energy's Office of Industrial Technologies through the Industries of the Future process. Goals were set and progress is being made toward major breakthroughs in smelting technology, such as more energy efficient combustion burners for smelting furnaces, new techniques for the purification of molten aluminum, and processes to lower costs and boost productivity. These advances will lead to achievements of economic, energy and environmental goals. The aluminum industry is committed and working toward energy-efficiency goals. Smelting is a priority area with its high energy use (15 kWh per kilogram of aluminum produced). Achievement of industry's 2020 goals for primary aluminum production will:

- Increase the energy efficiency of smelting by 25 to 30%.
- Reduce operating costs by as much as 10%.
- Eventually reduce greenhouse gas emissions by up to 8 million metric tons (carbon equivalent) assuming full market penetration.*



[2] http://www.recycle.alcan.com/NR/rdonlyres/ECB89725-DBA1-4643-B1A1-6AA8CA17295D/0/WasteAgeArticle.pdf

**Aluminum—Industry of the Future, Office of Industrial Technologies; Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, DOE/GO-102001-1153, February 2001, www.oit.doe.gov/aluminum*

Encourage students to explore aluminum suppliers (Rio Tinto Alcan, Alcoa Inc., ARCO Aluminum, Novelis Corporation) and aluminum can manufacturers (Ball Corporation, Metal Container Corporation, and Rexam Beverage Can Americas) websites for the latest news and exciting developments in improved energy-efficiency technologies and substantial savings in greenhouse emissions. A link to these websites is available at **www.aluminum.org** and at **www.cancentral.com** under the heading "About CMI" and then clicking on "Member Products." Helpful industry publications, allied organizations, and government websites also can be accessed via resource links. An extensive resource section concludes this *CANS: Infinitely Recyclable* curriculum.

Students may find the following government links and representative international organizations helpful in researching sustainable opportunities for their forward-thinking business plans.

- U.S. Environmental Protection Agency Office of Solid Waste (**www.epa.gov/epaoswer/**) and its Resource Conservation Challenge (**www.epa.gov/epaoswer/osw/conserve/partners.htm**)
- Department of Energy (**www.energy.gov/**)
- The International Council on Mining and Metals (ICMM) (**www.icmm.com**)
- World Business Council for Sustainable Development (WBCSD) (**www.wbcsd.org**)
- United Nations Global Compact (**www.unglobalcompact.org/index.html**)
- Transparency International (**www.transparency.org/**)
- Extractive Industries Transparency Initiative (EITI) (**http://eitransparency.org/**)
- Voluntary Principles on Security and Human Rights (**http://www.voluntaryprinciples.org/**)

## GAC Corporate Conglomerate Annual Meeting Presentation Guidelines

When working with your company to prepare your GAC Corporate Conglomerate Annual Meeting presentation, please be sure to consider and include the following elements:

1. Evaluate your company's sustainable business practices or potential ones. Also suggest possible extensions to other companies within the Corporate Conglomerate, or suggest opportunities to the entire conglomerate that have the potential to reduce costs, enhance competitiveness, and increase sustainability (3 Es).

2. Examine research and development opportunities, purchasing options, community empowerment, etc. for improved energy and natural resource conservation, reduced environmental impact, and community livelihood.

3. Express intended ways to minimize the negative impact company operations may have on the environment through environmental commitment, pollution prevention, reduction in use of natural resources, recycling efforts, technology, innovation, and continuous assessment.

4. Address the significance of recycling for your company, incentives/reasons for recycling, and ways to stimulate the community to recycle more.

5. Increase the company's positive impact on the *social equity*. How do you plan to make strides in nurturing human resources, providing educational opportunities, improve health and safety performance, earn employee respect, and see that each employee has the ability to succeed within the company?

6. Utilize provided background information and ideas gathered at the Round Table Discussions, and then creatively incorporate the data into your presentation and reinforce through displays or other visual aids such as charts, posters, and support material.

7. Build unity among audience stakeholders with positive answers to questions that might be asked by the audience (environmentalists, stockholders, reporters, investment brokers, and the community) following the presentation. This could help reduce "heckler" interference if your stakeholder meeting is a continuous one.

# LESSON 3 BE AN EXECUTIVE

## Student Backgrounder

Aluminum is made from a plentiful material found in the earth's crust. It occurs naturally in a mineral called bauxite ($Al_2O_3.2H_2O$). Most bauxite is mined overseas (Brazil, Australia, Russia, Greece, and Jamaica) and shipped to the United States for processing. The aluminum in bauxite is formed when the material is refined to remove impurities. Bauxite under the Bayer process removes impurities usually containing oxides of iron and silicon ($Fe_2O_3$, $SiO_2$) and produces a fine, white powder called alumina or aluminum oxide. Boxed Up Bauxite Co. refines the alumina further using the Hall-Heroult's process. A continuous electric current is applied to the alumina powder ($Al_2O_3$), separating the aluminum from the oxygen, creating pure aluminum. Once the aluminum has been separated from the oxygen, small amounts of other metals are added to the molten aluminum to add strength and corrosion resistance as specified by the can and end manufacturers. The molten metal is cast into ingots or blocks, which are then rolled into long sheets and coiled by Coils R Us. The aluminum is then sent to Cannery Row, Inc. and Can Endos manufacturing plants.[3] Can manufacturers create the can bodies and ends and ship them to the bottler. The aluminum beverage can is actually two pieces. The bottler, in turn, fills the can, crimps on its end, packages the cans for retail sale, and ships to the retailer.

Boxed Up Bauxite Co. is also a secondary processor of metal produced from scrap shipped from Coils R Us, Cannery Row, Inc., Can Endos and of used aluminum beverage cans received from Al's Recycling Center and The Waste Place. The post-consumer cans must be clean and dry for the re-melt process. The two most important sheet ingot variables controlled by Boxed Up Bauxite Co. are chemistry and metal cleanliness. This includes removing contaminates such as plastic, dirt and gravel, moisture, steel, batteries, and lead, which can jeopardize the melting operation, including the safety of workers. The contaminates can also cause an entire re-melt to be rejected and landfilled rather than recycled. Contaminants are separated from the metal through visual inspection, magnetic separation, air current, or vibrating screens. Today, about 50% of the beverage can is made from post-consumer recycled aluminum cans. The Used Beverage Can (UBC), along with manufactuing scrap, is sent to a shredder where the cans are hammered into quarter inch shreds before being de-coated (removing of the paint and coating material), transferred to a furnace, and heated to 1450° F. From this point, the molten metal is processed into ingots, perhaps adding some of the virgin aluminum to the mix, and then rolled into sheets and coiled. The aluminum beverage can is 100% recyclable indefinitely with no inherent degradation of properties, and the industry desires all cans be recycled.

Currently, the aluminum beverage can has the highest recycling rate of any beverage container at 52%, with about half the can comprised of post-consumer UBCs. By recycling beverage cans, the public has the opportunity to simultaneously make a positive contribution to cleaner air, energy efficiency, conservation of natural resources, and reduced landfill use. The aluminum can is the only packaging material that more than covers the cost of collection and re-processing for itself. It also helps subsidize the collection of other recyclable materials.

[3] This section has been adapted from William J. Forsythe's "Two Piece Aluminum Can and End Manufacture," 1996.

# LESSON 3 BE AN EXECUTIVE

TEACHER KEY

## Company Profile Teacher Key

| Company Name, Goal, and Natural Resource usage | Possible Partnership Ideas | Sustainability Efforts Current & Possible Future Ideas |
|---|---|---|
| **MINING CO.**<br>Deposits of bauxite ore are mined overseas (Brazil, Australia, Russia, Greece, and Jamaica) and shipped to the United States for refining and processing.<br>Works with Boxed Up Bauxite Co., Coils R Us, Cannery Row, Inc. and Can Endos regarding supply; The Waste Place – Landfill & Incinerate for MSW disposal, Al's Recycling Center for UBC recycling, and Corporate Conglomerate for leadership direction. | ***Possible answers might include:***<br>Partner with Al's Recycling Center to sell any collected metallic content from emissions equipment for recycling. | Located overseas<br><br>***Possible answers might include:***<br>• Achieve ISO 9002 Quality Accreditation, ISO 14001 Environmental Management Certification.<br>• Fifth year of no lost work-time injuries.<br>• Work-related employee training and education tests demonstrate employees at national education levels or above. |
| **BOXED UP BAUXITE CO.**<br>*(Responsible for refining alumina, primary smelting, re-melting, and ingot casting)*<br><br>Refines bauxite into quality feedstock for aluminum smelters. Alumina is derived through the Bayer process. The aluminum oxide is then reduced to aluminum metal using the Hall-Heroult process, melted, and cast into ingots. Works closely with<br><br>*continued next page* | ***Possible answers might include:***<br>Partner with the local university applied research lab to develop a process that would reduce the steps from smelting, casting and rolling, and associated energy requirements. Involve corporate conglomerate companies, all stakeholders, as part<br><br>*continued next page* | Located in the U.S., employs U.S. citizens<br><br>***Possible answers might include:***<br>• Current energy usage is high, but technology may change that, in the future will work toward changing this, as well as reducing overall waste.<br>• Supports "sister city's" local community (where the bauxite is mined).<br>• Work with the Department of Energy to make greater gains in reducing energy consumption.<br>• Set performance target goals.<br><br>*continued next page* |

| | | |
|---|---|---|
| Coils R Us on desired alloys on the can and end manufacturer specifications; bauxite supplier the Mining Co.; quality and quantity of used beverage cans from Al's Recycling Center and The Waste in Place for its municipal solid waste removal, and Corporate Conglomerate for leadership direction. | of your UBC performance rating system. Quality should improve, and it is an opportunity to increase recycled content in beverage cans. Another advantage is open communication channels for when issues arise. | • Identify technological barriers, then collaborate with industry, government, and academia to resolve.<br>• Continue ergonomic studies to improve the design of work stations.<br>• Establish a Best Suppliers and Producers Award because quality counts.<br>• Postmeltable-specification manual on website because contamination is a big deal.<br>• Provide suppliers a code and post their ratings on the website.<br>• Work with academia to develop a closed-loop water system for rolling mill to reduce water consumption by at least 90%. |
| **COILS R US**<br>Rolls aluminum metal ingots into long sheets and then into coils. The coils are shipped to parent company-owned Cannery Row, Inc. and Can Endos. | ***Possible answers might include:***<br>Coordinate a backhaul of coil protective materials after delivery of new coils to Coils R Us. Have Al's Recycling Center arrange coil delivery to Cannery Row, Inc. and Can Endos as the truck picks up corporate conglomerate companies used aluminum cans. Benefits include no empty loads, better utilization of time, and energy savings. | Located in the U.S., employs U.S. citizens<br><br>***Possible answers might include:***<br>• Current energy usage is high, but technology may change that, in the future, will work toward changing this, as well as reducing overall waste.<br>• 25% of energy for rolling comes from solar panels.<br>• Some excess metal is donated to local art schools. |
| **CANNERY ROW, INC.**<br>Forms through extrusion the can's body that is sold to the bottler. (The ends are manufactured by Can Endos.) Receives coils from Coils R Us and sends scrap manufacturing aluminum and recycled cans to Al's Recycling Center. Works closely with Al's Recycling Center regarding UBC stock and increasing recycled content in cans, Boxed Up Bauxite Co. and Coils R Us for aluminum that meets their | ***Possible answers might include:***<br>Coordinate with our customer, the bottler, so can manufacturing facility is adjacent to their filling lines. Ideally, the conveyor belt will seamlessly move the can bodies from one company's doorway to the next. | Located in the U.S., employs U.S. citizens<br><br>***Possible answers might include:***<br>• Have begun budgeting for renewable energy-saving technology.<br>• Encourage coil manufacturers to increase recycled content proportion in can body stock.<br>• Reduce the use of agents used in the can manufacturing process resulting in reduction in waste water and treatment requirements. |
| *continued next page* | *continued next page* | *continued next page* |

| | | |
|---|---|---|
| specifications. Works with the Mining Co. for supply as well as The Waste Place – Landfill & Incinerate for removal of MSW and Corporate Conglomerate for leadership. | | • Capture and reuse waste water after processing in a closed-loop cycle.<br>• Substitution of water-based lacquers for solvent-based lacquers.<br>• Introduction of vegetable-based emulsified lubrication oils.<br>• Reduce the weight of the aluminum can through new technology and advanced design techniques.<br>• Lighter cans impact transportation costs, amount of fuel used, impact on roads, lower emissions. |
| **CAN ENDOS**<br>Casts the shape of aluminum coils received from Coils R Us into ends for beverage cans sold to bottlers. Receives coils from Coils R Us and sends scrap manufacturing aluminum and recycled cans to Al's Recycling Center. Works closely with Al's Recycling Center regarding UBC stock and increasing recycled content in cans, Boxed Up Bauxite Co. and Coils R Us for aluminum that meets their specifications. Works with the Mining Co. for supply as well as The Waste Place – Landfill & Incinerate for removal of MSW and Corporate Conglomerate for leadership. | ***Possible answers might include:***<br>Partner with the your U.S. Corporate Conglomerate companies, their employees, U.S. Postal Service, and Al's Recycling Center for the recycling of all paper products including mail, newspapers, telephone directories, Kraft paper sleeves used to transport can ends, etc. to be recycled into Fridge Packs or 24-can tray packaging for cans. | Located in the U.S., employs U.S. citizens<br><br>***Possible answers might include:***<br>• Necking in of the body of the can allows for a smaller, lighter weight end—conserving resources and netting more ends per pound of aluminum.<br>• Campaign to encourage recycling of whole cans, not just tabs.<br>• Encourage coil manufacturers to increase recycled content proportion in can body stock.<br>• Reduce the use of agents used in the can manufacturing process resulting in reduction in waste water and treatment requirements.<br>• Substitution of water-based lacquers for solvent-based lacquers.<br>• Introduction of vegetable-based emulsified lubrication oils.<br>• Reduce the weight of the aluminum can through new technology and advanced design techniques. |
| **THE WASTE PLACE – LANDFILL & INCINERATE**<br>Collects and handles municipal solid waste from The Mining Co., Boxed Up Bauxite Co., Coils R Us, Al's Recycling Center, Cannery Row, Inc., Can Endos, and Corporate Conglomerate. | ***Possible answers might include:***<br>• Partner with the local government office of recycling for a pilot program to see if larger recycling bins would increase recycling and lessen landfill waste. (**www.recyclecurbside.org**) | Located in the U.S., employs U.S. citizens<br><br>***Possible answers might include:***<br>• Working toward capturing the methane gas produced in the landfills and converting it to energy.<br>• Reducing what is incinerated and increasing collection of what can be recycled. |
| *continued next page* | *continued next page* | *continued next page* |

| | | |
|---|---|---|
| Some aluminum UBC is recovered at the landfill and then sent to Al's Recycling Center, the rest is landfilled or incinerated. | • Partner with all Corporate Conglomerate companies to turn their waste into energy to run their operations. | • Initiate a compost program for yard and food waste and distribute the mulch back to the community for gardening and landscaping.<br>• Join with Al's Recycling Center to host E-cycle and hazardous waste collection days.<br>• Survey waste being landfilled for other recycling options and existing markets.<br>• Start a volunteer adopt-a-mile program<br>• Offer waste audits to businesses and residential customers.<br>• Build a landfill gas-to-energy facility to capture the methane gas to fuel engines or turbines to generate electricity for corporate partners, local hospitals, and schools.<br>• Invite schools to visit the landfill to learn firsthand about the workings of a landfill, how the layers are compressed, and how leachate ponds work. |
| **AL'S RECYCLING CENTER**<br>Accommodates the expanding recycling needs of local community. Collects, processes, and bales post-consumer used beverage cans (UBC) from Mining Co., Boxed Up Bauxite, Cannery Row, Inc., Can Endos, The Waste Place – Landfill & Incinerate, and the Corporate Conglomerate. Also collects, processes, and bales aluminum manufacturing scrap from Coils R Us, Can Endos and Cannery Row, Inc. UBCs and manufacturing scrap are sold to Boxed Up Bauxite Co. for use as secondary scrap for aluminum beverage cans. Works with Cannery Row, Inc., Can Endos, Coils R Us, and Boxed Up Bauxite Co. regarding quality and supply. | ***Possible answers might include:***<br>• Partner with all your U.S. corporate conglomerate company partners for an aluminum can recycling event to set a Guinness World Record.<br>• Work with The Waste Place – Landfill & Incinerate for convenient can drop-off locations for an Aluminum Cans for Burned Children program.<br>• Work with state recycling coordinator for a value of recycling education campaign. | Located in the U.S., employs U.S. citizens<br><br>***Possible answers might include:***<br>• Employees volunteer in local community to increase awareness about recycling and the need for clean, dry cans.<br>• Promote benefits (energy, effluents, emission reduction, cost of mining, and resource conservation) of recycling aluminum cans through education and outreach programs inside the conglomerate and to the community.<br>• Work with local municipality to increase recycling participation through the use of larger curbside bins, placement of recycling bins in parks, at sporting events, even gas station/ convenience stores.<br>• Establish a Saturday donation exchange of reusable items at the recycling center. |

*continued next page* *continued next page* *continued next page*

| | | |
|---|---|---|
| Looks to Corporate Conglomerate for leadership direction. | | • Invest in alternative fuel and hybrid trucks to transport the cans.<br>• Host contests rewarding the groups that recycle the most or bring in the cleanest, driest UBC.<br>• Get the mayor involved in the U.S. Conference of Mayors and Novelis City Wide Challenge (**http://usmayors.org/mwma/**).<br>• Promote keeping the tabs on the cans for safety and to increase the pounds being recycled — cans weigh more when tabs are left attached.<br>• Rally citizens to a new celebrity status — the Canniest — and set a new world record by recycling the most UBC per capita in the country and then the world.<br>• Expand aluminum can collection efforts to the local community for a steady supply of UBC and raise the can's recycled content to 90% from 50%.<br>• 15% of employees are now certified in Project Wild and volunteer an average of 20 hours per year training the trainer or teaching in schools. |
| **CORPORATE CONGLOMERATE**<br>Oversees the operations of all its companies with the goal to be the best company in the world for our customers, shareholders, communities, and people, and in turn, helps them create their own success. Work to continuously eliminate waste, reduce the use of natural resources, to improve the cost, quality, and speed of the manufacturing and business process, enabling sustainable, profitable growth. Enhance the quality and benefits of our products throughout their life cycle, especially through increased recycling. To do this,<br>*continued next page* | ***Possible answers might include:***<br>• Join EPA's WasteWise program to reduce and recycle MSW (**www.epa.gov/wastewise**).<br>• Continue your commitment to host countries and communities, respecting their laws and customs, and provide annual reports on long-term sustainable development.<br>• Maintain high standards of corporate governance, accountability, and responsibility with the community, government,<br>*continued next page* | International in scope<br><br>***Possible answers might include:***<br>• Organization learning across all companies.<br>• Engage in continuous sustainable leadership from the top to the bottom for all conglomerate companies.<br>• Implement risk management in decision-making process.<br>• Benchmark resource efficiency and convey progress.<br>• Continuously invest in the future and be mindful of markets and opportunities.<br>• Convey that sustainable programs can add financial value to stockholders.<br>• Buy renewable energy certificates to reduce the environmental footprint.<br>*continued next page* |

| | | |
|---|---|---|
| all transactions need to be open, honest, filled with integrity and respect. Safety for the individual and the environment is promoted and protected. Foster innovative product, procedures, and equipment and service and technological solutions initiated. Establish challenging objectives and targets to continually improve the effectiveness of our management systems where new ideas are allowed to flourish. | customers, within the corporation, and employees.<br>• For America Recycles Day (November 15), host a company-wide aluminum can recycling drive with all proceeds going to local Habitat for Humanity programs (**http://www.aluminum.org/Content/NavigationMenu/NewsStatistics/CansForHabitatorg/AboutCansforHabitat/default.htm**). | • Require energy efficiency improvements across the board and establish an ongoing taskforce to identify new opportunities.<br>• Maximize use of renewable fuels from motor fleet to facility operations.<br>• Set policy to compost food discards and yard waste for use to enrich soil, suppress plant diseases and pests, instead of chemical fertilizers.<br>• Company reflects the diversity of the world and benefits from the integration of a range of languages, cultures, races, religions, know-how, and business practices.<br>• Utilized its knowledge and experience and translated it into business best practices worldwide.<br>• Set metrics and develop targets for comprehensive sustainability principles and continuous improvement. |

**TEACHER TIP**

To add space to the Corporate Conglomerate Annual Meeting, arrange for several students to stage a brief minute-long disruption of perhaps a take over bid before being ushered out by security.

# LESSON 3 BE AN EXECUTIVE

TEACHER KEY

## Overall Sustainability Efforts Applicable to all Companies

- Manage to reduce total recordable injuries by 25% each year
- Being recognized as global leaders of excellence in everything companies do and everywhere they operate. (*Fortune Magazine*'s annual survey of "green giants")
- Zero work-related injuries
- Healthy workforce initiatives
- Workforce reflective of the diversity of the community
- Set targets and metrics reflective of continuous improvement
- Active engagement and community partnerships
- Allow best practices sharing
- Identify several projects aimed at reducing water use
- Operate without environmental non-compliance incidents
- Establish an advisory group, including upper management, and work with community organizations, government leaders, and citizens to achieve understanding and cooperation foster economic growth, environmental protection, and minimize their carbon footprint
- Contribute to healthier, safer, and more sustainable communities everywhere company operates
- Volunteer in community
- Create safe and sustainable products
- Increase aluminum recycling
- Meet the needs of current and future generations through efficient resource use
- Practice cleaner production to reduce environmental emissions/impacts accountability and governance
- Deliver net long-term benefits to our shareholders, employees, customers, suppliers, and communities where companies operate
- Strive for continuous improvement engagement at all levels
- Annual performance reviews
- Maintain strong balance sheet
- Respect for people and employees
- Integrate economic, social, and environmental aspects throughout the business
- Environmental impact minimization by setting and meeting goals
- Environmental regulation compliance or better
- Education and outreach programs
- Innovation and technology
- Sustainable consumption
- Resource efficiency
- Maximize opportunities to improve quality, competitiveness, and efficiency
- Respect for the individual and promote equal opportunity for his/her success

# LESSON 3 BE AN EXECUTIVE

## Running a Successful Company: Ten Rules that Worked for Me

Source: *Sam Walton*
**http://dfll.fudan.edu.cn/College%20English/DocFile/Second/new/0402-0406/Online%20Assignments/BK2Unit2reading.doc**

A whole lot has changed about the retailing business in the forty-seven years we've been in it, including some of my theories. We've changed our minds about some significant things along the way and adopted some new principles, particularly about the concept of partnership in a corporation. But most of the values and the rules and the techniques we've relied on have stayed the same the whole way. Some of them are such simple commonsense old favorites that they hardly seem worth mentioning.

This isn't the first time that I've been asked to come up with a list of rules for success, but it is the first time I've actually sat down and done it. I'm glad I did because it's been a revealing exercise for me. I do seem to have a couple of dozen things that I've singled out at one time or another as the "key" to the whole thing. One I don't even have on my list is "work hard." If you don't know that already, or you're not willing to do it, you probably won't be going far enough to need my list anyway. And another I didn't include on the list is the idea of building a team. If you want to build an enterprise of any size at all, it almost goes without saying that you absolutely must create a team of people who work together and give real meaning to that overused word "teamwork." To me, that's more the goal of the whole thing, rather than some way to get there.

I believe in always having goals, and always setting them high. I can certainly tell you that the folks at Wal-Mart have always had goals in front of them. In fact, we have sometimes built real scoreboards on the stage at Saturday morning meetings.

One more thing, if you're really looking for my advice here, trying to get something serious out of this exercise I put myself through, remember: These rules are not in any way intended to be the Ten Commandments of Business. They are some rules that worked for me. But I always prided myself on breaking everybody else's rules, and I always favored the mavericks who challenged my rules. I may have fought them all the way, but I respected them, and, in the end, I listened to them a lot more closely than I did the pack who always agreed with everything I said. So pay special attention to Rule 10, and if you interpret it in the right spirit — as it applies to you — it could mean simply: Break All the Rules.

For what they're worth, here they are. Sam's Rules for Building a Business:

**RULE 1:** COMMIT to your business. Believe in it more than anybody else. I think I overcame every single one of my personal shortcomings by the sheer passion I brought to my work. I don't know if you're born with this kind of passion, or if you can learn it. But I do know you need it. If you love your work, you'll be out there every

day trying to do it the best you possibly can, and pretty soon everybody around will catch the passion from you — like a fever.

**RULE 2:** SHARE your profits with all your associates, and treat them as partners. In turn, they will treat you as a partner, and together you will all perform beyond your wildest expectations. Remain a corporation and retain control if you like, but behave as a servant leader in a partnership. Encourage your associates to hold a stake in the company. Offer discounted stock, and grant them stock for their retirement. It's the single best thing we ever did.

**RULE 3:** MOTIVATE your partners. Money and ownership alone aren't enough. Constantly, day by day, think of new and more interesting ways to motivate and challenge your partners. Set high goals, encourage competition, and then keep score. Make bets with outrageous payoffs. If things get stale, cross-pollinate; have managers switch jobs with one another to stay challenged. Keep everybody guessing as to what your next trick is going to be. Don't become too predictable.

**RULE 4:** COMMUNICATE everything you possibly can to your partners. The more they know, the more they'll understand. The more they understand, the more they'll care. Once they care, there's no stopping them. If you don't trust your associates to know what's going on, they'll know you don't really consider them partners. Information is power, and the gain you get from empowering your associates more than offsets the risk of informing your competitors.

**RULE 5:** APPRECIATE everything your associates do for the business. A paycheck and a stock option will buy one kind of loyalty. But all of us like to be told how much somebody appreciates what we do for them. We like to hear it often, and especially when we have done something we're really proud of. Nothing else can quite substitute for a few well-chosen, well-timed, sincere words of praise. They're absolutely free — and worth a fortune.

**RULE 6:** CELEBRATE your successes. Find some humor in your failures. Don't take yourself too seriously. Loosen up, and everybody around you will loosen up. Have fun. Show enthusiasm — always. When all else fails, put on a costume and sing a silly song. Then make everybody else sing with you. Don't do a hula on Wall Street like I did. Think up your own stunt. All of this is more important, and more fun, than you think, and it really fools the competition. "Why should we take those cornballs at Wal-Mart seriously?"

**RULE 7:** LISTEN to everyone in your company. And figure out ways to get them talking. The folks on the front lines — the ones who actually talk to the customer — are the only ones who really know what's going on out there. You'd better find out what they know. This really is what total quality is all about. To push responsibility down in your organization, and to force good ideas to bubble up within it, you must listen to what your associates are trying to tell you.

**RULE 8:** EXCEED your customers' expectations. If you do, they'll come back over and over. Give them what they want — and a little more. Let them know you appreciate them. Fix all your mistakes, and don't make excuses — apologize. Stand behind everything you do. The two most important words I ever wrote were on that first Wal-Mart sign: "Satisfaction Guaranteed." They're still up there, and they have made all the difference.

**RULE 9:** CONTROL your expenses better than your competition. This is where you can always find the competitive advantage. For twenty-five years running, long before Wal-Mart was known as the nation's largest retailer, we ranked number one in our industry for the lowest ratio of expenses to sales. You can make a lot of different mistakes and still recover if you run an efficient operation. Or you can be brilliant and still go out of business if you're too inefficient.

**RULE 10:** SWIM upstream. Go the other way. Ignore the conventional wisdom. If

everybody else is doing it one way, there's a good chance you can find your niche by going in exactly the opposite direction. But be prepared for a lot of folks to wave you down and tell you you're headed the wrong way. I guess in all my years, what I heard more often than anything was: a town of less than a 50,000-person population cannot support a discount store for very long.

Those are some pretty ordinary rules, some would say even simplistic. The hard part, the real challenge, is to constantly figure out ways to execute them. You can't just keep doing what works one time, because everything around you is always changing. To succeed, you have to stay out in front of that change.

# LESSON 3
# BE AN EXECUTIVE

## Aluminum Processing Diagram

Diagram A - Aluminum Industry Flow Diagram

*Source: U.S. Energy Requirements for Aluminum Production: Historical Perspective, Theoretical Limits, and New Opportunities prepared by BCS Inc. for U.S. Department of Energy, February 2005 available in its entirety online at: http://www.eere.energy.gov/industry/aluminum/pdfs/al_theoretical.pdf*

# LESSON 3
# BE AN EXECUTIVE

## Life Cycle of the Aluminum Can

*Source: Novelis*

# LESSON 3 BE AN EXECUTIVE

## Company Profile
## BOXED UP BAUXITE CO.

Names: _____

**Company's Mission:** To provide our valued customers with world-class performance in product design, delivery and capability through the use of innovative technology, teamwork, integrity, accountability, environmental consciousness, and rapid response to changing needs in a global economy. Daily operations include creating high quality aluminum from bauxite using the Bayer and Hall-Heroult processes and the reclamation of used beverage can (UBC) scrap, which is refined for sale in an ecological and sustainable way.

**STUDENT/TEACHER NOTE:**
Because of the number of processes required in the production of aluminum and class-period time constraints, alumina refining, primary smelting, re-melting of UBC, and ingot casting steps in the production of aluminum have been combined within Boxed Up Bauxite Co. Student executives will be running their company within one large industrial complex owned by the Corporate Conglomerate. It is suggested that each Boxed Up Bauxite Co. student executive become familiar with the entire company's process, but specialize in a particular stage for the GAC Corporate Conglomerate Annual Meeting presentation.

## A. Alumina Refining Background

1. **The Bayer Process:** The aluminum in bauxite is extracted when the material is refined to remove impurities. The first step in refining bauxite from the mined grade is using the Bayer process. Bauxite is ground in giant crushers and then mixed in autoclaves, combined with caustic soda, lime, and steam to produce a sodium aluminate solution. Impurities remaining in a solid state are filtered or settled out of the solution, and alumina hydrate is precipitated out of the mixture. The "red mud" is inert and mostly composed of iron oxide, silicon, and titanium which are washed to recover the chemical products with the remainder layered at a site prepared for this purpose. Alcoa has developed a treatment process that involves mixing bauxite residue with carbon dioxide to lock up large volumes of $CO_2$ that would have been released to the atmosphere. Another benefit is that its pH level is reduced to that found naturally in alkaline soils, which can be used for road base, building materials, or to improve soil. Alcoa plans to share the technology with the aluminum industry. (For more information on this and other exciting industry developments toward long term sustainability go to **www.cancentral.com** and link to aluminum supplier websites,

www.cleantech.com/; www.aluminum.org.) The aluminum hydrate is calcined to remove moisture and drive off the boned water which removes impurities ($Fe_2O_3$, $SiO_2$). The caustic soda solution is returned to the autoclaves to be reused. Produced is a fine, white powder called alumina or aluminum oxide ($Al_2O_3$).

2. **The Hall-Heroult Process:** The second step in the refining of aluminum is via the Hall-Heroult process because aluminum is electropositive. This electrolysis process was discovered in 1886 and made large-scale production of aluminum economically feasible. A continuous electric current is applied to the alumina powder separating the aluminum from the oxygen. Gases, solids, and electrolytes are controlled by various treatment processes and efficiency of emission control equipment is checked regularly. At this stage, any necessary metallurgy requirements, the addition of small amounts of other metals to increase strength and provide corrosion resistance to the final product, specified by the can and end manufacturers are made. The high-quality aluminum molten metal is poured into large rectangular molds, cooled, and hardened to form ingots or slabs that can be up to 30 feet long and weighing 32,000 pounds. The ingots are sold to Coils R Us. (To learn more about the aluminum smelting process, go to http://www.alcoa.com/global/en/about_alcoa/pdf/Smeltingpaper.pdf)

Of the electricity consumed by the aluminum industry in smelting, over 50% is hydro-generated and not a source of greenhouse gases.

**Hall-Heroult Process Energy Advances Continue**

- Computers assess various current operating variables so that the voltage in the pot is always the best for prevailing conditions
- Improvements in bath chemistry to lower both the smelting temperature and heat losses and to increase the efficiency of the use of electrical current
- Improve insulation to reduce heat losses
- Improved baking technology for carbon anodes
- Reduced carbon anode consumption per kilogram of aluminum produced

Source: http://www.alcoa.com/global/en/about_alcoa/pdf/Smeltingpaper.pdf

## B. UBC Reclamation

Consider the energy used in the manufacturing of virgin aluminum as an environmental energy investment that can be returned endlessly as the can continues to be recycled. The energy required to recycle the metal is only 5% of that used to produce aluminum from raw materials.

Background on secondary processing (reclamation): Boxed Up Bauxite Co. purchases **post-consumer** used aluminum beverage cans from Al's Recycling Center. Recycled aluminum is an important source of raw material. Approximately 30% of Boxed Up Bauxite Company's metal input comes from recycled material, supplementing the purchase of primary metal and proving added sourcing flexibility. Another advantage of recycled aluminum is that it requires only about 10% of the capital equipment compared with primary aluminum.

The purchased aluminum UBCs have undergone visual inspection, magnetic separation, air current, or vibrating screens to remove contaminants from the metal. The clean, dry UBC is received at your loading dock in **biscuits** (compact bales) where it is again scrutinized for contamination and moisture. The UBC is de-baled and passed through an air knife to remove any plastic, paper, foil, or heavy metal object contamination and screened in the vibrating conveyor to remove

## Company Profile
# BOXED UP BAUXITE CO.

any additional small dirt or dust that could damage the equipment or endanger worker safety. Contamination is always a concern and the industry has established guidelines as do most companies to assure quality. Paper, plastic, and wood can alter the temperature and plastic and rubber can turn into a fuel source capable of creating a fire and shut down the de-coating furnace.

Shredder hammers turn the UBC into quarter -inch shreds before being **de-coated** (removing of the paint and coating material), transferred to a melting furnace, and heated to 1450˚F. The high temperatures destroy chemical compounds and bacteria. Aluminum oxide, called **dross**, floats to the top of the molten bath. Salt flux is added to separate the molten metal from the dross. Other contaminants in the metal will rise to the surface and mix with the dross. Every pound of dirt creates two pounds of dross. The dross is removed and sent out for further processing to reclaim any remaining entrapped aluminum — about half of the dross. This recovery process adds to the cost of the recycling process. The molten metal is transferred to the ingot casting area where final alloy adjustments to can manufacturer specifications are made. Some virgin aluminum may be added to the molten metal before being processed into ingots. The high-quality, molten-potted aluminum is poured into large rectangular molds, cooled, and hardened to form ingots that can be up to 30-feet long and weigh 32,000 pounds.

Today's aluminum beverage can is made from about 50% post-consumer, recycled aluminum cans. More recycled aluminum cans would be even better since using recycled aluminum saves 95% of the energy required to produce it from virgin materials, also saving 95% of the potential emissions, such as greenhouse gases. Recycling aluminum helps conserve natural resources such as bauxite and water. The recycling rate of aluminum cans is 52%, wasting 48 billion beverage cans a year. Aluminum cans have value — recyclers earn almost $1 billion a year.

The can manufacturing scrap metal from Coils R Us, Cannery Row, Inc., and Can Endos is added during smelting. Aluminum is 100% recyclable and turning a can into a can endlessly is **closed-loop recycling** at its best!

### Work with:

The Mining Co. is your source for imported bauxite; Al's Recycling Center your primary supplier of clean, dry, used beverage cans (UBC) and The Waste Place – Landfill & Incinerate for cans placed in MSW stream; and Coils R Us, Cannery Row, Inc., and Can Endos for aluminum scrap metal from the manufacturing process; the Corporate Conglomerate governing your company; local and Federal governments; and the community.

### Current efforts to be sustainable:

- Nearly ten years ago, Boxed Up Bauxite Co. initiated a "sister city" program in three international cities where mining for bauxite occurs. Through this program, your company supports the local communities by making regular donations to local schools and healthcare facilities through an employee-match donation program as well as multiple annual drives for books, clothing, and non-perishable foods.
- Since 2004 Boxed Up Bauxite Co. has purchased wind-powered energy that covers half of your energy requirements for the primary casting process (does not include other energy uses, such as power for lights in your plant).
- There are industry standards regarding contamination to which Boxed Up Bauxite Co. strictly adheres. Each year, reclamation

companies that exceed industry standards are awarded. They are presented a challenge trophy along with a banner, an excellence flag for their flag pole, and the company name and date are engraved on the Quality Achievement wall at Boxed Up Bauxite Co. as well as promoted on a website featuring the quality achievers. The awards celebration is advertised in local papers, and the community, media, and elected officials are all invited to take part in the award celebration. Quality at all levels improves and supports performance, integrity, teamwork, and a sense of a job well done by associates.

## Energy Usage and Technology:

The process of secondary casting is one of the lesser energy-intensive processes in the aluminum beverage can manufacturing process. New technology is being developed that could reduce your energy usage to be one of the lowest energy-consumption processes in can manufacturing. New, clean energy sources may enable the industry to meet its energy needs for melting, solidification, and recycling while further minimizing its impact on the environment. The aluminum industry is working with the Department of Energy to identify cost-effective ways to apply advanced energy technologies (combined heat and power (CHP), distributed generation (DG), hydrogen fuel and induction melting using renewable electricity sources) to aluminum processes. Your company has not made investments in this technology yet. You also have non-casting energy requirements such as fuel for transportation of waste collection vehicles, and electricity for plant buildings.

## About Aluminum

| | |
|---|---|
| **Symbol:** | Al |
| **Atomic number:** | 13 |
| **Atomic weight:** | 26.981538(2) |
| **CAS Registry ID:** | 7429-90-5 |
| **Group Number:** | 13 |
| **Group Name:** | none |
| **Period number:** | 3 |
| **Block:** | p-block |
| **Classification:** | metallic |
| **Color:** | silvery |

## Aluminum is…

- Strong and lightweight
- Repeatedly recyclable for environmental sustainability
- Resistant to corrosion
- Good conductor of heat and electricity
- Tough and non-brittle, even at low temperatures
- Easily worked and formed, can be rolled into thin foil
- Safe for use in contact with a wide range of foodstuffs
- Highly reflective of radiant heat
- Highly elastic and shock absorbent
- Receptive to coatings
- Aluminum is attractive

# LESSON 3
# BE AN EXECUTIVE

## Company Profile
## CORPORATE CONGLOMERATE

Names: _____

**Company's Mission:** To provide our valued customers from all the companies within the conglomerate seamless world-class performance in product design, delivery, and capability through the use of innovative technology, teamwork, integrity, accountability, environmental consciousness, and rapidly responsed to their changing needs in a global economy. As a producer and supplier of quality aluminum beverage cans, the company will continue to focus on the sustainable life cycle of the can from mining, recovery, and recycling, and build on our excellent track record of working with communities as a development partner.

## Background

The Corporate Conglomerate oversees the operations of all its companies with the goal to be the best company in the world for our customers, shareholders, and communities, and in turn help them create their own success. We work continuously to eliminate waste, reduce the use of natural resources, improve the quality and speed of manufacturing and business process, enhance the benefits of our products throughout their life cycle, and reduce cost, enabling sustainable, profitable growth. To do this, all transactions need to be open, honest, and filled with integrity and respect.

The aluminum beverage can conglomerate represents a uniquely integrated approach to manufacturing starting with aluminum mining and processing, including recycling operations through the manufacturing of beverage cans for our valued customer, the bottler, and the ultimate consumer. Corporate Conglomerate provides the direction and framework for strategic initiatives and is a staunch proponent of research and development, capital investment in advanced technology leading to corporate efficiency, profitability, and reducing its environmental footprint.

Safety for the individual and the environment is promoted and protected. Corporate companies are focused on the aluminum, its closed-loop recycling process, and its sustainable benefits to our environment and society. Each company works to continuously develop and improve their, and our, environmental performance through goals, tracking, and monitoring. We strive to work together within and reach out to customers and the community to understand each other's needs and objectives. By integrating and collaborating in an "eco-efficienct" manner, less waste and pollution is generated, consumption of resources and impact on nature is reduced, and value is added to the product at each stage

of the manufacturing process.

We believe management of environmental issues and opportunities, health and safety of our workforce, and employees' well being is best done by encouraging ownership at every level of our organization. The Corporate Conglomerate works to assure seamless delivery of each company's product throughout the supply chain to finished cans. It promotes trust, continuous improvement, recognition, production efficiency, energy conservation, cost-effective flow of product, removing waste from waste stream, reducing costs, environmental control, community stewardship, and partnerships among government, academia, and industry to support innovative ideas leading to improved performance, competitiveness, stability and profit.

## Work with:

Mining Co., Boxed Up Bauxite Co., Coils R Us, Cannery Row, Inc., Can Endos, Al's Recycling Center, and The Waste Place – Landfill & Incinerate within the conglomerate as well as our customers and consumers, local and National governments, and the community to assure a bright, sustainable, and productive future.

## Current efforts to be sustainable:

- Work throughout the supply chain to position and incorporate choices such as product design, science and technology, manufacturing process and continuous improvement tools (Lean Manufacturing/SixSigma) to improve supply chain efficiency, reducing product lead times and bringing higher value to customers.

The Corporate Conglomerate strives to follow EPA's integrated waste management four components in order of preference:

- Source reduction (or waste prevention, including reuse of products and on-site (or backyard) composting of yard trimmings;
- Recycling, including off-site (or community) composting;
- Combustion with energy recovery; and
- Disposal through landfilling.*

## Energy usage and technology:

- Work with the Department of Energy Industrial Technologies and the Aluminum Association to develop a technology roadmap to reduce energy use. **http://www.aluminum.org/Content/NavigationMenu/TheIndustry/TechnologyAdvancement/default.htm** and **http://www1.eere.energy.gov/industry/aluminum/pdfs/alum_vision.pdf**

** www.epa.gov/msw/msw99.htm "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2006", November 2007.*

## Company Profile
# AL'S RECYCLING CENTER

Names: _____

**Company's Mission:** To provide our valued customers with world-class performance in product (scrap aluminum), delivery, and capability through the use of innovative technology, teamwork, integrity, accountability, environmental consciousness, and rapid response to changing needs in a global economy. Daily operations include recycling and the collection of as many recyclable, used beverage cans (UBC) and secondary aluminum scrap as possible, process, transport, and sell clean, dry UBC and aluminum scrap in biscuits or bailed form to Boxed Up Bauxite Co. for aluminum for beverage cans.

## Background

Aluminum's compelling advantages over competing materials is its ability to be repeatedly recycled with high recovery rates without loss of quality. Secondary aluminum production offers energy and environmental benefits as it requires only 5% of the energy that is needed to produce primary aluminum and avoids up to 95% of the greenhouse gas emissions associated with primary production. Recycling also reduces the amount of material going into landfills, conserves natural resources such as bauxite and water, plus has a high intrinsic value as a commodity. Recycled aluminum requires only about 10% of the capital equipment compared with primary aluminum. The projected shift in North America toward an increased share of secondary rather than primary aluminum production will consequently improve the aluminum industry's overall energy efficiency. UBCs can be manufactured back into new cans in a "closed-loop" process that can be repeated endlessly. Aluminum UBCs represent an important resource, while reducing the need for mining virgin aluminum, and provides the aluminum industry with added sourcing flexibility. Empty beverage cans can be recycled and back on store shelves in as little as 60 days.

Al's Recycling Center provides covered roll-off containers to each of the Corporate Conglomerate companies and separate roll-offs to Coils R Us, Cannery Row, Inc., Can Endos for can manufacturing scrap. Every two weeks Al's Recycling Center collects the aluminum from the roll-off containers. Each company's UBC is visually inspected for contaminates, moisture tested, weighed, and poundage recycled recorded. Monthly checks are sent to the respective companies based on an agreed-to percentage below the London Metal Exchange rate, less deductions for contamination.

*** Novelis, UBC Specifications and Guidelines, July 2006 (http://www.novelis.com/NR/rdonlyres/72030193-07EB-4408-A5ED-FA28D5CE8EA4/4031/UBCSpecificationsandGuidelinesforNovelisNorthAmeri.pdf)*

Back at the Center, the post-consumer used aluminum beverage cans are processed to remove contaminants from the metal. This is done through manual inspection, magnetic separation, and air current or vibrating screens. Contaminants that are removed such as small dirt or dust could damage processing equipment or endanger worker safety. Paper, plastic, and wood can alter the temperature, and plastic and rubber can turn into a fuel source capable of creating a fire and shut down the de-coating furnace. The clean, dry UBC is then baled into biscuits and sold to re-processor Boxed Up Bauxite Co. Manufacturing aluminum scrap is separately weighed, baled, and sold to the Boxed Up Bauxite Co. for secondary processing as well. Each month the accounting department provides a statement and a check to each company it purchases aluminum scrap from (UBCs and manufacturing scrap).

Before Al's Recycling Center is paid, the aluminum is scrutinized again for contamination by Boxed Up Bauxite Co. The UBC is de-baled and passed through an air knife to remove plastic, paper, foil, or heavy metal object contamination that could damage the equipment or endanger worker safety. Shredder hammers turn the UBC into quarter-inch shreds. The shreds via conveyor pass under a magnetic separator and then to vibrating screens for dirt separation. High moisture causes the dirt to cling to the shreds and clog the screens. A weight belt transports the shreds, controlling the quantity entering the de-coating furnace where paint or coating material is removed. The metal passes over a hot fines screen in the vibrating conveyor to remove any additional small dirt or dust. Then the metal is transferred to a melting furnace. At 1450˚F the cans melt, and aluminum oxide, called dross, floats to the top of the molten bath. Salt flux is added to separate the molten metal from the dross. Other contaminants in the metal will rise to the surface and mix with the dross. Every pound of dirt creates two pounds of dross. The dross is removed and sent out for further processing to reclaim any remaining entrapped aluminum, about half the dross. This recovery process adds to the cost to the recycling process. The molten metal is cast into ingots.

The recycled UBCs and aluminum manufacturing scrap are primarily utilized to produce new quality can sheets. This recycling loop can be repeated endlessly but needs everybody in the supply and consumer chain to keep the cans clean, dry, and contaminant-free. Cannery Row, Inc. and Can Endos depend on Boxed Up Bauxite Co., and Coils R Us for a consistent supply of quality aluminum. Beverage can manufacturers would like to increase the amount of recycled content (nearing 50%) used in can production. An aluminum beverage can be made of 100% recycled content. The demand for UBCs in the production of new aluminum can body stock continues to grow. The aluminum industry's decision to rely on UBC as a primary source of aluminum for can sheet creates a huge demand for high-quality, recycled aluminum cans. It also equates to a long-term market for recyclers, dealers, and processors as long as it is preferred by beverage manufacturers and consumers.

Only post-consumer UBC is calculated in the recycled content percentage. The aluminum industry calculates the aluminum can recycling rate capturing the can at the point of smelt, eliminating the potential for duplicate counting. The secondary production of aluminum saves 95% of the energy required to produce it from virgin materials, also saving 95% of the potential emissions. The recycling rate of aluminum cans is 52%, leaving nearly 48 billion beverage cans a year going to waste. Recyclers earned almost $1 billion a year and could double that amount by recycling.

**According to EPA, the United States recycling industry provides approximately 1.4 million jobs, producing billions of dollars in annual revenues that contribute to the prosperity of our country.**

## Company Profile
# AL'S RECYCLING CENTER

### Work with:
Boxed Up Bauxite Co. to whom you sell your recycled UBC and manufacturing scrap, The Waste Place – Landfill & Incinerate to divert cans placed in MSW stream; Coils R Us, Cannery Row, Inc., and Can Endos for aluminum scrap metal from the manufacturing; Mining Co., Boxed Up Bauxite Co., Coils R Us, Cannery Row, Inc., Can Endos, Corporate Conglomerate for their UBC; Corporate Conglomerate governing your company; the local and Federal governments; and the community.

### Current efforts to be sustainable:
Your company has a strong presence in the local community by working to encourage aluminum beverage can recycling. Employees are asked to volunteer at least three days a year to talk with local community groups, schools, and political leaders about your company and industry's efforts to increase the recycling rate of aluminum cans, as well as to improve the recycling process to make it more efficient and less energy intensive. You also have launched a worker-safety campaign to inform recyclers about what contaminants are harmful to the recycling process. For example, non-aluminum metal that gets put into batches of aluminum beverage cans, such as fishing weights or batteries, will not be shredded by your plant's equipment; instead these hard metal objects get fired out of the shredder, like small and hard UFOs, and can harm employees and equipment at your recycling facility. Another example is that if consumers do not empty their cans completely, too much liquid can reduce the value of the aluminum you collect and recycle, increasing your costs to process the scrap aluminum.

**STUDENT/TEACHER NOTE:**
Not only should Al's Recycling Center executives be trying to increase the number of aluminum beverage cans available for recycling, but they should be looking at ways to help their corporate partners turn waste materials into valuable resources. Working together, we can conserve valuable resources and energy by managing materials more efficiently.

### Environmental Benefits of Recycling One Ton of Aluminum
- Saves 95% of the energy required
- Avoids the emission of about 10 tons of $CO_2$ equivalents
- Reduces the use of natural resources and chemicals
- Eliminates the need for 5 tons of bauxite ore to be mined
- Eliminates the generation of nearly 2 tons of "red mud" byproduct
- Minimizes our overall impact on biodiversity

*Source: Novelis http://www.novelis.com/Internet/en-US/Sustainability/Recycling/default.htm*

## Company Profile
# COILS R US

Names: _____

**Company's Mission:** To provide our valued customers with world-class performance in product design, delivery, and capability through the use of innovative technology, teamwork, integrity, accountability, environmental consciousness, and rapid response to changing needs in a global economy. Daily operations include producing aluminum sheet and coils to the exacting standards required by can manufacturers supportive of an ecological and sustainable future.

## Background:

Cannery Row, Inc. and Can Endos depend on Coils R Us for a consistent supply of high quality aluminum. Your company takes the primary casting of cooled 32,000 pounds ingots and creates flat sheets from which can bodies and ends are made. The ingots are first sent through a scalper, where the surface of the metal is shaved to remove impurities in the metal. These filings, along with other processing scrap, will be recycled for can manufacturing. The ingot is then sent through a series of three rolling mills. A hot rolling known as "Hotline" anneals the sheet to soften and make it less brittle as it transforms the 21" thick ingot into a 3,000 foot long, 1/8" thick coil in about seven minutes. The coil advances to the continuous cold rolling mill where it is cold rolled at speeds up to 60 miles per hour to reduce the metal to its final gauge (hardness and thickness) only a few thousandths of an inch thick. The sheet is trimmed on high-speed slitting equipment. The finished sheet, ranging from 20,000 to 30,000 feet long, 5 to 6 feet wide, and about 0.0108 inches thick, is then rolled into coils typically weighing about 25,000 pounds each. The coils are shipped by truck or train, wrapped with special waterproof materials to control moisture and airborne contaminants and steel strapping onto hardwood pallets, and sold to can manufacturers — Cannery Row, Inc. and Can Endos. The coils will undergo visual inspection for carrier defects, dents, or discoloration. The coil will be visually inspected again for surface defects as the uncoiler feeds the aluminum at the beginning of the can and end-making line before payment is made.

## Work with:

Boxed Up Bauxite Co. from which you purchase your aluminum ingots; Boxed Up Bauxite Co., Cannery Row, Inc. and Can Endos to be certain that sheet and coil meet can manufacturers' specifications; Al's Recycling Center and The Waste Place – Landfill & Incinerate to assure scrap recycled is void of contaminates; Al's

## Company Profile
# COILS R US

Recycling Center for recycling any aluminum scrap as well as used beverage cans; The Waste Place – Landfill & Incinerate for pickup and processing of your municipal solid waste; the Corporate Conglomerate governing your company; local and Federal governments; and the community.

## Current efforts to be sustainable:

Your plant happens to be located in sunny Arizona. Five years ago you made a large capital investment to line the roof of your large plant with solar panels which now supplies 25% of the current energy requirements of the rolling process. With the recent rising costs of energy, the money saved through the use of your plant-generated energy has completely covered the cost of installing the solar panels and now the cost savings from the panels goes to your company's bottom line. You will continue to engage your key stakeholders to help develop even lighterweight cans which are 40% lighter in weight than in the 1970s and increase the recycled content which at 50% contains the most recycled content of any beverage container. Furthermore, your company has made arrangements for some of your minimal aluminum scrap to be sent to regional trade schools where the material is used by art and design students in metalworks and sculptures. Your pallets are returned by your customers for reuse.

# LESSON 3 BE AN EXECUTIVE

## Company Profile
## CANNERY ROW, INC.

Names: _____

**Company's Mission:** To provide our valued customers with world-class performance in beverage can product design, delivery, and capability through the use of innovative technology, teamwork, integrity, accountability, environmental consciousness, and rapid response to changing needs in a global economy. Daily operations induce generating quality beverage **can body** (cylinder of beverage cans) through a drawn and iron process ready for filling by the bottler in an environmentally sustainable manner. Coils of aluminum sheets are cut and shaped to create the can body, including exterior and interior coatings and **lithography** (exterior graphic printing). The ends or lids are manufactured at a separate plant and both are shipped to the bottler or filler.

## Background:

**Aluminum Coils.** The aluminum coils arrive at the can plant from Coils R Us. The coils are visually inspected for shipping damage and again for surface defects, dents, or discoloration when loaded into the uncoiler after the shipping protection — steel bands, the wrapping paper protection from moisture and airborne contaminates — and pallet are removed. The coils are loaded one at a time onto an "uncoiler" — a machine that feeds the aluminum at the beginning of the can-making line.

**Lubricator.** The lubricator applies a thin film of water-soluble lubricant on both sides of the aluminum sheet to allow the metal to flow smoothly over the tooling surfaces and avoid scratching during the can-shaping processes.

**Cupper.** A large, dual-action punch press called a cupping press, with one set of tooling, cuts circular discs from the coil. The punches force the disc through dies to create the cup at speeds up to 250 strokes per minute. A cup approximately 3.625 inch in diameter and 1.25 inch high is formed.

**Bodymakers.** The cups travel by conveyor to the next machine — the bodymaker. At the bodymaker, a press forces each cup through a series of progressively smaller dies to stretch or draw and iron the cup into the familiar can shape. The dome bottom of the can is formed at the end of the stroke to help increase the strength of the container and stackability. A single production line may have up to eight bodymakers to make a total of 2,000 cans per minute.

**Trimmer.** The can moves to the trimmer where it is trimmed to the proper height. All aluminum manufacturing scrap is collected and sold for recycling at Al's Recycling Center. The cans are spot-checked and measured for quality assurance at this point as well as at various stages during the manufacturing process.

## Company Profile
# CANNERY ROW, INC.

**Washer/Oven.** The washer removes the oil that was used to lubricate the can during the cupping and bodymaking processes in preparation for decorating. The lubricant is constantly recirculated through a filter and reused.

**Basecoater/Basecoater Oven.** Depending on the **lithography** (label graphics), the cans are either sprayed with a base coat or conveyed directly to the high-speed printers. If the can goes to the basecoater, a white smooth, high-gloss coating on the outside of the can is applied to enhance the quality of the graphics. This can goes through a hot air oven to dry the white basecoat before transit to the decorator.

**Printer.** The smooth, shiny cans proceed to a printer, where six to eight colors of ink may be applied through a rubber mat simultaneously using an offset printing method. The cans spin around as the lithography is applied for its label. The printed cans are varnished in the decorator. Finally, the cans pass by a bottom coater and receive a coat of varnish on their base and dried at temperatures of 350–400˚F to prevent chipping.

**Internal Coaters/Internal Coater Oven.** The can's inside is coated with an epoxy-based organic protective coating which prevents the beverage from contacting or reacting with the metal in the can body, even though aluminum is a relatively non-reactive material. Both the exterior overvarnish and the interior protective coating are made with water-based materials to prevent harm to the environment. The can is baked in an oven to seal the coating onto the can.

**Die Necker.** The top of the can in now made narrower to end specifications.

**Flanger.** Rolls back the top edge of the can to form a lip used to attach the end to the can after beverage is added by the bottler or filler.

**Camera Inspection.** Finally, all finished cans are tested for leaks. A light tester can find holes smaller than a strand of human hair.

**Palletizer.** The cans are put on pallets (389 cans per layer up to 21 layers high) for immediate shipment to our customer for fill.[4]

## Work with:

Coils R Us from which you obtain your coiled sheet; Boxed Up Bauxite Co. regarding the metallurgy and recycled content; Al's Recycling Center and The Waste Place – Landfill & Incinerate to assure scrap void of contaminates and a steady stream of used aluminum cans for stock; Al's Recycling Center for purchasing and recycling of your production scrap and staff's used beverage cans; the Corporate Conglomerate governing your company; local and Federal governments; and the community.

## Current efforts to be sustainable:

Your company is continuously making improvements to the can design so that fewer resources are needed to create final products. Specifically, aluminum cans have gotten much lighter in weight as manufacturing technology improves. In 1972, one pound of aluminum yielded only 21.75 cans. Today by using less material to make each can, one pound of aluminum makes approximately 34 cans, a 56% improvement.[5] Called "lightweighting," this has saved your company a significant amount of money, and has greatly reduced the amount of natural resources required.

Cannery Row, Inc.'s philosophy goes beyond supplying can bodies to your beverage customer (the bottler), but to provide support for the customer's own innovation activities and enhance the quality and benefits of your products throughout their life cycle. This could be helping to increase recycling along the entire closed-loop recycling process; teaming your R&D department with the others in the



[4] This section has been adapted from William J. Forsythe's "Two Piece Aluminum Can and End Manufacture," 1996.
[5] *Talkin' Trash with Aluminum Beverage Cans*, page 25.

Corporate Conglomerate and the bottler to foster innovation and improvement measures, enhance performance procedures, equipment efficiencies, and promotion of the beverage can as the environmental package. Even more directly is your need for collaboration with the beverage company and Can Endos, including education workshops, plant tours, and knowledge exchange; discussion of new technological developments; and joint continuous improvement efforts to engineer the lightest weight can possible to deliver its product to the consumer using the least amount of resources; sharing knowledge of pertinent legislative and regulatory action that could affect your business, etc.

# LESSON 3
# BE AN EXECUTIVE

## Company Profile
## CAN ENDOS

Names: _____

**Company's Mission:** To provide our valued customers with world-class performance in can end product design, delivery and, capability through the use of innovative technology, teamwork, integrity, accountability, environmental consciousness, and rapid response to changing needs in a global economy. Daily operation includes forming quality can ends in an environmentally-sustainable manner. Coils of aluminum from Coils R Us are cut and shaped to make the can ends and sold to the bottler. After the can is filled with beverage, the lid is secured on to the can and shipped to the retailer.

## Background

The can end manufacturing process begins with coils of aluminum supplied by Coils R Us via commercial carrier. The first step is to visually check for shipping damage, stage them in the warehouse, and then store them. When needed, the shipping protection — steel bands, the wrapping paper protection from moistures and airborne contaminates — and pallets are removed. The coil is checked for general appearance, burred edges, enamel voids, rolled-in metal, and other visual defects as it is loaded onto an "uncoiler" at the beginning of the can end-making line. The lubricator deposits a thin film of water-soluble lubricant on both sides of the aluminum sheet and allows the metal to flow smoothly over the tooling surfaces during the **shape-casting** process. The coil is fed through a series of rollers that guide the coil into the shell press. The shell press is a double action vertical press which cuts out a circular blank and then draws that blank into an uncurled shell. Some shell presses can produce 4,400 shells per minute. The uncurled shell is conveyed to the curlers where a set of stationary rails set a precise distance from a rotating ring. The uncurled shell enters the area between the spinning ring and the stationary rail. The shell is rolled between the rotating and stationary surfaces. As the gap between them decreases, the lower, cut edge of the shell is curled inward. When the correct diameter specifications are reached, the rail opens and centrifugal force throws the shell out of the curler where it travels to end liners. The curling operation provides the channel for the sealing compound which facilitates proper sealing of the end as it is double-seamed to the can body by the bottler/filler. A beverage can is actually only two pieces. Sealing compound is applied to the curled channel of the compound liner machine and the ends are carried by flat vacuum belt for

electronic computerized visual inspection on their way to a hot-air drying oven. The conversion press forms the shell into a finished end by a progression of tooling. A metal belt with circular cutouts holds the end and moves it from station to station within the conversion press. At the same time, the end is moving from station-to-station gaining the finger well, key, scoreline, panel, rivet, and regulatory information, and a tab strip is being fed through the tab die tooling, changing the flat strip of tab stock into the retained tab end. The finished tab quality assurance check and measurement ensure that dimensions and performance standards meet industry and customer criteria. The completed ends are sent to the bagging station where they are counted electronically, stacked into paper tubes called sleeves, stacked on pallets, stretch–warped in plastic to ensure cleanliness, labeled, and shipped to the bottler.[7]

## Work with:

Coils R Us, from which you obtain your coiled sheet meeting your specifications; Boxed Up Bauxite Co. for metallurgy and recycled content; Mining Co., Boxed Up Bauxite Co., Coils R Us regarding supply, Al's Recycling Center, The Waste Place – Landfill & Incinerate, Boxed Up Bauxite Co., Coils R Us, Cannery Row, Inc., and Corporate Conglomerate for clean, dry, post-consumer UBC, and Cannery Row, Inc. for its secondary manufacturing scrap. The Waste Place – Landfill & Incinerate for collecting and processing your municipal solid waste; Corporate Conglomerate governing your company; local and Federal governments; your customer the bottler, and the community.

## Current efforts to be sustainable:

The can ends your company produces have been tapered (decreased in diameter) over time; in fact, the amount of taper on the average aluminum beverage cans results in a savings of raw material (aluminum) of about 15% versus a non-tapered can.[6] Specifically, size 206 can ends weigh 8.12 pounds per thousand ends (including the tabs); size 204 can ends weigh only 6.67 pounds per thousand ends (including the tabs); and the size 202 can ends weigh a mere 6.07 pounds per thousand ends (including tabs).[7] A new can introduced in 1993 with a lid a quarter-inch less in diameter saved manufacturers an estimated $3 per thousand. By necking-in a can to accommodate a smaller end, Can Endos worked closely with Cannery Row, Inc. in creating a lighter weight and necked-in can that conveniently delivers the same 12 ounces of refreshing beverage.

Your company has also recently launched a public service campaign with the National Recycling Coalition to encourage consumers to recycle their entire aluminum beverage can, not just the body or the tab. Free posters were distributed to schools, libraries, and community groups in selected target regions.

*Source: How Products Are Made: Volume 2, Aluminum Beverage Can, (www.madehow.com/Volume-2/Aluminum-Beverage-Can.html)*

[7] This section has been adapted from William J. Forsythe's "Two Piece Aluminum Can and End Manufacture," 1996 and Ball Corporation www.ball.com/page.jsp?page=27.
[6] Wikipedia search for Beverage Can, aluminum, online at http://en.wikipedia.org/wiki/Beverage_can
[7] Can Central http://www.cancentral.com/canc/nontext/lesson4.pdf

## Company Profile

# THE WASTE PLACE – LANDFILL & INCINERATE

Names: _____

**Company's Mission:** To provide the community with world-class performance in landfill design, delivery, effective utilization of resources, recycling, diversion, energy generation, and extension of landfill life, through the use of innovative technology, teamwork, integrity, accountability, environmental consciousness, and rapid response to changing needs in a global economy. Daily operations include collecting, handling, and transporting municipal waste, promoting and increasing recycling, reclaming used beverage cans, and processing municipal waste via landfill or incineration according to safety and environmental regulations in an ecological and sustainable way. Landfilling and incineration are the two main forms of waste disposal used.

**STUDENT/TEACHER NOTE:**
Waste Place executives should be exploring a variety of options such as utilizing methane gas as a productive energy source (**www.epa.gov/landfill/**); increasing aluminum can recovery by building a multi-material recovery facility (MRF) for separation of recyclable commodities, equiping the solid waste incinerators with technology to convert water into steam to fuel heating systems or generate electricity; initiating consumer recycling education campaigns, and making recycling of beverage cans easier with convenient recycling bins (**www.recyclecurbside.org/**); and, using combustion ash as daily cover in landfills and road construction.

## Background

According to EPA's *Municipal Solid Waste (MSW) Generation, Recycling, and Disposal in the United States: Facts and Figures for 2006*, Americans generated about 251 million tons of trash and recycled 82 million tons of materials for a recycling rate. More than 31 million tons (12.5%) of waste were combusted with energy recovery and 138 million tons (55%) were landfilled. Also, the number of MSW landfills has steadily declined over the years from 8,000 in 1988 to 1,754 in 2006 with about the same capacity. However, the average landfill size has increased. Landfilling and incineration rank third and fourth to reduce/reuse and composting in EPA's solid waste management hierarchy. MSW is often considered a renewable power source. The ash produced reduces volume of waste that would have gone to the landfill up to 90% by volume and 75% in weight. Combustion equipment can convert water into steam to fuel heating systems or generated electricity.

Incineration facilities can also remove materials for recycling. Testing ensures that residual ash is non-hazardous before being landfilled. Efforts are underway to reuse the ash. About 10% of the total ash formed in the combustion process is used for beneficial use such as daily cover in landfills and road construction. In the United States there are 88 Waste-to-Energy facilities with a capacity of 98,765 tons per day. (See **www.epa.gov/cleanenergy/muni.htm**.)

Since 1980, the total annual generation of MSW has increased more than 65% to its 2006 level of nearly 251 million tons per year. Americans per capita generate 4.6 pounds per person per day and recycle 1.5 pounds. In 2006 the MSW recycling rates rose to 32.5% (composting included), which was still below the 35% goal set in 2002 and extended to 2008. To continue to encourage Americans to recycle, a new national recycling rate goal of 40% by 2011 has been established by EPA. Containers and packaging (80 million tons or 31.7% of total generation) make up the major portion of solid waste. The recovery of containers and packaging is at 40.2%. High recycling achievers were: 72% corrugated boxes, 63% steel packaging (predominately steel cans), 45% aluminum beverage cans. By volume, beverage containers discarded represent 4.8% of the products discarded in municipal waste stream (glass 3.1%, aluminum 0.5%, and PET 0.4%).

## Specifics about Landfills.

The Waste Place landfill is a carefully designed structure built into the ground in which trash is isolated from the surrounding environment (groundwater, air, and rain). This isolation is accomplished with a bottom liner and daily covering of soil. The Environmental Protection Agency's website states, "Modern landfills are well-engineered facilities that are located, designed, operated, monitored, closed, cared for after closure, cleaned up when necessary, and financed to insure compliance with federal regulations." Below is a summary of a cross section from The Waste Place landfill and ongoing operations. (For a diagram, please see page 163 in *Talkin' Trash* curriculum at **www.cancentral.com**.)

**Bottom Liner System.** The landfill contains a bottom liner (usually of durable, puncture-resistant synthetic plastic 30–100 mils thick or combined with compacted clay soils) which prevents the trash from coming in contact with the outside soil, particularly the groundwater. MSW is compacted into areas called cells which contain only one day's trash.

**Cells (Old and New).** Perhaps the most precious commodity and overriding problem in a landfill is air space. The amount of space is directly related to the capacity and usable life of a landfill. By conserving air space, the useable life of a landfill can be extended. At The Waste Place, a landfill cell is approximately 50 feet long by 50 feet wide by 14 feet high (15.25m x 15.25m x 4.24m). The amount of trash within the cell is 2,500 tons and is compressed at 1,500 pounds per cubic yard. This compression is done by heavy equipment (tractors, bulldozers, rollers, and graders) that go over the mound of trash several times. Once the cell is made, it is covered with 6 inches of soil and compacted further. Cells are arranged in rows and layers of adjoining cells.

**Storm Water Drainage.** It is important to keep the landfill as dry as possible to reduce the amount of leachate. This can be accomplished in two ways:

- Exclude liquids from the solid waste. Solid waste must be tested for liquids before entering the landfill. This is done by passing samples of the waste through standard paint filters. If no liquid comes through the sample after ten minutes, then the trash is accepted into the landfill.
- Keep rainwater out of the landfill. To exclude rainwater, the landfill has a storm drainage system. Plastic drainage pipes and storm liners collect water from areas of the landfill and channel it to drainage ditches surrounding

the landfill's base. The ditches are either concrete or gravel lined and carry water to collection ponds on the side of the landfill. In the collection ponds, suspended soil particles are allowed to settle and the water is tested for leachate chemicals. Once settling has occurred and the water has passed tests, it is then pumped or allowed to flow off-site.

**Leachate Collection System.** No system to exclude water from the landfill is perfect, and water does get into the landfill. The water percolates through the cells and soil in the landfill much like water percolates through ground coffee in a drip coffee maker. As the water percolates through the trash, it picks up contaminants (organic and inorganic chemicals, metals, biological waste products of decomposition) just as water picks up coffee in the coffee maker. This water, with the dissolved contaminants, is called leachate and is typically acidic.

To collect leachate, perforated pipes run throughout the landfill. These pipes then drain into a leachate pipe, which carries leachate to a leachate collection pond. Leachate can be pumped to the collection pond or flow to it by gravity.

The leachate in the pond is tested for pH and acceptable levels of various chemicals (biological and chemical oxygen demands, organic chemicals, calcium, magnesium, iron, sulfate, and chloride) are allowed to settle. After testing the leachate, it must be treated like any other sewage/wastewater; and treatment may occur on-site or off-site. At The Waste Place landfill, the leachate is released to the county's wastewater treatment plant where it is treated and released into the river. Some landfills recirculate the leachate and treat it later. This method reduces the volume of leachate from the landfill, but increases the concentrations of contaminants in the leachate.

**Methane Collection System.** Municipal solid waste landfills are the largest source of human-related methane emissions in the United States, accounting for about 25% of methane emission in 2004. Bacteria in the landfill break down the trash in the absence of oxygen (anaerobic) because the landfill is airtight. A byproduct of this anaerobic breakdown is landfill gas, which contains approximately 50% methane and 50% carbon dioxide with small amounts of nitrogen and oxygen. This presents a hazard because the methane can explode and/or burn. Methane is a very potent greenhouse gas that is a key contributor to global climate change (over 21 times stronger than $CO_2$.) So the landfill gas must be removed. To do this, a series of pipes are embedded within the landfill to collect the gas. In some landfills, this gas is vented or burned.

More recently, it has been recognized that this landfill gas (LFG) represents a renewable energy resource reducing the dependency from other sources such as fossil fuels. Between 60 to 90% of the methane can be extracted from the LFG and used as fuel, depending on system design and effectiveness. The captured methane is destroyed (converted to water and the much less potent $CO_2$ when gas is burned to produce electricity). The sale of the energy helps offset the cost of operating the facility as well as reduce emissions of greenhouse gases. For example at the North Wake County Landfill, Raleigh, North Carolina, a company collects the landfill gas, extracts the methane, and sells it to a nearby chemical company to power its boilers. The extraction system is a split system, meaning that methane gas can go to the boilers and/or the methane flares that burn the gas. The reason for the split system is that the landfill will increase its gas production over time (from

300 cubic feet per minute to 1,250 cubic feet per minute) and exceed the capacity of the boilers at the chemical company. Therefore, the excess gas will have to be burned. At the Live Oak landfill in DeKalb County, Georgia, a public-private partnership will pump methane through a commercial pipeline to provide natural gas to customers in the area. Delaware's renewable energy portfolio standard enacted July, 2006 requires electric suppliers to use renewable energy to generate at least 10% of the electricity they sell by 2018. Collected methane can be compressed to fuel electric generators. For more information visit, **www.epa.gov/lmop/** and **http://media.cleantech.com/274/Delaware-now-generating-power-from-land**).

**Covering of Cap.** As mentioned above, each cell is covered daily with 6 inches of compacted soil. This covering seals the compacted trash from the air and prevents pests (birds, rats, mice, flying insects, etc.) from getting in the trash. This soil takes up quite a bit of space. Because space is a precious commodity, many landfills are experimenting with tarps or spray coverings of paper or cement/paper emulsions. These emulsions can effectively cover trash, but take up only a quarter-inch instead of 6 inches.

When a section of the landfill is finished, it is covered permanently with a polyethylene cap (40 ml). The cap is then covered with a 2-foot layer of compacted soil. The soil is then planted with vegetation to prevent erosion of the soil by rainfall and wind. The vegetation consists of grass and kudzu. No trees, shrubs, or plants with deep penetrating roots are used so that the plant roots do not contact the underlying trash and allow leachate out of the landfill. Efforts are underway to reuse ash from combustion. About 10% of the total ash formed in the combustion process is used for beneficial uses, such as daily cover in landfill and road construction.

Scientists in France have found a commercial application for the bauxite residue including the by-product "Bauxaline," which can be used as a colorant in plastics, cement, rubber floors, ceramics, and paints to larger applications for road construction, artificial reefs, and as a covering to rehabilitate landfill sites. Explore this last option with the Mining Co.

**Groundwater Monitoring.** Groundwater monitoring stations are located at many points surrounding the landfill. These are pipes that are sunk into the groundwater so water can be sampled and tested for the presence of leachate chemicals. The temperature of the groundwater is measured. Because the temperature rises when solid waste decomposes, an increase in groundwater temperature could indicate that leachate is seeping into the groundwater. Also, if the pH of the groundwater becomes acidic, that could indicate seeping leachate.

## Landfill Facts

- The public sector owns two-thirds of the landfills and the private sector owns one-third.
- Nationally, the United States has 20 years of disposal capacity.
- Alaska, Connecticut, Delaware, North Carolina, New Hampshire, and Rhode Island have less than five years of available landfill capacity.
- Landfill capacity is measured in volume (cubic yards). When MSW is placed in a landfill, the solid waste has a density of 1,200 to 1,400 pounds per cubic yard. After settled and degraded, the waste can have a density of 1,700 to 1,900 pounds.
- The average landfill tip fee in 2004 was $34.29 per ton up from $8.20 per ton in 1985. The Northeast had the highest tipping fees at $70.53 per ton.
- Puente Hills Landfill in Whittier, California received more garbage than any other landfill in America in 2005.
- Pontiac Landfill in Pontiac, Illinois has the largest remaining capacity of almost 233 million tons.

*Source: National Solid Wastes Management Association, http://wastec.isproductions.net/webmodules/webarticles/anmviewer asp?a=1127*

*Information for The Waste Place – Landfill & Incinerate adapted from howstuffworks: http://people.howstuffworks.com/landfill.htm/printable*

## Company Profile
# THE WASTE PLACE – LANDFILL & INCINERATE

Your company receives all of the "non-recyclable" waste, excluding construction and demolition debris, sludges, and hazardous industrial waste from each of the companies within the Corporate Conglomerate. Some aluminum metal is recovered and then sent to Al's Recycling Center; the rest is landfilled or incinerated.

According to EPA's *Municipal Solid Waste Generation, Recycling, and Disposal in the United States – 2006 Facts and Figures*, containers and packaging comprised the largest portion of products generated at 31.7% (80 million tons, nondurable good followed at 25.5% (64 million tons) and durable goods at 16% (40 million tons) is the third-largest category.

Of the 251 million tons of products generated in MSW, containers and packaging 39.8% was the highest recovered for recycling (45% of all aluminum cans were recovered, while 63% of steel packaging (mostly cans) were recovered and more than 9% of plastic containers and packaging were recovered). Paper and paperboard containers and packaging were recovered at a rate of 58.8%, 25% of glass containers was recovered, and 9% of plastic containers and packaging was recovered (mostly soft drink, milk and water bottles). By volume, of products generated in the MSW, glass beer and soft drink bottles are 3%; and less than 1% are aluminum beverage cans at 0.6%; and plastic soft drink bottles are 0.4%.

### Work with:

The community; Mining Co., Boxed Up Bauxite Co., Al's Recycling Center, Coils R Us, Cannery Row, Inc.; Can Endos; Corporate Conglomerate's picking up and processing their municipal solid waste; look to the local and Federal governments for compliance and regulation; Corporate Conglomerate for guidance; Boxed Up Bauxite Co., Al Recycling Center, Can Endos, Cannery Row, Inc. for help with encouraging recycling, especially of aluminum beverage cans.

### Energy usage and Technology:

You are not involved with the actual manufacturing of aluminum beverage cans; you simply provide a service for those companies. Your company's primary energy requirements include fuel for transportation of waste collection, vehicles, bulldozers, and front end loaders; and landfill monitoring, baling and compaction equipment; incineration initiation fuel, and electricity or other fuel options to power plant, buildings, transfer stations, and their mechanicals; equipment maintenance, scales, pumps, emission and monitoring equipment; and to light collection areas, parking, other yard areas. Earnestly consider the landfill as an energy resource and explore existing opportunities for energy star energy efficiency. (**http://www.energystar.gov**).

### Current efforts to be sustainable:

- Your company has been researching new opportunities to collect methane gas (created when micro-organisms consume organic waste) from your landfill. This gas can then be converted to energy to fuel engines or turbines to generate electricity and sold, adding to company revenue, as well as providing a use for methane, a greenhouse gas, that would otherwise be released into the atmosphere.
- Expanding collection to include land clearing and green waste into useable products of fuel and mulch. Various screens and different cutting and grinding teeth produce a uniform end product of almost any size and shape, maximizing return on investment. Some systems not only grind tree debris and logs but can grind asphalt shingles and demolition waste.

- Currently studying waste being landfilled to determine what additional recycling opportunities exist, along with a cost-benefit analysis to determine feasibility. Some options being investigated include: expanding commodities accepted for recycling; establishing a single-stream recycling, collection and processing program; coordinating with neighboring communities to plan, site, build, invest, and run a large scale, conveniently located multi-material recovery facility (MRF) with the capacity to handle projected population growth and corresponding solid waste.
- Continue to retrieve aluminum cans from MSW. By recycling one ton of aluminum cans rather than throwing them away conserves more than 207 million BTUs, the equivalent of 36 barrels of oil or 1,655 gallons of gasoline according to U.S. EPA.

# LESSON 3 BE AN EXECUTIVE

## Landfill Methane Partners and Projects Receive EPA Awards

*MSW Management*, May/June 2007
(**www.gradingandexcavation.com/mw_0705_methane.html**)

### New and exciting uses for landfill gas continue to surface.

*By Brian Guzzone, Rachel Goldstein, and Joe Fanjoy*

At the U.S. Environmental Protection Agency's (EPA's) 10th Annual Landfill Methane Outreach Program (LMOP) Conference and Project Expo held this January in Baltimore, the EPA recognized its LMOP Partners for their excellence in landfill-gas-to-energy (LFGTE) project innovation and creativity, their success in promoting LFGTE project development, and the environmental and economic benefits achieved by their projects.

LMOP is a voluntary technical assistance and partnership program that helps businesses and communities reduce methane emissions from landfills by encouraging the recovery and use of landfill gas as a renewable energy resource. "Across the nation, the EPA is helping transform landfill waste into energy wealth," writes Bill Wehrum, acting assistant administrator for the EPA's Office of Air and Radiation in a January

24, 2007, press release. "We are recognizing Partners who have demonstrated superior innovation and environmental achievement in advancing landfill-gas-to-energy projects." The 2006 LMOP award winners include LFGTE projects that are helping to reduce the nation's dependence on fossil fuels, proving the viability of landfill gas as an alternative energy source, and helping to reduce emissions of greenhouse gases.

## LMOP Project of the Year: Fueling the Local Economy

The Board of Commissioners for Jackson County, NC, gave the county's economy a boost by creating the Jackson County Green Energy Park, where landfill gas helps produce biodiesel made from rapeseed grown by local farmers. The gas also provides process heat for a craft center that includes pottery and glass-blowing studios, blacksmith forges, and other uses. "When using local tax dollars to finance a project, you have to find out what works in your community," says Timm Muth, project manager for Jackson County. "You can't build a craft facility anywhere; but here in Jackson County, tourism and recreation are the major industries."

Every minute, 40 cubic feet of landfill gas flows from the Jackson County Landfill to the Jackson County Green Energy Park. The park is believed to be the first site in the world to use landfill gas to fire a blacksmith forge. Using hot water from a landfill gas-fired boiler, Smoky Mountain Biofuels makes biodiesel from rapeseed and from vegetable oil recovered from restaurants. Smoky Mountain Biofuels plans to produce over 1 million gallons of biodiesel in its first year — some of which is sold to Great Smoky Mountains National Park as vehicle fuel for the National Park Service. Heat exchangers mounted on the neighboring blacksmith forges recover enough waste heat to leave the biodiesel refinery with a near-zero energy footprint. Future plans include pottery and glass-blowing studios, retail space, a botanical drying facility, and a greenhouse where the county will grow and propagate landscape plants for county properties.

## LMOP Project of the Year: A Unique Partnership

In Pennsylvania, the Lancaster County Solid Waste Management Authority is committed to renewable energy, and LMOP recognized the authority's 3.2-MW LFGTE project as an LMOP Project of the Year. The project involved a unique partnership of the county, the PPL Corp., and Turkey Hill Dairy.

The authority voluntarily installed 20,000 feet of piping to tie together the collection systems of the co-located Creswell and Frey Farm landfills. The authority sells the gas to PPL Energy Services, which operates an electricity plant that uses Caterpillar engines to generate enough green electricity to power 2,000 homes. Waste heat from the engine exhaust is recovered to produce steam used in the adjacent Turkey Hill Dairy, a producer of ice cream, milk, and tea products. By using steam generated by this combined heat-and-power project, Turkey Hill has reduced the use of diesel fuel in its boilers by 80%, achieving fuel-cost savings and environmental benefits.

The project is helping the county meet its commitment to voluntarily reduce overall greenhouse gas emissions from county solid waste management operations by 6% by 2010. The authority is also the first public environmental services organization to join the Chicago Climate Exchange (CCX), and it sells carbon dioxide offset credits generated by the methane reduction achieved by the landfill gas energy project on the CCX. By selling up to 80,000 metric tons of carbon-dioxide emission offset credits, Lancaster County anticipates up to $300,000 per year in revenues.

## LMOP Project of the Year: Persistence Is the Key

Another innovative project was completed in record time, despite hurdles the project partners faced in the wakes of Hurricanes Rita and Katrina. Renovar, the project developer, sells 1,820 cubic feet per minute of landfill gas collected from the Jefferson Parish Landfill to the West Paterson, NJ-based Cytec Industries, which uses it as the fuel for a process air preheater in a sulfuric-acid regeneration plant. Cytec now has an affordable, reliable, and predictable energy source at a cost savings compared to the market price of natural gas on a per-million-Btu basis. This reduced cost enabled Cytec to offset the cost required to make retrofits to its duct work, gas burners, and control systems in order to utilize landfill gas.

"Perseverance was the key to this project," says Larry Gilbert, cofounder of Renovar Energy Corp. in Midland, TX, referring to the enormous challenges presented after Hurricanes Katrina and Rita. Project construction was due to begin the day after Hurricane Katrina struck the region. Project partners faced impassable streets, no commercial power, gas leaks, and floodwaters, while utilities, workers, and available materials were focused on cleanup and recovery. Despite these daunting obstacles, the project team, led by Renovar, came together to complete the job as planned.

"The current energy crisis is very real to us at Cytec," says Greg Deis of Cytec. "The price of pre-Katrina energy had already resulted in the shutdown of two of our major production units. Burning landfill gas was the chance to take an untapped energy resource in our backyard and do something significant to push back on the cost of energy." Cytec celebrated the project's completion during a February 2006 ribbon-cutting ceremony.

## LMOP Project of the Year: Tapping Landfill Gas

In what is believed to be a first in landfill gas energy history, a major U.S. manufacturer — Jenkins Brick Co. — has located a plant near a landfill for the specific purpose of tapping the valuable landfill gas.

Jenkins Brick has been using clean-burning landfill gas to fuel its Montgomery, AL, brick plant since 1998. Based on the success of this first project, Jenkins decided to site its new plant at a location where it would once again be possible to take advantage of local landfill gas. The new project captures 600 cubic feet per minute of landfill gas from Veolia Environmental Services' Star Ridge Landfill and transports it via a 6.5-mile underground pipeline to Jenkins Brick's new $56 million, state-of-the-art, brick-manufacturing plant in Moody, AL. There, the landfill gas is used as fuel in brick kilns. The new facility is expected to create approximately 55 new jobs. Although incorporating the landfill gas capability to the new plant added $4 million to its capital cost, the company expects to realize significant savings in fuel costs as a result.

"Our years-long cooperation with EPA's LMOP program has provided us with valuable technical expertise as we identify ways to save money — and the environment," writes Mike Jenkins IV, chief executive officer of Jenkins Brick Co., in an EPA news release from October 2006. "In building this innovative facility, our American-owned company shows that it is much more than a brick manufacturer and distributor."

## LMOP Community Partner of the Year

When Atlanta residents and businesses purchase green power, they can thank DeKalb County, GA, for hard work and persistence. The county owns two Caterpillar engines that burn landfill gas from the Seminole Road Landfill to produce electricity that is sold to Georgia Power. The project generates a minimum of 22,500 MWh

per year of electricity, enough to power 3,000 homes.

Development of this project required detailed planning and many meetings with county officials and the community to educate them about the benefits of LFGTE projects and alleviate potential concerns. For several years, county solid waste officials pursued the vision of generating green energy in the county using landfill gas. Billy Malone, an assistant director with the county sanitation division, says he was inspired by the energy, excitement, and available resources he discovered at the 2000 LMOP Conference in Washington, DC. "LMOP was instrumental in encouraging me to move forward with a landfill-gas-to-energy project," says Malone. "LMOP provides a communication network that is invaluable in assisting small communities like DeKalb County in promoting the development and benefits of green energy projects."

Working under limited budgets but armed with persistence, county solid waste officials took on roles usually reserved for project developers. They negotiated a power purchase agreement and successfully obtained construction and operating air permits and procured a design/build/operate contract. Once approvals were obtained, project construction was completed in just seven months.

## LMOP Energy End User Partner of the Year

For BMW Manufacturing Co., one LMOP award-winning landfill-gas-energy project was not enough. With excess landfill gas available and a continued desire to go green, BMW focused its attention on the largest consumer of energy in its Spartanburg, SC-based assembly plant: the paint shop. Working with Dürr Systems, the shop's original designer, BMW converted paint shop equipment to burn landfill gas. In so doing, the facility became the world's first automotive paint shop to integrate the use of landfill gas in such a creative, energy-saving application. This effort earned BMW Manufacturing Co. recognition as LMOP's 2006 Energy End User Partner of the Year.

Today, landfill gas fulfills nearly 70% of the plant's energy requirements, insulating the company from rising and fluctuating natural gas prices. Four turbines generate 4.4 MW, a quarter of the plant's electricity needs, while supplying hot water and much of its heating and cooling needs. The paint shop uses 800 cubic feet per minute of landfill gas in 19 of its 23 oven burners, exceeding original estimates of overall savings and volume of landfill gas used.

Landfill gas is a key component of BMW's corporate commitment to sustainability. BMW bases its decisions on social and ecological considerations, as well as environmental ones. "Using methane gas generated from the nearby landfill to power the factory is an excellent example of sustainability," says Briggs Hamilton, environmental services manager at BMW Manufacturing. "The project allows us to take a previously wasted energy source and use it to generate electricity, which protects the environment and our community through lower emissions."

## LMOP Energy Provider Partner of the Year

With a demonstrated commitment to environmental stewardship, Murray City Power (MCP) in Murray, UT, is continually seeking new environmental opportunities. MCP responded to a proposal from the Salt Lake City/County Landfill Gas Recovery Project and aggressively pursued the entire 3-MW capacity. LMOP named MCP the 2006 Energy Provider Partner of the Year in recognition of its creativity and success.

"Tenacity was the key," says Gary Merrill, general manager of MCP. "This project took a personal and organizational commitment to be good environmental stewards. The landfill-gas-to-energy project is valuable for the community and greater Salt Lake area."

A disappointing initial cost/benefit analysis and a unanimous "no" vote by the City Council sent MCP back to the drawing board. To make the project work economically, MCP developed a creative time-of-use pricing mechanism that proved to be a winner for all parties. The pricing profile establishes seasonal pricing with on-peak and off-peak hour components so that the project's power-supply costs parallel daily and seasonal market pricing, even though the power is delivered on a flat 24-hour, seven-day, year-round basis. The pricing profile achieves financial thresholds for the facility owner, while providing pricing and cash-flow advantages to MCP.

## LMOP State Partner of the Year

Already a leader in economically sustainable solid waste management practices, the Delaware Solid Waste Authority (DSWA) also leads the way in environmental sustainability. As early as 1995, DSWA demonstrated its commitment to excellence in solid waste management when it began collecting landfill gas and selling it for electricity generation. With the addition of two new landfill gas electricity projects, every municipal solid waste landfill in Delaware managed by DSWA now has an LFGTE project. Such leadership earned DSWA LMOP's State Partner of the Year in 1999 and again in 2006.

In 2006, DSWA brought two LFGTE projects online that generate a combined 7.4 MW — enough to meet the annual power needs of over 4,500 homes. Project developer Ameresco Inc. of Framingham, MA, owns and operates the electrical-generating facilities at two DSWA landfills in Kent and Sussex Counties, which include seven GE Jenbacher engines designed to burn landfill gas. The Baltimore-based Constellation Energy Group Inc. signed a contract with DSWA to purchase the power for 10 years. Through this purchase, Constellation is working to achieve the Delaware renewable portfolio standard, which requires power providers to derive 10% of their power from renewable resources by 2019.

"Landfill-gas-to-energy projects are shining examples of how the public and private sectors can come together and make something great happen," says DSWA Chief Executive Officer Pat Canzano, who emphasizes the valuable role of LMOP in bringing together project partners. "There's a tremendous synergy between LMOP and the public and private sectors."

LMOP is pleased to honor its partners and their achievements each year with LMOP Awards. In the face of fluctuating and volatile energy prices, hundreds of businesses and communities across America are seeing the benefits of LFGTE.

Beyond the environmental gains of reducing greenhouse gases and air pollutants, businesses and communities are realizing millions of dollars in cost savings by offsetting fossil fuel purchases. With hundreds of landfills still untapped, LMOP has assisted a growing number of companies and governments across the nation in assessing project opportunities. To encourage the use of landfill gas, LMOP provides software tools, marketing assistance, access to technical experts, and tailored technical services to facilitate development of LFGTE projects.

**Specifically LMOP works to:**

- assess landfills that are viable candidates for project development;
- estimate energy potential from landfills and match the supply to end-user demand;
- conduct preliminary feasibility studies for LFGTE projects;
- facilitate the location of corporate/industrial facilities adjacent to candidate landfills;
- provide technical expertise in the use of landfill gas in boilers and other thermal applications;
- promote the environmental and economic benefits of LFGTE projects.

*Brian Guzzone and Rachel Goldstein are with EPA's Landfill Methane Outreach Program in Washington, DC. Joe Fanjoy is a technical writer for Eastern Research Group at Research Triangle Park in Raleigh, NC.*

# LESSON 3
# BE AN EXECUTIVE

## Company Profile
## MINING CO.

Names: _____

**Company's Mission:** To mine bauxite minerals overseas with world-class performance in delivery and capability through the use of innovative technology, teamwork, integrity, accountability, environmental consciousness, and rapid response to the changing needs of a global economy. Daily operations include bauxite mining, removal of clays, selling and shipping the bauxite to the United States, rehabilitation of the land, and working with the community and local governments to "unearth the infinite value of finite resources" in a sustainable, ecologically friendly way throughout the process.

### Background on Mining:

Since aluminum mining didn't begin until the second century, it is a young industry compared to other mining of metals. Aluminum is made from the most common metal on earth found in the 8% of the earth's crust. It occurs naturally in a mineral called bauxite. Most bauxite is mined overseas (Brazil, Australia, Russia, Greece and Jamaica) and shipped to the United States for processing. In 1998, a typical mine employed about 200 people for each million ton per year of bauxite produced. Mining companies usually offer well-paid jobs, work to establish common objectives through regional development plans and government coordination, match commitment with resources and actions that will enhance the local community. Bauxite mining is accompanied by land rehabilitation including native plants, soil, and water to help the community remain viable following mine closure. Bauxite is generally found in tropical regions with sensitive populations and can bring tremendous improvements to standards of living both in developed and developing regions. Mining has turned into a partnership for national governments who want the development for social and economic reasons as well as its citizens.

Eighty percent of world bauxite production is from large blanket-type deposits from surface mines, with the rest mainly from Southern Europe and Hungary from underground excavations. Some deposits lay on the surface, while others may be covered by rock and clay, which will need to be loosened into manageable pieces. The pieces of bauxite are then loaded into trucks or rail cars and transported to crushing or washing plants. Two to three tons of bauxite is required to produce one ton of alumina, and two tons of alumina are required to produce one ton of aluminum metal. Unlike the base metal ores, bauxite does not require complex processing, and what is mined is of an acceptable grade. The clay is removed by a combination of washing, wet screening,

## Company Profile
# MINING CO.

cycloning, hand-picking, or sorting before further refining using the Bayer and Hall-Heroult's processes. Bauxite residue (composed of 40% bauxite (red earth) and 60% chemical liquid that is a low-level caustic) is an intrinsic part of the refining process for which the industry is always looking for new and innovative ways to reduce its natural by-product. Scientists in France have found a commercial application for the bauxite residue, including the by-product "Bauxaline," which can be used as a colorant in plastics, cement, rubber floors, ceramics, and paints, to larger applications for road construction, artificial reefs, and as a covering to rehabilitate landfill sites.

### Work with:

The Corporate Conglomerate as its international company with operations in five countries. The Mining Co. interfaces with the local and country's governments; U.S. Federal Government, your operation's community; Boxed Up Bauxite Co. to whom you sell and ship (by boat, train, or truck) to the United States in the most efficient way your mined bauxite can be further processed into ingots for can manufacturing. Coils R Us, Cannery Row and Can Endos are consulted regarding their supply and demand requirements. For example, beverage can sales spike in the summer months so more aluminum is needed in the spring to produce the cans for the soft drink bottler. Communication also occurs with Al's Recycling Center and recycled market conditions. If more aluminum is recycled and container demand remains steady, then there is a possibility that less bauxite may be needed.

### Current efforts to be sustainable:

- Provide tools and training to employees to adopt safe behaviors, on the job and off
- Minimize environmental effects of activities and maximize the benefit of operations to local communities
- Contribute to conservation of biodiversity and integrated approaches to land use planning throughout the mining life cycle

### Energy use and technology:

- Set energy improvement efficiency goals of 2% per year
- Initiated energy audit teams at each location responsible for identifying and implementing energy savings throughout the operation and share progress reports with other audit teams

**According to the National Safety Council, accidental injury remains the number one cause of death in the United States for people under 40 years old. It is the leading cause of death for people of all ages. Nine out of 10 deaths and about two-thirds of disabling injuries suffered by U.S. workers in 2004 occurred off the job.**

## GAC Corporate Conglomerate Annual Meeting Schedule

Name: _____ Company Name: _____

Welcome to the 22nd Annual Great Aluminum Can (GAC) Corporate Conglomerate Annual Meeting. This year's conference theme is Sustainability. We are pleased that you will be joining us this year to share your company's 3 Es business challenges, expectations, market dynamics, and forward-thinking projections for the year and ideas on how GAC companies can partner for successful years ahead.

This year, one company will be awarded the coveted Great Aluminum Can Manufacturing Corporate Company of the Year. The honor will go to the company demonstrating the most dedication and diligence. Good luck!

| Day | Topic | Description |
|---|---|---|
| **Day One** | **Introduction** | **Evaluate Your Own Sustainability**<br>Learn the detailed process of your company, and conduct research to gather information to prepare for the Round Table Discussion. Learn what other companies you depend on, and what companies depend on you and why. Identify areas where you might want to partner with other companies in order to improve efficiency, save money, and be more sustainable. |
| **Day Two** | **Round Table Discussions** | **Get to Know Your Partners and Synergies**<br>Be prepared to share what your company does, and identify areas of possible collaboration. Learn what other companies do, how they work, and what they may be doing that could help your company's sustainability practices. One part of the discussion will focus on the impact of recycling and determining the need and effect of increased recycling. |
| **Day Three** | **Presentations** | **Final Report on Future and Sustainability**<br>Compile the information from the first two sections of the conference to put together a final report on your company's future goals and efforts toward sustainability. Be sure to address the Six Expectations that are listed and the B*e an Executive – Student Executive Assignment* handout, and to have supporting material, data, and visual aids for your presentation. |

## Company Profile Worksheet

Name: _____ Company Name: _____

Use the table below to record key information about your company. These notes will be used later during the Round Table Discussions and Presentations.

| Topic | Notes |
|---|---|
| **Goal**<br>What does your company do? | |
| **Natural Resources**<br>What are the inputs your company uses? | |
| **Energy Usage**<br>Is it significant?<br>Is there room for improvement? | |
| **Partner Companies**<br>What other businesses do you rely on?<br>Who relies on your company? | |
| **Sustainability (3 Es)**<br>Current examples of sustainability efforts. | |
| **Sustainability (3 Es)**<br>Possible future goals and actions toward sustainability. | |

# LESSON 3 BE AN EXECUTIVE

## Round Table Discussion Notes

Use the table below to record key information about the other companies in your industry. Utilize your Company Description to inform other companies about your business. You do not need to complete the information regarding your company.

| Company Name & Description | Possible Corporate Partnership Ideas | Sustainability (3 Es) Efforts |
|---|---|---|
| Mining Co. | | |
| Boxed Up Bauxite Co. | | |
| Coils R Us | | |
| Cannery Row, Inc. | | |
| Can Endos | | |
| The Waste Place – Landfill & Incinerate | | |
| Al's Recycling Center | | |
| Corporate Conglomerate | | |

## Student Executive Assignment

You and your team are now the Executives for an Aluminum Can Manufacturing Company within a Corporate Conglomerate. On _____, (date of presentations) your team must present to the attendees of the GAC Corporate Conglomerate Annual Meeting a vision of the future of your company and ways to improve the sustainable performance. You also will create a large, professional visual display (three-fold style) to use during the presentation and turn it in with your names on the back after the presentation. The Mission Statement of your company is:

> *"Always strive to provide a top-quality product and service and use economic resources wisely by continuously assessing, researching, and developing opportunities for improved quality and cost savings, while minimizing negative impacts on the environment and always maintaining and increasing the positive impact on social equity."*

As Executives, you will be expected to address as many of the following as possible:

1. Evaluate your company's business and suggest potential corporate partnerships or corporate-wide implementation that may reduce your company's costs and enhance sustainability efforts.
2. Briefly, provide an update on areas of environmental action including research and development opportunities for improved energy and natural resource savings and efficiencies.
3. Describe ways your company is minimizing its carbon footprint.
4. Discuss ways your company is increasing its positive impact on the social equity.
5. Reflect on the company's community leadership and global implications.
6. Since employees are one of your greatest assets, describe your company's health and safety and human resource commitment.

Be sure to utilize all provided background information, as well as information gathered at the Round Table Discussions and other methods, to create visual aids to assist in communicating your company's business philosophy.

Checklist to be successful with this presentation:

1. Address the six expectations listed above.
2. Utilize the data from previous lessons and use supporting material.
3. Place information, such as graphs, quotes, pictures, and goals in a clear and creative manner on a display board.
4. All group members are to work as a team.
5. Communicate effectively during presentation, being professional, succinct and informative.

## Three Questions Your Company Anticipates after the GAC Corporate Conglomerate Annual Meeting Presentation

Name: _____ Company Name: _____

| Questions |
| --- |
| 1. |
| 2. |
| 3. |

## Student Recommendations Sheet

During the class GAC Corporate Conglomerate Annual Meeting presentations, fill in the table below reflective of the other companies' presentations. Your own company may be left blank.

| Company Name | GAC Corporate Conglomerate Annual Meeting Presentation Recommendations | Questions, Ideas, Difference of Opinion |
|---|---|---|
| Mining Co. | | |
| Boxed Up Bauxite Co. | | |
| Coils R Us | | |
| Cannery Row, Inc. | | |
| Can Endos | | |
| The Waste Place – Landfill & Incinerate | | |
| Al's Recycling Center | | |
| Corporate Conglomerate | | |

# LESSON 3 BE AN EXECUTIVE

EXTENSION

## Interested in Becoming an Executive?

**Packaging Education Possibilities**
Explore the many exciting opportunities awaiting you in the packaging field by visiting college and university packaging schools and exploring their course offerings. An estimated $100 billion worth of materials are used for packaging each year in the United States. Interested in conducting research to solve packaging problems and develop new technology for industry application, or learning about brand positioning and market and supply chain demands? Packaging education could be a perfect fit.

## University and College Programs with a Packaging Interest

| University | Program & Description | Web Address (URL) |
|---|---|---|
| Michigan State University | School of Packaging | packaging.msu.edu |
| California Polytechnic State Institute | Industrial Technology Dept. | ime.calpoly.edu |
| Clemson University | Dept. of Packaging Sci. | clemson.edu/pkgsci/ |
| Fashion Institute of Technology | | fitnyc.edu/html/dynamic.html |
| Ferris State University | | ferris.edu |
| Indiana State University | Dept. of Industrial & Mechanical Technology | web.indstate.edu/imt |
| Mohawk College | | mohawkc.on.ca/dept/pmt/index.html |
| North Carolina State University | | ncsu.edu |
| Pratt University | Communication & Packaging Design | pratt.edu |
| Purdue University | | purdue.edu |
| Rochester Institute of Technology | Dept. of Packaging Technology | rit.edu |

| University | Program & Description | Web Address (IRL) |
|---|---|---|
| Rutgers – The State Univ. of New Jersey | Center for Packaging Sci. & Engineering | ruinfo.rutgers.edu/external/views/view1.asp?serial=590 |
| San Jose University | Dept. of Nutr. & Food Sci. | engr.sjsu.edu/ise/pkg/ |
| School of Military Packaging Technology | | smpt.apg.army.mil |
| Sinclair Comm. College | Quality Engineering Technol. | sinclair.edu |
| University of Akron | | uakron.edu |
| University of Florida | Institute of Food & Agricultural Science | ifas.ufl.edu |
| University of Illinois | Dept. of Food Sci., Human Nutr. & Agricultural Engineering | age.uiuc.edu |
| University of Massachusetts at Lowell | Dept. of Plastics Engineering | plastics.caeds.eng.uml.edu |
| University of Missouri-Rolla | Dept. of Engineering Management | campus.umr.edu/ |
| University of Wisconsin Stout | Dept of Technology | uwstout.edu |
| Virginia Polytechnic Institute & State University | Center for Unit Load Design | unitload.vt.edu/ |
| Western Michigan University | | wmich.edu |

*Source: University of Michigan School of Packaging http://packaging.msu.edu/UniversityCollegeProgramswithaPackagingInterest.php*

**Unlimited Career Opportunities**

Corporations are looking for talented individuals with leadership potential and imagination. Take time to research via the Internet beverage can manufacturers, aluminum can suppliers or other companies for career information. Employment opportunities are vast, including manufacturing, marketing, IT, human resources, and sales. From **www.cancentral.com**, you can click member companies, their name, and then "careers" on their website. Explore their corporate culture, management philosophy, sustainability efforts, and career prospective and vision. Write down impressions and factors that attract you a particular company.

LESSON 4

# RECYCLING PLANT WOES

**Goal:** To learn about the effects of contaminants on recycled aluminum and other commodities, as well as the responsibilities of consumers and stakeholders for making the recycling process a resounding success for our immediate environment and our planet for generations to come.

**Background:** Environmental responsibility is everybody's responsibility. Just as each sector (consumers, collectors, governments, processors, and manufacturers) in the recycling cycle are responsible, their diligent follow-through to assure clean, dry quality reclamation is imperative to making the recycling process successful. Scrap is not waste, nor is recycling a waste-disposal mechanism. The goal is to return resources to manufacturing as a viable feedstock, thus helping our environment, nurturing its resources, and leading us to a sustainable future. It is the right thing to do!

Recycling reduces the need for raw material extraction and consumption, which results in energy, water, and emission savings. Recycling aluminum saves 95% of the effluents, emissions, and energy used for raw materials. These manufacturing cost efficiencies lower container production costs through the supply chain, including savings to the consumer. Contamination among all commodities is a big deal and makes the difference between collected commodities being recycled or sent to the landfill.

The municipal **closed-loop recycling** process, or **primary recycling**, enables the remanufacturing or reprocessing of discarded materials into the same product, such as an aluminum can to be recycled into a new can endlessly — closed-loop recycling at its finest! Depending on the community's recycling program, collected beverage cans can be placed curbside in a recycling bin, taken to a community drop-off center or a buy-back center (including reverse vending machines), given to a charity, or a retailer in deposit states.

From there, haulers take the beverage cans to material recovery facilities (MRF) or processing centers, where the collected materials are sorted by commodity (aluminum, steel, glass, and plastics by number) along with any other materials included in the municipality's recycling collection program. An average of 113,204 aluminum cans are recycled every minute nationwide (more than 1,621 million pounds annually). The recovered used beverage cans must be contaminate free from steel, lead, plastics, glass, wood, dirt, grease, trash, moisture, and other foreign substances. Before the MRF or scrap dealer bales the clean, dry aluminum cans for processing into can sheet, the material undergoes a regime of manual inspection, magnetic separation, air current, and/or vibrating screening to assure quality. Toll processors further refine the aluminum by smelting and casting into ingots, which are then rolled into long sheets, coiled, and sent to the can or end manufacturing plant. The cans and ends are purchased by the bottler, who fills the cans and transports them to retailers' shelves for purchase. The continuous closed-loop recycling process starts again with consumer recycling. Aluminum is endlessly recyclable, with beverage cans completing the cycle in as little as 60 days or 6 times a year.

Contamination not only jeopardizes workers' health and safety, but affects the industry's efficiency rates, the ability to increase recycled content, and the bottom-line costs to consumers. In the aluminum industry, for example, every pound of used beverage cans (UBCs) must meet specifications to be converted directly into quality rigid container sheets used to make new aluminum cans. Contamination lowers the conversion rate. Lower conversion rates mean higher costs, because eliminating contamination at the plant level is expensive and hard on equipment. High "clean-up" costs also lower the price paid to recyclers or municipalities for their collected UBCs.[1]

Contaminated aluminum cannot stand up to the rigors of rolling a can sheet capable of delivering a product using the least amount of materials — the essence of good packaging. The typical beverage can has a body wall thickness of between 0.0038" to .0040". In 1972, one pound of aluminum yielded only 21.75 cans. Today, by using less material to make each can, one pound of aluminum makes approximately 34 cans — a 57% improvement. Even can ends have been made lighter; ends used to weigh about 8.12 pounds per thousand and have been reduced to a mere 6.07 pounds per thousand. This difference multiplied by the 100 billion cans that are made each year means that the weight savings is a phenomenal 200 million pounds of aluminum. In addition, recycling facilities, just like all other companies, are governed by regulations, corporate governance practices, health and safety issues, ethics, environment, human resources, and other policies essential to their daily business operations and ultimate success.

[1] McNealy, P.R.(October 10, 2000) Contaminants: *What They Are and Why They're an Issue*. Alcoa, Inc. April 14, 2008 retrieved from http://www.alcoa.com/rigid_packaging/en/docs/quality_rating_procedures.doc

**Objectives:** Students will…

- Learn about industry contamination specifications.
- Experience contamination challenges and try to resolve some of the common contamination problems that recycling facilities encounter in collecting and processing aluminum cans for can stock.
- Understand the nuances between civic duty, society and social relations, the potential consequences of government regulations, and human resource issues that come into play returning valuable materials to the economic mainstream.

## Materials

(for a class of 32 working in groups of 4):

- 8 copies of *Recycling Plant Woes – Balance Sheet*
- 1 copy of *Recycling Plant Woes – Teacher Key*
- 1 set (28 cards) *Recycling Plant Woes – Fate Cards*
- 1 set (8 cards) *Recycling Plant Woes – Action Fate Cards & Teacher Set Up Sheet* for reference
- Two 1-pound bags of M&M's® (or other tokens)
- 8 cups for M&M's® (1 for each group)
- 8 markers
- 2 hats or recycling containers from which students may draw cards
- **Optional** hand sanitizer

**For Action Fate Cards:**

- 1 teddy bear or stuffed animal
- Several ace bandages or gauze (to cover animal)
- 1 bag of mini marshmallows
- Two shoe boxes
- 1 deck of playing cards
- 100 dimes and/or nickels
- 30 pennies
- 4 tweezers
- 1 cone party hat
- Overhead of *Recycling Plant Woes – Action Fate Card 4*, *Contamination Word Search*, or 4 copies of *Contamination Word Search*
- Vis-a-Vis markers, or dry erase markers, if able, to project on to dry erase board
- Dry erase board
- 4 highlighters if not using overhead
- 1 pair of chopsticks
- 28 misc. pieces of combustible contaminates (wood, such as toothpicks, plastic, plastic bags, cardboard, rubber bands, paper, oil, grease, etc.)
- 15 other contaminates (steel, copper, brass, lead, rocks, plaster)
- 24 clean, dry, used aluminum beverage cans
- 1 "decontamination" container
- 4 sterile plastic pipettes
- 4 aluminum 5.5 ounce new juice cans, opened for activity
- 4 empty cups, one for each team member
- 1 graduated cylinder (to measure 30ml)
- 2 heavy books
- 30 paper Dixie cups

**Time Required:** 45–60 minute period

**Standards Met:** C5, E1, E2, E8, G5, S1, S6, S7

# LESSON 4 RECYCLING PLANT WOES

## Procedure:

**Prep**

- Copy and cut one set of the "Student Column" from *Action Fate Cards*. There are 8 cards total.
- Put them in a hat or receptacle that students can randomly select from.
- Copy 2 sets of *Fate Cards* (one for your reference and the other set cut for class activity). There are a total of 18 Fate Cards.
- Put the cut set of Fate Cards in a second hat or recycling bin so students can draw.
- Review *Action Fate Cards & Teacher Set Up*.
- Determine which *Action Fate Card* activities you will implement and set up as instructed.
- Fill the 8 cups with an equal amount of about 30 of M&M's® (or other edible commodities such as shelled peanuts, uncooked popcorn, wrapped candy, or similarly sized items such as buttons can be substituted, especially if there is a chance of student allergy) in each cup.
- Review Contaminate Concerns Teacher Sheet for a quick recap of criteria that could lead to a rejected load, why, and quantity.

**In Class**

- Assign students to groups of four.
- Tell them they are the managers of a recycling facility. They can determine if the recycling facility is a private recycling center or owned by the town. Either way, they need to name their recycling facility.
- Hand out one *Student Sheet*, one cup, and one marker to each group.
- Instruct students to write their company name on the cup with the marker.
- If you use M&M's® or other edible commodities which students will be permitted to eat at the end of the lesson, going around the room with Hand Sanitizer at this point may be a good idea.
- Have each company draw four *Fate Cards* from the *Fate Card* hat or recycling bin.
- Take turns allowing companies to read aloud their *Fate Cards* and discuss, if necessary, what impacts each card could have on companies.
- After reading the *Fate Cards*, each group should perform tasks, if required, and record any fines or bonuses assigned on their Student Sheet. Distribute or collect M&M's® or othe commodity as directed on each *Fate Card*. (You may want to select a student to be the "M&M's® Banker" to do this job.)
- Pass out additional *Fate Cards* at your discretion.
- Next, have one company group choose an *Action Fate Card*.
- They should read the card aloud and perform the action indicated on the card.
- Be sure to fine or award any M&M's® the group might owe or earn and remind them to mark these any changes on their *Student Sheet*.
- Repeat the process with each company group.
- Once all the cards are gone, instruct students on their *Balance Sheet* to add their subtotals (Debits & Credits) and to then calculate their Net Assets.

- With any remaining time, wrap up with a fast-paced question-and-answer recap of criteria that could lead to a rejected load, why, and the quantity of aluminum cans for reclamation.
- Tell students they may eat their M&M's® or other edible tokens at the end of the lesson, provided no allergies.

## Assessment:

- Class participation
- Completed activity

## Extension:

- Internationally accepted standard specifications are used to trade various commodities throughout the world. Compare what are considered contaminants for used beverage containers (aluminum, glass, and PET). What contaminants are the same? How would you minimize commodity contamination based on your community's recycling program? As the recycling center operator, are there differences in how you sort, process, and broker the commodities?

*(Scrap Specifications Circular—Guidelines for Nonferrous, Ferrous Scrap, Glass Cullet, Paper Stock, Plastic Scrap, Electronics, Tire Scrap—2007, Institute of Scrap Recycling Industries www.isri.org/AM/Template.cfm?Section=Home1&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=13683)*

# LESSON 4 RECYCLING PLANT WOES

## Action Fate Cards & Teacher Set Up

| Student Column | Teacher Instruction Column |
|---|---|
| **Action Fate Card 1**<br>A 12-pound metal shot was concealed in your last bale of scrap aluminum that was fed into the shredder and then launched out of the shredder. Ted E. Bayer was severely injured during this accident. Immediate first aid must be given while waiting for the paramedics to arrive; this could save Ted's life. One company member will have 1 minute to completely wrap Ted E. Bayer's body with an ace bandage or gauze. His body must be completely covered — no fur showing. If you fail, you will have to pay Ted's hospital, rehabilitation expenses, unpaid medical leave, and additional labor for temporary help assessed at 10 M&M's®. If the student's immediate first aid attempt is successful, you are awarded with 10 M&M's®. | **Action Fate Teacher Instruction Card 1**<br>• 1 teddy bear or stuffed animal<br>• Several ace bandages or gauze (to cover animal)<br><br>Students must choose 1 accident first-responder to wrap Ted. Give this student the bandages and Ted. Time the student for one minute. Fine students 10 M&M's® if unsuccessful, reward students with 10 M&M's® if they succeed. |
| **Action Fate Card 2**<br>The recycling bin roll-off programs at local schools have been so successful that the number of aluminum cans being processed exceeds warehouse storage capacity for your processed bales of aluminum cans. You need to build a new warehouse that is 3 stories high to hold and protect from the elements all of the compacted cans (a "story" is the short height of a playing card). You will have 2 minutes to build the new warehouse that must stand for at least 10 seconds by itself. If you succeed, you earn 10 M&M's®. Failure will cost 10 M&M's®. | **Action Fate Teacher Instruction Card 2**<br>• 1 deck of playing cards (52 cards)<br><br>Dump cards into a big pile on a flat surface. Time students for two minutes. If they do not build a warehouse 3 stories high, fine students 10 M&M's®, if they succeed, reward students with 10 M&M's®. |

| Student Column | Teacher Instruction Column |
| --- | --- |
| **Action Fate Card 3**<br>Heavy metal "UFOs" have contaminated your latest bale of aluminum. As the bale was fed into the shredder, small pieces of non-aluminum metal (steel, fishing weights, auto parts, batteries, etc.) started flying out of the shredder, endangering life and limb! You and your company employees must avoid the flying UFOs for two minutes until the dangerous contaminants (steel, lead, glass, plastic, wood, dirt, trash) can be removed from the shredder. If you fail, your group will loose 10 M&M's®, if successful your group will earn 10 M&M's®. | **Action Fate Teacher Instruction Card 3**<br>• 1 bag of mini marshmallows<br>• Two shoe boxes<br>• 100 dimes and/or nickels<br>• 30 pennies<br>• 4 tweezers<br>• 1 cone party hat<br><br>Place the box with all the coins on a sturdy surface and the second empty shoebox about 10 feet away in the "safe zone." Tell the 4 students that they must avoid getting hit by the marshmallows (the metal UFOs) while they move between the two shoe boxes and use the tweezers to remove the pennies that are contaminating the aluminum (dimes and nickels) from the shredder. Only one student may leave the "safe zone" at a time, and when they leave, they must be wearing their safety hardhat (a party hat). Distribute a handful of mini marshmallow to select (responsible) students around the classroom- instruct them to throw the marshmallows only at the student who is wearing the party hat as they move back and forth from the shoeboxes. Time the student for two minutes. Fine students 10 M&M's® if unable to remove all the pennies, reward students with 10 M&M's® if they succeed. (There is no penalty for getting hit by the mini marshmallows.) |
| **Action Fate Card 4**<br>Many possible contaminants have been mixed into your supply of scrap aluminum. You must find all of the hidden contaminants before being able to process and sell your supply of aluminum. You must find at least 8 contamination words in the word search in two minutes. If you fail, your group will loose 10 M&M's®, if successful your group will earn 10 M&M's®. | **Action Fate Teacher Instruction Card 4**<br>• Overhead of Contamination Word Search<br>–or–<br>• 4 copies of Contamination Word Search<br>• Vis-a-Vis markers, or dry erase markers, if able, to project on to dry erase board<br>• Dry erase board<br>• 4 highlighters if not using overhead<br><br>Put the overhead on the projector and put over the dry erase board or pass out Contamination Word Search to the 4 students. Pass out markers. Set timer and time students for two minutes. Fine students 10 M&M's® if unsuccessful, reward students with 10 M&M's® if they succeed. |

| Student Column | Teacher Instruction Column |
| --- | --- |
| **Action Fate Card 5**<br>Large amounts of various combustibles contaminate a batch of your scrap aluminum. All company staff members must help to remove these contaminating particles. The goal is to remove the debris and minimize contamination. Each company member must form a line in front of the batch of aluminum where they will take turns removing three pieces of "dirt" each. Successful removal of this contaminant will earn 10 M&M's®, for unsuccessful removal the fine will be 10 M&M's®. | **Action Fate Teacher Instruction Card 5**<br>• 1 pair of chopsticks<br>• 28 misc. pieces of combustible contaminates (wood, such as toothpicks, plastic, plastic bags, cardboard, rubber bands, paper, oil, grease, etc.)<br>• 15 other contaminates (steel, copper, brass, lead, rocks, plaster)<br>• 24 clean, dry used aluminum beverage cans<br>• 1 "decontamination" container<br><br>Spread out the combustibles, other contaminates, and aluminum beverage cans on a flat table in front of room. Line up all the students in the group in front of table and give the first person one set of chopsticks. Instruct the students that they will have two minutes to remove 3 combustible contaminates each and place them in the decontamination container. Members of the group cannot pass the chopsticks to the next person until they have successfully picked up and transferred three combustible contamination pieces. Group members may only use one hand in transferring the pieces. Fine the company 10 M&M's® if they fail to complete the task, reward students with 10 M&M's® if they complete the task. |

| Student Column | Teacher Instruction Column |
| --- | --- |
| **Action Fate Card 6**<br>The amount of moisture (soft drink, water, rain, etc.) in your last batch of aluminum exceeds the allowed 4% by weight. In order to avoid a penalty on the value of your aluminum and your reputation as a top-flight supplier of quality aluminum UBC, the excess moisture has to be removed. Each member of your company will put a sterile plastic pipette in their mouth, line up next to the "batch of aluminum" — the juice cans — and, one at a time, insert their pipette into their designated aluminum can without using their hands, drawing up as much juice as held by the pipette. Then they must transfer the juice to the empty waste receptacle (their empty cup) and return to the end of the line. The next person in line follows the same pattern, drawing from their individual can, transferring the liquid until the time has elapsed. Your company has two minutes to transfer 30 ml of moisture, which will be poured in the graduated cylinder to measure after the two minutes have expired. If you fail to transfer all the excess moisture, your company will loose 10 M&M's®. Success will earn your company 10 M&M's®. | **Action Fate Teacher Instruction Card 6**<br>• 4 sterile plastic pipettes<br>• 4 aluminum 5.5 ounce new juice cans, opened for activity<br>• 4 empty cups, one for each team member<br>• 1 graduated cylinder (to measure 30ml)<br><br>Set the cans of juice together and the empty cups approximately six to ten feet apart on a stable surface. Give each student a sterile pipette and assign one can of juice to each student. Students will draw water from their own aluminum can, but deposit it into the same empty can. Review directions on the student Action Fate Card. Time for two minutes. If they fail to remove 30 ml, fine students 10 M&M's®, reward students with 10 M&M's® if they succeed. For reference, actual industry rules: "Shipments with moisture in excess of 4% will be subject to weight deductions or rejection. The deduction will equal the tested moisture percent minus 2%. For example, if the tested moisture is 5%, the deduction equals 5% less 2%, or 3%. If the tested moisture is equal to or less than 4%, no deduction will be taken." |
| **Action Fate Card 7**<br>Your forklift truck has malfunctioned. In order to continue stacking compressed cans you will have to move smaller bales by hand to the storage area. This will take some strength and agility on the part of your employees. Your plant foreman must demonstrate the process to his employees before the process can begin. He (she) must balance a heavy book on each of his (her) outstretched arms (palms down) for 2 minutes without letting them fall off. If he (she) fails, your company will loose your group 10 M&M's®. Success will earn your group 10 M&M's®. | **Action Fate Teacher Instruction Card 7**<br>• 2 heavy books<br><br>Select a member from the group that will act as the foreman of the plant. Have them stand in the front of the room with two other members of the group (one on each side of the foreman). When you are ready to start, have the foreman stretch out his (her) arms at shoulder level and have the two individuals on the side of the foreman place a heavy book on the hands (palms down) of the foreman. When you say go, they must let go of the books and the foreman must balance them for 2 minutes without letting them fall off. If he (she) fails, penalize the group 10 M&M's®. If successful, award the group 10 M&M's®. |

| Student Column | Teacher Instruction Column |
| --- | --- |
| **Action Fate Card 8**<br>Your air-conditioning units have overheated and shut down. The temperature is rising in your plant to a very uncomfortable level. The Human Resources manager has brought in several fans to try to restore a workable environment for the employees. In order to reduce the temperature of the plant, the "hot air" must be blown out of the plant. Two members from your group must blow away all of the "heat" within 30 seconds or the plant will have to shut down. If you succeed, you earn 10 M&M's®. Failure will cost 10 M&M's®. | **Action Fate Teacher Instruction Card 8**<br>• 30 paper Dixie cups<br><br>Pick two members from the group. Place the 30 Dixie cups top down spread out on a flat table. Tell the two group members that when you say start, they will have 30 seconds to blow all the "heat" out of their plant (off the table). If they succeed, they will earn 10 M&M's®. Failure will cost 10 M&M's®. |

# LESSON 4 RECYCLING PLANT WOES

## Fate Cards

**Fate Card 1**
Your health care cost for your employees has increased by 25%. You will have unbudgeted increase in labor expenses, pay 4 M&M's®.

**Fate Card 2**
In order for your plant to comply with Americans with Disabilities Act, the plant is required to install a handicap-accessible ramp and restroom facilities. This modification will cost your company 3 M&M's®, but because you are now providing universal access to the plant, you are awarded 6 M&M's®.

**Fate Card 15**
One of your employees slipped in the parking lot which is considered an on-the-job injury. OSHA is fining you and the company's workmen's compensation is sure to increase. Pay 8 M&M's® for a safety violation.

**Fate Card 16**
Your recycling plant won an Occupational Health and Safety Administration award for an accident-free environment for the past five years. Creating, maintaining, and advocating for a safe workplace has increased profits as well. In order to collect your bonus, write down 3 safety measures you implemented and present them to your teacher with this card to receive 8 M&M's®.

### TEACHER KEY

Examples:

- All workers participate in an OSHA 10-hour training course.
- All workers are required to sign and follow the "Safely or Not At All" pledge.
- Management considers worker and customer safety in every decision they make.
- Safety posters and reminder signs are posted throughout the plant.
- Workers and visitors are required to wear safety glasses and ear plugs when touring the recycling area, and these items are supplied with signage at the entrances to the recycling area. Further, visitors are required to be escorted by an employee while in the recycling areas.
- While the forklift is warehousing the bales of aluminum beverage cans, no other workers are allowed in that section.

| | |
|---|---|
| **Fate Card 3**<br>Your company has opened a childcare center for employees at its facility. This has decreased employee absenteeism by 10%, saving your company money and increasing productivity. Earn 5 M&M's®. | **Fate Card 17**<br>Your company has begun offering after-hour education classes to train employees in new technology. This has increased your productivity, lowered employee turnover, increased moral, and reduced your costs. Earn 4 M&M's®. |
| **Fate Card 4**<br>The driver of your recycling truck left the truck unattended and the hose unmonitored during fueling. The result was a diesel fuel spill. While only a gallon, the spill still required cleanup to minimize environmental impact. Fortunately, the property owner took immediate action to contain the spill. The recycling center will pay 3 M&M's® to the service station for its environmental assistance. The quantity was less than what would have violated state regulation; however, you must give the Department of Environmental Protection a list of three preventative measures you will implement in the future to remain in compliance or be fined 3 M&M's®. | **Fate Card 18**<br>High winds knock out power and the ability to process aluminum scrap into biscuits as planned and promised to the toller whose truck has just arrived. Pay the trucking company for their effort, costs 2 M&M's®. |
| **Fate Card 5**<br>In an effort to become more sustainable, your company has decided to embark on conservation practices including solar hot water heaters, Energy Star lighting and related electronics, automatic lavatory faucets, waterless urinals, use of reclaimed rain water irrigation system, efficient native landscaping, use of non-toxic cleaners, purchase of recycled content, chlorine-free paper, and invested and installed more energy-efficient machinery. Earn 6 M&M's® in net savings. (The new technology cost you 4 M&M's®, but you saved 10 M&M's® in energy costs.) | **Fate Card 19**<br>The National Recycling Coalition is awarding a "Recycling Works Award" to your company in recognition of its significant commitments to recycling, the environment, and the communities in which it operates, demonstrating every day that recycling really does work! Collect a bonus of 6 M&M's®. |

**Fate Card 6**
One of your employees initiated a new relationship with a local school and has created a very successful aluminum beverage can recycling program. The school district is interested in taking the program districtwide. Your aluminum can poundage for recycling already has increased by 10%! Collect 7 M&M's®.

**Fate Card 7**
Forklift operator mistakenly backed into a customer's car hitting the side panel. Pay auto insurance deductible of 4 M&M's® and brace yourself for higher insurance premiums.

**Fate Card 20**
New state and local tax initiatives to generate revenue for highway and transportation improvement were just approved. Effective immediately, state gas and diesel taxes are to increase by 2%. You must now pay additional transportation expenses. Pay 4 M&M's®.

**Fate Card 21**
Union contract is about to expire. Renegotiations will lead to wage increases and added employee benefits. Pay 6 M&M's®. However, if management can devise two innovative contract provisions that the labor negotiator (your teacher) can agree to, you earn back 2 M&M's® per accepted proposal.

## TEACHER KEY

Examples:

- Choice of benefit packages rather than universal coverage allowing workers flexibility to meet their needs and reduce cost of insurance.
- Closing the facility during Christmas week so families can be together, which would count as three paid vacation days and Christmas Eve, Christmas, and New Year's Eve and New Year's Day would be paid company holidays.
- Extra paid vacation day per year for each 5% additional aluminum cans recycled
- Vacation days at the end of the year that would have been lost because not used would transfer into a reserve pool for workers on medical leave.
- Employees using mass transit regularly would receive a 25% reimbursement of the average system's rider fare as a thank you for helping reduce greenhouse emissions.

**Fate Card 8**
Three lead tire weights (15 pounds) were found in a bale of used beverage cans sent to you from a scrap dealer. Your yard workers accepted the load without pre-screening carefully enough. Concealed contamination resulted in overpaying the recycler by 15 pounds, plus now must open all bales from the shipper to check for lead and other contaminants. Reduce profits by 4 M&M's®.

**Fate Card 9**
Someone calls the recycling plant inquiring if we purchase beverage can tabs. The answer is no because our equipment, like most recycling centers, bales cans into biscuits for shipment and cannot compact the little pieces of tabs. The next day, the person baling the cans has can tabs all over the floor. Now an employee has to sweep up the mess and call around to find a recycling center that shreds their cans and blows them into an 18-wheeler for transport to the smelter. If unsuccessful, then the tabs will be wasted as landfill garbage. Deduct 2 M&M's® for equipment downtime for cleanup, potential landfill tipping fees, and overtime wages to keep production on schedule.

**Fate Card 10**
A union strike at your plant results in a pay increase for all employees, not to mention a backlog of material to process and overtime hours to get back on schedule. Pay out 4 M&M's®.

**Fate Card 11**
One of your aluminum shredders has failed because of wear and tear along with age. Your replacement cost is 5 M&M's®. The new machine meets Northeast Energy Efficiency Partnerships (**www.neep.org/**) standards qualifying for an EPA tax rebate, in addition to energy cost savings of better than 50% — earn back 2 M&Ms®.

**Fate Card 22**
EPA inspector notices smoke coming out of delacering or decoater furnace which is normally clear. This environmental excess emission is determined to be from a can containing cigarette butts — a contaminate — after cutting open several cans from that load. Now the company must file an emission report, prove that this is not a regular occurrence or will have to add additional air pollution equipment and meet increased reporting requirements. Pay fine: 5 M&M's® .

**Fate Card 23**
A truck load containing five 100 pound bales of aluminum beverage cans is received on the loading dock from a regular supplier. The driver is in a hurry and it is almost closing time at the plant. The purchasing representative accepts the bales into the warehouse. The next day it is discovered that they are grossly contaminated by 3% dirt from being stored outside on soil that became mud from a rain storm. Your bottom line is reduced because the dirt can affect the chemistry of the melt and decrease operation efficiency. Pay 3 M&M's®.

**Fate Card 24**
Due to the instability in the Middle East, the cost of oil has risen to $145.00/barrel. This has caused your transportation partner to pass the increase on to you, their customer, as an unbudgeted surcharge. Pay 4 M&M's®.

**Fate Card 25**
Your company has joined a group health insurance plan with several other recycling companies in your area. This reduces your health insurance premiums, reduces your labor costs, and means your company can continue to offer health insurance as a benefit. Earn 5 M&M's®.

| | |
|---|---|
| **Fate Card 12**<br>Your company has just received a major contract from an aluminum beverage can manufacturing company. This order allows you to upgrade the technology in your plant which in turn will reduce emissions, save energy and decrease facility operating costs, and recycle more aluminum cans! Earn 8 M&M's®. | **Fate Card 26**<br>Your company has realized synergies with other local municipal solid waste management districts and has formed a regional partnership to accept their aluminum cans. This central location reduces your transportation costs since the cans will be shipped to your site. With increased market share you will have a greater quantity of UBCs to be sold at a time which equates to higher price paid per pound and increased profit. Earn 6 M&M's®. |
| **Fate Card 13**<br>Your employees have taken the initiative to promote aluminum can recycling at the state fair by building a mountain of a million cans. Aluminum cans have value and everyone is excited to think that recycling proceeds would purchase land and build a skateboard park. Kids, teachers, the local Chamber of Commerce, parents, elected officials, community, and even the press are bringing cans by the bag full. Score 10 M&M's®. | **Fate Card 27**<br>Ouch! As a worker off-loads a cart of bagged aluminum cans, he thinks, but is not sure, that he was stabbed through his glove by a hypodermic needle protruding from one of the beverage cans. There is a slight mark on his hand sending him to the emergency room. Pay 3 M&M's® for hospital claims and worker's wages for the day. |
| **Fate Card 14**<br>As part of your company's continuous process improvement, employees were asked what would make their job less physically demanding or more efficient. The task force determined that hamper dumpers and hydraulic tilt trucks would reduce exposure to ergonomic heavy-lifting stressors. Management concurs and has scheduled product training, testing, and evaluation of staff identified products before purchase. Pay 3 M&M's® for training on products that will be returned. Earn 7 M&M's® for employee involvement and input which will increase product acceptance, usability, durability, and improve safety, health, and productivity. | **Fate Card 28**<br>A teacher visited the recycling center inquiring whether it would be more profitable to recycle tabs from beverage cans or the entire aluminum can. Do the math:<br>1,000 tabs = 1 pound<br>34 cans = 1 pound<br>1 pound = $.35 to $.70<br>1,000 Tabs = $.35 to $.70<br>versus<br>Recycle cans with ends 1,000 = $350 to $700<br>Earn 7 M&M's® for providing good environmental stewardship guidance and reducing the possibility of cuts associated with the removal of the tabs. |

## Action Fate Card 4 — Contamination Word Search

### Contamination!!

C S A E T X A S F R E E L E A D G V F K Q T N O H R F L E H
G V N X P R F E L E S M R Q F A O E Y O D K H H S H E I X L
W R Q A E C C C J B G W U W S V B M T I C A O E V E P O P G
X X A D C H B R M T I S O O F Y U S R E Z I L I T R E F L U
K T W V M L A U A O P U L C Z F T T I C R D F S V P G F O Z
Q O R S E T O O C A I I Y E Q N A A F G E C Z Z R D S A S Z
P A Z A T L G S C M N I R O N N N L L E M S N R R E R W I H
C R Q O S R P E O E M N M T S B E L N J S V D O J N F U V J
F Q I K E H L V H R C G E O R M L C J G D T B S C P A M E Y
Q A L A R T U I S D E W A T E R I S Y R I N G E S J R H S Z
W C S Q T G H T P I N A I D F M G M W K P R Q L O V J A T H
S E W O V T U C O R I P I N R A H S A N D G F R V I U C U D
S C B P O A S A O O O C L E G S T Y G G R N N V B E A A Y C
G M T I W Z H O T T A P D H D P E Y L Q N C P P K I Q R R L
F F C Z F R Q I Y L B O A F C X R M G I I Y Z C C Q I D E I
A V Y Q C T L D W Y P R W N O J S K D S F Y D A U Z A B S Q
S Y D N E S X A W Y H B D P E L I V E A M M U N I T I O N U
A S I O D V S R H A K R C T B B I N S U L A T I O N Z A R I
L Z A A O T H L F R O A E W P S O F I N B E A T R X P R Y D
R G Q L E W W V B I I S J X O E M T B X E O P H J I P D N A
L N L O G B Z D Q A A S B L F T O B T H Z R J N I A U G E M
N W B W G E A N D I T G A J S D N O G L L C R Y T G Z P E C
O W H C O P P E R C U T O I W D B P S M E G C R O J X F J T
H J P E T H P X P Y M B E X D U T L F B M S H W R K Q Y K S
K S A F D X F W X R A L J R Y J C A R S L A P T Z W A A B C
A I P I U W I C S V K A N M I H C S J A Q L O C V V P R H E
N G E T L I L V Q T L C D J F E C T K U M V R D L F Z X E F
T X R V T A N Q H P J P J Y V X S I M O H D I N E J C J T O
A D Q J P U X A I Q L P L G H J G C M P Q I Y L O J L G M V
V G G C H A U S S E J F U M Y Z D S U J N B I A W K M K M H

AEROSOL CANS
BATTERIES
BOTTLE CAPS
BRASS
BUTANE LIGHTERS
CARDBOARD
CONCRETE
COPPER
DIRT
EXPLOSIVES
FERTILIZERS
FOIL
FREE LEAD
GASOLINE
GLASS
GRAVEL
GREASE
HYPODERMIC NEEDLES
INSULATION
IRON
LIQUID
LIVE AMMUNITION
MEDICAL WASTE
PAPER
PCB
PLASTIC
POWDER
PROPANE BOTTLES
RADIOACTIVE SOURCES
SAND
STEEL
SYRINGES
TRASH
WATER
WOOD
ZINC

## Action Fate Card 4 — Contamination Word Search

### Contamination!!

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | S | A | E | T | X | A | S | F | R | E | E | L | E | A | D | G | V | F | K | Q | T | N | O | H | R | F | L | E | H |
| G | V | N | X | P | R | F | E | L | E | S | M | R | Q | F | A | O | E | Y | O | D | K | H | H | S | H | E | I | X | L |
| W | R | Q | A | E | C | C | C | J | B | G | W | U | W | S | V | B | M | T | I | C | A | O | E | V | E | P | O | P | G |
| X | X | A | D | C | H | B | R | M | T | I | S | O | O | F | Y | U | S | R | E | Z | I | L | I | T | R | E | F | L | U |
| K | T | W | V | M | L | A | U | A | O | P | U | L | C | Z | F | T | T | I | C | R | D | F | S | V | P | G | F | O | Z |
| Q | O | R | S | E | T | O | O | C | A | I | I | Y | E | Q | N | A | A | F | G | E | C | Z | Z | R | D | S | A | S | Z |
| P | A | Z | A | T | L | G | S | C | M | N | I | R | O | N | N | N | L | L | E | M | S | N | R | R | E | R | W | I | H |
| C | R | Q | O | S | R | P | E | O | E | M | N | M | T | S | B | E | L | N | J | S | V | D | O | J | N | F | U | V | J |
| F | Q | I | K | E | H | L | V | H | R | C | G | E | O | R | M | L | C | J | G | D | T | B | S | C | P | A | M | E | Y |
| Q | A | L | A | R | T | U | I | S | D | E | W | A | T | E | R | I | S | Y | R | I | N | G | E | S | J | R | H | S | Z |
| W | C | S | Q | T | G | H | T | P | I | N | A | I | D | F | M | G | M | W | K | P | R | Q | L | O | V | J | A | T | H |
| S | E | W | O | V | T | U | C | O | R | I | P | I | N | R | A | H | S | A | N | D | G | F | R | V | I | U | C | U | D |
| S | C | B | P | O | A | S | A | O | O | O | C | L | E | G | S | T | Y | G | G | R | N | N | V | B | E | A | A | Y | C |
| G | M | T | I | W | Z | H | O | T | T | A | P | D | H | D | P | E | Y | L | Q | N | C | P | P | K | I | Q | R | R | L |
| F | F | C | Z | F | R | Q | I | Y | L | B | O | A | F | C | X | R | M | G | I | I | Y | Z | C | C | Q | I | D | E | I |
| A | V | Y | Q | C | T | L | D | W | Y | P | R | W | N | O | J | S | K | D | S | F | Y | D | A | U | Z | A | B | S | Q |
| S | Y | D | N | E | S | X | A | W | Y | H | B | D | P | E | L | I | V | E | A | M | M | U | N | I | T | I | O | N | U |
| A | S | I | O | D | V | S | R | H | A | K | R | C | T | B | B | I | N | S | U | L | A | T | I | O | N | Z | A | R | I |
| L | Z | A | A | O | T | H | L | F | R | O | A | E | W | P | S | O | F | I | N | B | E | A | T | R | X | P | R | Y | D |
| R | G | Q | L | E | W | W | V | B | I | I | S | J | X | O | E | M | T | B | X | E | O | P | H | J | I | P | D | N | A |
| L | N | L | O | G | B | Z | D | Q | A | A | S | B | L | F | T | O | B | T | H | Z | R | J | N | I | A | U | G | E | M |
| N | W | B | W | G | E | A | N | D | I | T | G | A | J | S | D | N | O | G | L | L | C | R | Y | T | G | Z | P | E | C |
| O | W | H | C | O | P | P | E | R | C | U | T | O | I | W | D | B | P | S | M | E | G | C | R | O | J | X | F | J | T |
| H | J | P | E | T | H | P | X | P | Y | M | B | E | X | D | U | T | L | F | B | M | S | H | W | R | K | Q | Y | K | S |
| K | S | A | F | D | X | F | W | X | R | A | L | J | R | Y | J | C | A | R | S | L | A | P | T | Z | W | A | A | B | C |
| A | I | P | I | U | W | I | C | S | V | K | A | N | M | I | H | C | S | J | A | Q | L | O | C | V | V | P | R | H | E |
| N | G | E | T | L | I | L | V | Q | T | L | C | D | J | F | E | C | T | K | U | M | V | R | D | L | F | Z | X | E | F |
| T | X | R | V | T | A | N | Q | H | P | J | P | J | Y | V | X | S | I | M | O | H | D | I | N | E | J | C | J | T | O |
| A | D | Q | J | P | U | X | A | I | Q | L | P | L | G | H | J | G | C | M | P | Q | I | Y | L | O | J | L | G | M | V |
| V | G | G | C | H | A | U | S | S | E | J | F | U | M | Y | Z | D | S | U | J | N | B | I | A | W | K | M | K | M | H |

(Over, Down, Direction)

| | |
|---|---|
| AEROSOL CANS | (12,11,NW) |
| BATTERIES | (9,20,SE) |
| BOTTLECAPS | (3,13,NE) |
| BRASS | (12,17,S) |
| BUTANE LIGHTERS | (17,3,S) |
| CARDBOARD | (28,12,S) |
| CONCRETE | (25,9,NW) |
| COPPER | (9,23,W) |
| DIRT | (21,2,SW) |
| EXPLOSIVES | (29,10,N) |
| FERTILIZERS | (28,4,W) |
| FOIL | (28,4,N) |
| FREE LEAD | (16,1,W) |
| GASOLINE | (17,1,SW) |
| GLASS | (5,21,NW) |
| GRAVEL | (1,2,SE) |
| GREASE | (7,7,SW) |
| HYPODERMIC NEEDLES | (9,18,NE) |
| INSULATION | (17,18,E) |
| IRON | (12,7,E) |
| LIQUID | (30,14,S) |
| LIVE AMMUNITION | (16,17,E) |
| MEDICAL WASTE | (16,9,SW) |
| PAPER | (3,28,N) |
| PCB | (5,2,SE) |
| PLASTIC | (18,29,N) |
| POWDER | (1,7,NE) |
| PROPANE BOTTLES | (9,11,SE) |
| RADIOACTIVE SOURCES | (8,18,N) |
| SAND | (21,12,W) |
| STEEL | (24,5,NE) |
| SYRINGES | (18,10,E) |
| TRASH | (2,5,SE) |
| WATER | (12,10,E) |
| WOOD | (6,20,NW) |
| ZINC | (2,19,NE) |

# LESSON 4 RECYCLING PLANT WOES

TEACHER KEY

## Balance Sheet

Name of Company: _____

Employees' Names: _____

## Directions:

- Draw 4 "Fate Cards" and follow the instructions
- Draw 1 "Action Fate Card" and perform task
  - Collect or pay M&M's® or other tokens accordingly and record below
- Add all of your fines, those in your Debits column and record subtotal
- Add all of your rewards, those in your Credits column and record subtotal
- Calculate the Net Total (subtract Subtotal Credits from Subtotal Debits)
- With permission, eat your M&M's® or other edible tokens
- Answer the three questions below

| Description of Challenge/Scenario | Debits (-) (in M&M's®) | Credits (+) (in M&M's®) |
|---|---|---|
| ***Example:*** Remove excess water from aluminum UBCs — Successful | | 10 |
| Crush 20 aluminum cans in 2 minutes — Failed | 5 | |
| | | |
| | | |
| | | |
| **Subtotal** | | |
| **Net Assets (Total)** *(Subtotal Credits – Subtotal Debits)* | | |

1. As the recycling plant manager, what steps would you use to assure high quality, contaminate-free containers from your recycling program? Your goal is to improve the marketability and derive the highest value from the commodity.

   *Answers will vary. Possible answers might include:*

   • If your recycling facility is a government entity, and publicize that contaminate-free recyclables will reduce trash collection fees i.e. taxes.
   • Increase quality control.
   • Know market specifications and work to achieve even better quality assuring ready markets for your recyclables.
   • Conduct inspections throughout the recycling process enabling continuous improvement performance.
   • Protect recyclables from weather and contamination for dirt or gravel during loading and off-loading.
   • Implement new systems and technologies.
   • Educate citizens about the importance of what they put in the bin and how it is prepared — clean, dry, contaminate free commodities deliver the greatest value.
   • Add incentives for residents to recycle and recycle properly.
   • Help recycling collection crews to encourage low residual and contamination rates, reject bins with contaminates and inform bin owners regarding rejection and their legal responsibility.
   • Have your Mayor follow the City of Dallas' lead and create a comprehensive website addressing green issues (www.greendallas.net), especially recycling.

2. List three new things you learned about Do's and Don'ts of recycling aluminum:

   *Answers will vary. Possible answers might include:*

   • Keep tabs on your cans. Cans are traded like a commodity and the price paid is determined by weight which includes the tabs.
   • Setting containers out in the rain uncovered can be considered a contaminate.
   • Rinse out your can and shake it dry — clean, dry UBCs bring the greatest value.

3. List several advantages to recycling aluminum cans:

   *Answers will vary. Possible answers might include:*

   • Aluminum can be recycled into a new can endlessly and are 100% recyclable.
   • By recycling aluminum cans, you reduce emissions (greenhouse gases) by 95%.
   • Saves 95% more energy than if had to start with raw materials.
   • Aluminum is the only beverage container that more than covers the cost of collection and re-processing for itself and subsidizes other containers, including plastic and glass.
   • Recycling one beverage can saves enough electricity to power a TV for three hours or a 100 watt light bulb for four hours.
   • Aluminum can recycling can be an easy, good for the environment, and profitable fundraiser with each can worth a conservative 2 cents. Plus, there is no selling.

## Balance Sheet

Name of Company: _____

Employees' Names: _____

### Directions:

- Draw 4 "Fate Cards" and follow the instructions
- Draw 1 "Action Fate Card" and perform task
  - Collect or pay M&M's® or other tokens accordingly and record below
- Add all of your fines, those in your Debits column and record subtotal
- Add all of your rewards, those in your Credits column and record subtotal
- Calculate the Net Total (subtract Subtotal Credits from Subtotal Debits)
- With permission, eat your M&M's® or other edible tokens
- Answer the three questions below

| Description of Challenge/Scenario | Debits (-) (in M&M's®) | Credits (+) (in M&M's®) |
|---|---|---|
| ***Example:*** Remove excess water from aluminum UBCs — Successful | | 10 |
| Crush 20 aluminum cans in 2 minutes — Failed | 5 | |
| | | |
| | | |
| | | |
| **Subtotal** | | |
| **Net Assets (Total)** *(Subtotal Credits – Subtotal Debits)* | | |

## Balance Sheet, *continued*

Name of Company: _____

Employees' Names: _____

1. As a recycling plant manager, what steps would you use to assure high quality, contaminate-free containers from your recycling program? Your goal is to improve the marketability and derive the highest value from the commodity.

2. List three new things you learned about Do's and Don'ts of recycling aluminum:

3. List several advantages to recycling aluminum cans:

# LESSON 4 RECYCLING PLANT WOES

TEACHER KEY

## Contaminate Concerns Teacher Sheet

| Issue | Rejection |
|---|---|
| Safety | Explosives, gasoline, propane bottles, hypodermic needles/syringes, batteries. |
| Moisture | Ice or snow covering or embedded in the load. Moisture can have a negative impact on processing operations because it acts as a magnet for dirt. It also takes more fuel to process wet cans, thus increasing the cost of the raw material. Moisture becomes trapped when cans are compacted. |
| Glass | Heavy concentrations in load. |
| Heavy Metal Objects | Copper, brass, lead metals, even in small amounts represent significant sources of contamination. Plus, these materials have their own recycling network. Brass and bronze may contain lead. |
| Unloading | Any load that might pose a threat to the safety of personnel or damage unloading equipment. |
| Dirt | Heavy concentration of embedded dirt throughout the load can affect the chemistry of the melt and decrease operation efficiency. Every pound of dirt creates two pounds of dross or skim that must be removed from the molten metal—time-consuming, expensive and waste, valuable natural resources. |
| Combustibles | Heavy concentrations of paper, cardboard, or plastic bags or more than six PET containers visible in any one bale/bundle. |
| Aluminum other than used beverage cans | All aluminum is not the same. Different alloys are used to produce a variety of aluminum products. The alloy used to produce aluminum can sheet is a precise mixture which includes primarily manganese and magnesium. |

*Source: McNealy, P.R.(October 10, 2000)* Contaminants: What they Are and Why They're an Issue. *Alcoa, Inc. April 14, 2008 retrieved from http://www.alcoa.com/rigid_packaging/en/docs/quality_rating_procedures.doc*

# LESSON 5
# ECONOMIC VALUE OF RECYCLING

**Goal:** To compare the economic value of recycling with familiar beverage recyclables: aluminum beverage cans, plastic #1 (PET) bottles, and glass, explore how your locale compares to other jurisdictions, and ascertain ways to generate greater recycling volumes ultimately benefiting the taxpayer and the community and planet.

**Background:** Cities across America have been offering recycling collection programs for over 35 years. Most residential recycling involves curbside recyclables collection, drop-off programs, buy-back operations, and/or container deposit systems. The Environmental Protection Agency reports that, in 2006, over half the population was served by more than 8,660 curbside recyclables collection programs. Recycling aluminum cans began in the early 1970s, with the emergence of environmental awareness peaking in 1997. Some believe that attention to our environment, climate change, and the desire for sustainability will revitalize recycling participation.

Aluminum beverage cans represent the most recycled beverage container with 51.4 billion cans recycled for a recycling rate of 52% which is less than one percent (0.6%) of Municipal Solid Waste (MSW) generation. The recycling rate for glass packaging is 25.3%, representing 4.5% of MSW generation; PET soft drink bottles are 23.5% or 0.3% of MSW generation. Aluminum is the only packaging material that more than covers the cost of collection and re-processing for itself and subsidizes other containers, including plastic and glass. Not only from a revenue source is it advantageous for localities to promote aluminum can recycling. By promoting the recycling of one commodity, the recycling of all other commodities increases as well. If revenue from recycling programs drop, the cost to provide these recycling options to taxpayers begins to rise. Many cities, such as Indianapolis, are being forced to consider dropping the recycling

services they offer to citizens. The U.S. EPA has developed a Full Cost Accounting program which enables cities to evaluate waste management options for their city. This lesson allows students to follow a similar approach. Students also will explore how communities are tackling this issue through a variety of creative marketing, communication, and operational changes that could be helpful to increasing recycling locally.

*Source: www.cancentral.com;* Talkin' Trash; 2006 Report on Post Consumer PET Container Recycling Activity, *North America PET Plastics Organization at www.napcor.com/; and www.epa.gov/msw/facts.htm.*

**Objectives:** Students will…

- Determine the value of three commonly recycled materials
- Evaluate the economic impact of these recycled materials on their town's recycling revenue
- Recommend personal action-taking steps to increase recycling in their home, school, and town
- Compare their municipality's recycling rate to another of similar demographics
- Examine other community recycling practices and their potential applicability to their community and proactively make recommendations to local recycling coordinator, mayor, or town council

**Materials:** (for a class of 30):

- 30 copies of *Economic Value of Recycling – Fact Sheet 1*
- 30 copies of *Economic Value of Recycling – Fact Sheet 2*
- 30 copies of *Economic Value of Recycling – Instruction Sheet*
- 30 copies of *Economic Value of Recycling – Questions for Thought*
- 30 copies of *Economic Value of Recycling – Data Table*
- 1 copy of *Economic Value of Recycling – Data Table Teacher Key*
- 1 copy of *Economic Value of Recycling – Teacher Market Value Information*
- 1 pair of dice
- **Optional** 30 copies of *Economic Value of Recycling – Indianapolis Articles*
- **Optional** 30 copies of *Economic Value of Recyclng – San Francisco Article 1*
- **Optional** 30 copies of *Economic Value of Recycling – San Francisco Article 2*
- **Optional** 30 copies of *Economic Value of Recycling – Value of What's Not Getting Recycled Chart*
- **Internet access optional.** For students without computers, provide data for one or two jurisdictions of similar size, population, and demographics so students can complete the town comparison section on the *Economic Value of Recycling – Data Table*. Encourage students involved with Extension Exercises to utilize research sources such as public libraries with computer Internet access, periodicals, and other journals.

**Time Required:** 45–60 minute period

**Standards Met:** S6, LA4, LA7, LA8, N3, A3, M1, M2, DA1, DA3, PS3, COM2, COM3, CN3, C1, C5, E1, E2, E3, E4, E16, E17, G4, G5

# LESSON 5 ECONOMIC VALUE OF RECYCLING

## Procedure:

- Group students in pairs.
- **Optional** Pass out the *Indianapolis Articles*. Give students a few minutes to read them and discuss as a group. These articles are provided to give students a current look at a city dealing with the challenge of how to promote and increase recycling.
- Students are going to compare the economic value and impact of three different beverage container commodities commonly recycled: Aluminum Beverage Cans, Plastic (#1 PET) Bottles, and Glass.
- To each student, hand out one of each of the following: *Data Table, Instruction Sheet,* and *Fact Sheets 1* and *2*.
- Discuss instructions and answer any questions.
- Depending on the level of your students, you may or may not want to go through the process of filling out the *Data Table* together or helping them with equations.
- Have students research the current market value of these three materials utilizing the information on the *Fact Sheet 2* handout or by researching data online at the London Metal Exchange website **www.lme.com** and the Recycler's World website **www.recycle.net**. Refer to *Teacher Market Value Information* for specifics on market value.
- Students will select a new recycling rate by rolling dice to determine the change. For example, a roll of each die first with a 3 and then a 6 means to calculate the new rate at 36%.
- Use the *Data Table Teacher Key* to assist students, if needed, and to review results toward the end of class.
- To highlight the national impact of not recycling, distribute the *Energy and Value Consequences of What's Not Getting Recycled Charts*.
- Compare your local municipality's recycling rate and recycling practices to at least one other jurisdiction of similar size, population (age and sex), and demographic resources (household size, solid waste budget, geographic area) (**http://fisher.lib.virginia.edu/collections/stats/**; **http://fisher.lib.virginia.edu/collections/stats/ccdb/**; **http://www.refdesk.com/factpop.html**; and **http://www.census.gov/statab/www/ccdb.html**).
- Allow time for students to complete the *Questions for Thought* after completing their Data Table.
- Review *Questions for Thought* together as a class and discuss.

## Assessment:

- Completion of *Data Table.*
- Completion of *Questions for Thought.*
- Class participation in activity.

## Extensions:

- Contact your town or county recycling coordinator to obtain actual data or invite them to discuss the value and economics of recycling.
- Visit the EPA website below to see how U.S. cities can measure and compare municipal solid waste through "full cost accounting." **http://www.epa.gov/epaoswer/non-hw/muncpl/fullcost/docs/appen.pdf**.
- Students can research market trends for aluminum and other recyclables:
  - Students can investigate the historical prices and trends of recyclable beverage containers.
  - On **www.lme.com**, the London Metal Exchange, students can track the value of aluminum back several years to see the history of aluminum's value and predict what may happen in the future. Since 2005, aluminum value has increased. Currently, students can see what analysts are predicting for the future. Explore investment publications such as *Forbes* (**www.forbes.com**), *Kiplinger Report* (**www.kiplinger.com**), *Business Week* (**www.businessweek.com**), *Fortune* (**http://money.cnn.com/magazines/fortune/**), *Financial Times* (**www.ft.com/home/us**), *The Economist* (**www.economist.com**), and *The Wall Street Journal* (**http://online.wsj.com/public/page/2_0433.html?mod=hpp_us_pageone_more**) for additional information.
- Investigate what your local area is doing to invigorate recycling and increase its revenue potential.
- Visit your state (**http://www.epa.gov/msw/states.htm**) and local government's department of the environment website, explore recycling legislation and proclamations introduced during the legislative session (**http://www.llsdc.org/org/sourcebook/state-leg.ntm**) or by the governor.
- Explore your state's recycling association at Grassroots Recycling Network (**http://www.grrn.org/resources/sros.html**) or Keep America Beautiful (**www.kab.org/**) local affiliate websites to learn more. Read articles in the daily and weekly newspapers and magazines on recycling and determine who is the reporter assigned to the recycling/environmental area. Take a trip down the street on recycling and trash pickup days or visit the landfill and observe its workings including waste hauler and citizen participation.
- Start a discussion about what the students have learned and have them pair together to develop several insightful questions they would like to ask their county or state representative, environmental reporters, local political candidates, or recycling coordinator about increasing container recycling and deriving clean, dry source-separated commodities for reuse by industry.
- During a national election year, students can compare and contrast Democratic and Republican National Party Environment Platforms for recycling direction and its hierarchy in Presidential and Congressional campaigns.
- Research ways other communities are tackling their municipal solid waste and recycling challenges. Suggested reading includes *GAO Report to Congressional Requesters: Recycling — Additional Efforts Could Increase Municipal Recycling*, Dec. 2006, **www.gao.gov/new.items/d0737.pdf** and EPA publications such as *Cutting the Waste Stream in Half — Community Record-Setters Show How* and *Recycling Works! State and Local Solutions to Solid Waste Problems* found at **http://www.epa.gov/osw/**. Other suggested websites include: The White House Closing the Circle News, featuring ways the Federal Government is leading by example, under recycling award winners at **http://www.ofee.gov/eo/closing2.asp**; evening recycling pick up **www.jciaonline.org/FINALRELEASEVENINGSWRCYCPU.pdf**,

**Community Activism Extension**

Have students or the Ecology/Recycling Club compile a list of ideas to increase recycling in their area from completed student *Economic Value of Recycling – Questions for Thought* worksheets, adding new ideas as well. Students will then discuss which of the ideas would be best to increase the recycling rate in their community. The students will prepare a written proposal and a presentation including implementation suggestions, case studies, and estimated implementation costs for each idea. Using the *Economic Value of Recycling – Data Table* to summarize all recommendations, calculate the anticipated increase in the recycling rate and its economic and environmental impact on the town. Students will then present their findings to the local recycling coordinator, mayor, and/or town council. Suggest sending a copy of their report to their state representative and member of Congress who also would be interested in their findings.

**www.recyclecurbside.org**; **http://www.epa.gov/payt/comm-2.htm** as well as reference links found in the last section of *Talkin' Trash with ABCs* curriculum found at **www.cancentral.com**. Then discuss options for stimulating and sustaining greater recycling rates in your area.

- Apply communication strategies to encourage greater recycling participation in your community. Write a 15 second and 30 second radio public service announcement. For ideas, visit the Ad Council at **www.adcouncil.org**.

CANS: INFINITELY RECYCLABLE

# LESSON 5 ECONOMIC VALUE OF RECYCLING

TEACHER KEY

## Data Table

| | Our Town | Aluminum Beverage Cans (Soft Drink & Beer) | Plastic PET Soft Drink Bottles | Glass Containers (Soft Drink & Beer) | Comparable Town: _____ |
|---|---|---|---|---|---|
| Town Population | Y | | | | |
| Town's total daily trash (in pounds) | Y*4.6lbs=X | | | | |
| Town's total annual trash (in pounds) | X*365days=Z | | | | |
| Potential total tipping fee | Z * $0.02 | | | | |
| % of total trash for each type of material (using 2006 statistics) | | 0.6% of town's total trash are aluminum cans | 0.4% of town's total trash are plastic soft drink containers | 3.0% of the town's total trash are glass bottles | |
| Calculate the pounds of each type of material generated as waste annually for your town | | Z * 0.6% = A<br>or<br>Z * 0.006 = A | Z * 0.4% = P<br>or<br>Z * 0.004 = P | Z * 3.0% = G<br>or<br>Z * 0.3 = G | |
| Recycling Rate for each type of material (%) | | 45.1% of aluminum cans are recycled | 30.9% of the plastic bottles are recycled | 25.3% of the glass containers recycled | |
| Calculate the pounds of each type of material recycled annually | | A * 45.1% = Ar<br>or<br>A * 0.451 = Ar | P * 30.9% = Pr<br>or<br>P * 0.309 = Pr | G * 25.3% = Gr<br>or<br>G * 0.253 = Gr | |
| Total lbs of waste diverted from landfills (recycled) | Ar + Pr + Gr = Tr | | | | |
| Total savings from landfill tipping fee | Tr * $0.02 | | | | |
| Market value of recycled materials | | $1.02/lb | $0.12/lb | $0.003/lb | |
| Calculate the revenue from each type of material | | Ar * $$ = $Ar | Pr * $$ = $Pr | Gr * $$ = $Gr | |
| Total revenue generated by town recycling | $Ar + $Pr + $Gr = $Tr | | | | |
| What would the effect be if recycling rates changed to _____%? (We've used 75% as an example.) | **Overall trend:** Revenue would increase/ decrease | **Change in Revenue:** A * 75% = $Ar_{75}$ $Ar_{75}$ * $$ = $\$Ar_{75}$ Plus change in tipping fee… | **Change in Revenue:** P * 75% = $Pr_{75}$ $Pr_{75}$ * $$ = $\$Pr_{75}$ Plus change in tipping fee… | **Change in Revenue:** G * 75% = $Gr_{75}$ $Gr_{75}$ * $$ = $\$Gr_{75}$ Plus change in tipping fee… | |

Y=Town Population
X=Town's Total Daily Trash (pounds)
Z=Town's Annual Total Trash (pounds)
A=Aluminum Generated as Waste Annually

G=Glass Generated as Waste Annually
P=Plastic Generated as Waste Annually
Ar=Aluminum Recycled Annually
Pr=Plastic Recycled Annually

Gr=Glass Recycled Annually
$Ar=Market Value of Aluminum
$Pr=Market Value of Plastic
$Gr=Market Value of Glass

## Data Table

| | Our Town | Aluminum Beverage Cans (Soft Drink & Beer) | Plastic PET Soft Drink Bottles | Glass Containers (Soft Drink & Beer) | Comparable Town: _____ |
|---|---|---|---|---|---|
| Town Population | | | | | |
| Town's total daily trash (in pounds) | | | | | |
| Town's total annual trash (in pounds) | | | | | |
| Potential total tipping fee | | | | | |
| % of total trash for each type of material (using 2006 statistics) | | | | | |
| Calculate the pounds of each type of material generated as waste annually for your town | | | | | |
| Recycling Rate for each type of material (%) | | | | | |
| Calculate the pounds of each type of material recycled annually | | | | | |
| Total lbs of waste diverted from landfills (recycled) | | | | | |
| Total savings from landfill tipping fee | | | | | |
| Market value of recycled materials | | | | | |
| Calculate the revenue from each type of material | | | | | |
| Total revenue generated by town recycling | | | | | |
| What would the effect be if recycling rates changed to _____%? | **Overall trend:** | **Change in Revenue:** | **Change in Revenue:** | **Change in Revenue:** | |

## Instruction Sheet

Name: _____ Date: _____

Use the *Fact Sheets 1 & 2* as needed, or conduct research to complete the following steps to complete the non-shaded sections of your *Data Table*:

- Find and record the population of your town.
- Find the amount of waste produced per person, on average per day, in the U.S. and use it to calculate your town's daily and annual trash (in pounds) generated and record on your chart. The data can be found on the *Fact Sheet 2*.
- Next, calculate the potential cost for your town's trash to be taken to a landfill annually (potential total tipping fee) and record on your chart. The average tipping fee can be found on the *Fact Sheet 2*.
- Research the percent of total trash for each, type of material generated (before material recovery and combustion) annually using the data provided on the *Fact Sheet 1* and record on your chart.
- Use this data to calculate the pounds of each type of material generated as waste annually for your town.
- Using the data from the *Fact Sheet 2*, record the 2006 recycling rates for each type of material on your chart.
- Then calculate the number of pounds of each material recycled annually by your town — this is amount of trash that is diverted from the landfill.
- Add the three totals to get the total pounds of waste diverted from landfill and record on your chart.
- Find a town that is comparable to your town and repeat the above steps. If class time is minimal, provide similar town and have students use this town for the exercise.
- Calculate the cost savings of the reduced trash going to landfill (total savings from landfill tipping fee) and record on your chart.
- Next, you will need to research the market value, per pound, of your recycled materials. To do this, use the provided data on the *Fact Sheet 2*, or research the market value at the London Metal Exchange website **www.lme.com** and/or the Recycler's World website **www.recycle.net**.
- Record the market value for each type of material on your chart.
- Use these market values to calculate the amount of revenue your town will generate annually from each of the recycled materials.
- Add these three dollar amounts to get the total revenue generated by town recycling.
- Next, explore what would be the economic effects if the recycling rate for each material increased or decreased. See your teacher for a

pair of dice. Roll each die to determine what percentage to recalculate the recycling rates. For example, if you roll a 3 and 6, you need to recalculate the rates using 36%.

- Record the change in revenue, using your new percentages, for each of the three materials on your chart.
- Complete the *Questions for Thought* and prepare to discuss with the class. For the last question regarding ideas from other communities to increase recycling in yours, students should visit the Curbside Value Partnership at **www.recyclecurbside.org** and read EPA's *Cutting the Waste Stream in Half — Community Record-Setters Show How*, especially pages 12 to 28, at **www.epa.gov/epaoswer/non-hw/reduce/r99013.pdf**

## Questions for Thought

Name: _____ Date: _____

1. If you focused on beverage containers (aluminum, plastic, glass) to increase the amount recycled, which one would you focus on and why?

2. Which of the three materials (aluminum, glass and PET) had the highest market value and why?

3. What recommendations would you make to your local recycling coordinator to increase the recycling rates of the highest value container in your recycling program?

4. Why don't you get $1.02 per pound for your aluminum cans when you take them to be recycled at your local recycler, redemption center or, if in a deposit state, a retailer selling your product?

5. What are the economic impacts of waste diverted from landfills?

6. Assume a recycling rate of 90% for each of the three materials. List the revenue generated by each of the three materials and how this might impact the total revenue generated by your town.

7. What are some possible benefits to your town from increased revenue from recycling?

8. What are some personal actions you can take to reduce the amount of package containers going to the landfill?

9. If you were your municipality's recycling coordinator, what ideas would you consider implementing from the other communities to increase recycling rates?

10. What differences and similarities exist between your town and its counterpart as they relate to recycling programs?

**EXTRA CREDIT:**

11. The City of San Francisco, California, has set a 75% recycling diversion rate (total for residential, commercial, and construction) by 2010; 100% diversion rate by 2020. In 2002, San Francisco reached a recycling rate of 52%. Do you think San Francisco will make its goals?

    What are the pros and cons of city planners setting a 100% diversion rate? (Please see *Economic Value of Recycling – San Francisco Article 1 and 2*.)

12. The environmental impact of recycling cans be felt in many ways. Rising gas prices and electricity bills put one environmental impact at the top of the list: energy. The table below shows you the energy (and dollars!) lost by not recycling. Now that oil is hovering above $100 per barrel, calculate the estimated energy value lost of recyclables at $100 per barrel.

## Energy Consequences of Not Recycling

| Recyclable Material | Annual Lbs Per Household | Annual Value | Barrels of Oil Saved Per Ton* | Energy Value of Lost Recyclables (@75 per Barrel) | Estimated Energy Value of Lost Recyclables (@ $100 per Barrel) |
|---|---|---|---|---|---|
| Aluminum Cans | 27 | $24.57 | 40 | $2,092,153,864 | |
| Fiber | 1,821 | $52.62 | 1.7 | $6,159,015,000 | |
| Steel Cans | 19.2 | $1.19 | 1.8 | $129,870,000 | |
| PET Bottles | 39 | $11.70 | 16.3 | $2,222,143,140 | |
| HDPE Bottles | 30.1 | $9.63 | 16.3 | $1,578,935,748 | |
| Glass Bottles | 883.4 | $2.21 | 0.12 | $340,789,091 | |
| TOTAL | 2,819.70 | $97.64 | 12.70 | $12,522,906,845 | |

*Source: www.productstewardship.net/powerpoints/productsContainersCaurbsideValue.ppt#9*

** Per John Skinner, E.D. of SWANA in* Resource Recycling *magazine, September 2005*

## Questions for Thought

Name: _____ Date: _____

1. If you focused on beverage containers (aluminum, plastic, glass) to increase the amount recycled, which one would you focus on and why?

   *Answers will vary. Possible answers: for example, could be aluminum because it has the highest market value, can be recycled endlessly, and saves 95% of the energy, emissions and effluents than to create aluminum from raw materials, conserves the energy equivalent of over 30 million barrels of crude oil worldwide, has a strong market, and is easy to recycle.*

   *PET — greatest number of containers. Glass because of weight.*

2. Which of the three materials (aluminum, glass and PET) had the highest market value and why?

   *Aluminum because it is in high demand, can be recycled infinitely, has multiple uses, intensive refining process can be avoided by using used beverage cans and enabling higher recycled content rates, is an essential material for modern economies, market demand and recycling infrastructure.*

3. What recommendations would you make to your local recycling coordinator to increase the recycling rates of the highest value container in your recycling program?

   *Answers will vary. Start a promotional campaign capitalizing on the importance of aluminum can recycling and its value to the program — "Bin the Aluminum Can." Increase the curbside recycling bin size as advocated by the Curbside Value Partnership (www.recyclecurbside.org). Challenge school classes to an aluminum can recycling contest with winning class being able to wear jeans to school on a designated day or no homework night, etc. Build a mountain of cans to see what a million looks like. Recycling proceeds could purchase a climbing wall that would travel from school to school in the county, marching band uniforms, or limo transportation for the prom committee.*

4. Why don't you get $1.02 per pound for your aluminum cans when you take them to be recycled at your local recycler, redemption center or, if in a deposit state, a retailer selling your product?

   *The market value reflects the price paid per pound of clean, dry aluminum beverage cans. Since beverage cans are traded as a commodity, their price fluctuates day-to-day from recycling center to recycling center and is often tied to trading on to the London Metal Exchange. If you have large quantities of UBCs and/or present the UBCs in compressed bales or shredded form, the value of the cans increases because of the processing which has occurred. Beverage cans collected were not clean and dry, reducing the value.*

   *If you live in a deposit state, another party collects the value of the aluminum metal as specified by law.*

   *California is considered a redemption state where a person has the opportunity to can take their beverage cans to a "redemption" center to receive the deposit amount and the market rate determined by the center for the metal. Thus, your deposit plus the value of the aluminum cans may mean that you receive more than $1.02 paid per pound.*

5. What are the economic impacts of waste diverted from landfills?

   *Towns can generate more revenue by recycling more materials. The life of the landfill would be extended, reducing capitol outlay for a new landfill. Also the cost avoidance associated with landfill operations would be reduced.*

   *There is the economic environmental savings of water, greenhouse gases and energy associated from mining the bauxite by the unique closed-loop recycling of cans into cans again, endless in this pattern like money in the bank.*

   *Waste diverted from landfills helps keep the economy going with more than 56,000 recycling and reuse establishment nationwide employing approximately 1.1 million people, generating an annual payroll of $37 billion, and gross $236 billion in annual revenue according to the U.S. Recycling Economic Information Study.*

   *Companies rely on the feedstock supplied by recycling programs to provide the materials to make new products which helps our economy.*

   *The purchase of recycled products can provide high-quality, cost-effective products with environmental benefits. As demand for products made with higher recycled content increases, the recycling infrastructure grows, quality improves lead by R&D and technology advances, new commodities become recycled, new markets are found for use of these materials, and recycled products will be able to compete favorable with regard to cost.*

6. Assume a recycling rate of 90% for each of the three materials. List the revenue generated by each of the three materials and how this might impact the total revenue generated by your town.

   *Aluminum Cans = $904.69*
   *Plastic Drink Bottles = $88.70*
   *Glass Containers = $11.97*
   *Total Revenue = $1005.36*
   *These values almost doubled the town's revenue.*

7. What are some possible benefits to your town from increased revenue from recycling?

   *Answers will vary. Possible benefits could include expanded material curbside collection, less litter, reduced taxes, money for new projects of improvements such as a new skateboard park or free summer concerts, or could be used to offset or reduce the cost of garbage pickup to taxpayers. Tax-paying manufacturers may want to establish plants to take advantage of feedstock and reduce transportation costs which lead to jobs for the local economy, etc.*

8. What are some personal actions you can take to reduce the amount of the package containers going to the landfill?

   *(http://epa.gov/epaoswer/osw/citizens.htm)*

   *Answers will vary. Possible suggestions: to increase awareness by creating posters for the school or community, educating the community on the location of recycling containers, place a container recycling bin near soft drink machines and in teacher lounges, locating labeled, clear plastic bags for container recycling on chain link fences during soccer games or other sport events and then recycling the containers, not purchasing products with excessive packaging, hosting container recycling competitions within the school or community, applying peer pressure against putting non-recyclable materials into recycling bin, set up a recyclable material hunt with prizes for those bringing back the most for America Recycles Day (November 15) or Earth Day (April 22), share fun recycling facts in the school newspaper or during afternoon announcements, adopt a lower grade class and teach a lesson from either* Talkin' Trash *or* ABCs of Environmental Education *curriculum, establish a recycling club with recycling proceeds to pay for a limo to take students to the prom, set up an environmental bulletin board with fun recycling facts, remind someone depositing a container in the garbage that a better place is in the recycling bin, establish a recycling team at football games, or during park clean-ups, separate the litter from the recyclables and then recycle them.*

9. If you were your municipality's recycling coordinator, what ideas would you consider implementing from other communities to increase recycling rates?

   *Answers will vary. Possible ideas might include larger 95 gallon recycling bins; increasing the commodities recycled curbside to include grass trimmings, compost, U.S. mail; smaller recycling trucks to negotiate narrow streets, evening pick-up of both solid waste and recyclables; recognize those who put the proper recyclables in the bin with merchant discount cards; help recycling coordinators return bins with improper recyclables back to the home with a note as to what is recyclable; set up a PSA competition among colleges or high schools to produce a 30-second spot to promote local recycling; configuring the MSW trucks with recycling on one side and separate trash units to allow simultaneous recycling and MSW pickup, etc.*

10. What differences and similarities exist between your town and its counterpart as they relate to recycling programs?

    *Answers will vary. Differences might include: elected officials supportive of recycling, recyclables picked up once a week on the same day as the garbage, curbside bins with the commodities to be recycled on the bin, drop-off only, paid full-time recycling coordinator, large number of multi-unit residences, sizeable senior citizen community, resort area, recycling education campaign, legislated recycling goals or mandatory recycling, larger budget for solid waste management, snow-bird population, mandatory recycling for government, businesses, and citizens, recent natural disaster, percentage of landfill tipping fees directed to recycling program.*

**EXTRA CREDIT:**

11. The City of San Francisco, California, has set a 75% recycling diversion rate (total for residential, commercial, and construction) by 2010; 100% diversion rate by 2020. In 2002, San Francisco reached a recycling rate of 52%. Do you think San Francisco will make its goals?

    What are the pros and cons of city planners setting a 100% diversion rate? (Please see *Economic Value of Recycling – San Francisco Article 1 and 2*.)

    *Answers will vary. Possible answers might include: San Francisco appears to have a forward-thinking government and a population interested in the environment. A 75% recycling goal is doable since many items not now recycled can be added to the recycling mix especially as manufacturers design for recycling and technology and markets open to items currently not able to be recycled. However, a 100% recycling rate is overly optimistic. There will always be impediments to recycling including a transient workers, a visitor population and uneducated new comers. Goals that are not achievable can reduce the impetus to move forward after the 75% goal is made. Would have preferred an 80% mark, then a 85% mark that could conceivably be achieved and raised to the next level.*

12. The environmental impact of recycling can be felt in many ways. Rising gas prices and electricity bills put one environmental impact at the top of the list: energy. The table below show you the energy (and dollars!) lost by not recycling. Now that oil is hovering above $100 per barrel, calculate the estimated energy value lost of recyclables at $100 per barrel.

## Energy Consequences of Not Recycling

| Recyclable Material | Annual Lbs Per Household | Annual Value | Barrels of Oil Saved Per Ton* | Energy Value of Lost Recyclables (@75 per Barrel) | Estimated Energy Value of Lost Recyclables (@ $100 per Barrel) |
|---|---|---|---|---|---|
| Aluminum Cans | 27 | $24.57 | 40 | $2,092,153,864 | $2,789,538,485 |
| Fiber | 1,821 | $52.62 | 1.7 | $6,159,015,000 | $8,212,020,000 |
| Steel Cans | 19.2 | $1.19 | 1.8 | $129,870,000 | $173,160,000 |
| PET Bottles | 39 | $11.70 | 16.3 | $2,222,143,140 | $2,962,857,520 |
| HDPE Bottles | 30.1 | $9.63 | 16.3 | $1,578,935,748 | $2,105,247,667 |
| Glass Bottles | 883.4 | $2.21 | 0.12 | $340,789,091 | $454,385,354 |
| TOTAL | 2,819.70 | $97.64 | 12.70 | $12,522,906,845 | $16,697,209,127 |

*Source: www.productstewardship.net/powerpoints/productsContainersCaurbsideValue.ppt#9*

** Per John Skinner, E.D. of SWANA in* Resource Recycling *magazine, September 2005*

## Fact Sheet 1 Products Generated Before Materials Recovery or Combustion

**PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2006**
**(WITH DETAIL ON CONTAINERS AND PACKAGING)**
**(In percent of total generation)**

| | PERCENT OF TOTAL GENERATION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **PRODUCTS** | **1960** | **1970** | **1980** | **1990** | **2000** | **2002** | **2004** | **2005** | **2006** |
| **Durable Goods** | 11.3% | 12.1% | 14.4% | 14.5% | 15.5% | 16.1% | 16.0% | 16.2% | 16.0% |
| **Nondurable Goods** | 19.7% | 20.7% | 22.7% | 25.4% | 26.9% | 25.9% | 26.3% | 25.9% | 25.5% |
| ***Containers and Packaging*** | | | | | | | | | |
| **Glass Packaging** | | | | | | | | | |
| Beer and Soft Drink Bottles | 1.6% | 4.6% | 4.4% | 2.7% | 2.4% | 2.9% | 2.8% | 2.9% | 3.0% |
| Wine and Liquor Bottles | 1.2% | 1.6% | 1.6% | 1.0% | 0.8% | 0.7% | 0.6% | 0.7% | 0.7% |
| Food and Other Bottles & Jars | 4.2% | 3.7% | 3.2% | 2.0% | 1.4% | 0.9% | 0.9% | 0.8% | 0.9% |
| ***Total Glass Packaging*** | 7.0% | 9.8% | 9.2% | 5.8% | 4.6% | 4.5% | 4.4% | 4.4% | 4.5% |
| **Steel Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | 0.7% | 1.3% | 0.3% | 0.1% | Neg. | Neg. | Neg. | Neg. | Neg. |
| Food and Other Cans | 4.3% | 2.9% | 1.9% | 1.2% | 1.1% | 1.0% | 1.0% | 0.9% | 1.0% |
| Other Steel Packaging | 0.3% | 0.2% | 0.2% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% |
| ***Total Steel Packaging*** | 5.3% | 4.4% | 2.4% | 1.4% | 1.2% | 1.1% | 1.1% | 1.0% | 1.1% |
| **Aluminum Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | Neg. | 0.1% | 0.6% | 0.8% | 0.6% | 0.6% | 0.6% | 0.6% | 0.6% |
| Other Cans | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | 0.03% |
| Foil and Closures | 0.2% | 0.3% | 0.3% | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% |
| ***Total Aluminum Packaging*** | 0.2% | 0.5% | 0.8% | 0.9% | 0.8% | 0.8% | 0.8% | 0.8% | 0.8% |
| **Paper & Paperboard Pkg** | | | | | | | | | |
| Corrugated Boxes | 8.3% | 10.5% | 11.3% | 11.7% | 12.7% | 12.6% | 12.6% | 12.5% | 12.5% |
| Milk Cartons | | | 0.5% | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% |
| Folding Cartons | | | 2.5% | 2.1% | 2.4% | 2.3% | 2.2% | 2.2% | 2.2% |
| Other Paperboard Packaging | 4.4% | 4.0% | 0.2% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% |
| Bags and Sacks | | | 2.2% | 1.2% | 0.6% | 0.6% | 0.5% | 0.5% | 0.5% |
| Wrapping Papers | | | 0.1% | 0.1% | Neg. | Neg. | Neg. | Neg. | Neg. |
| Other Paper Packaging | 3.3% | 3.1% | 0.6% | 0.5% | 0.7% | 0.7% | 0.6% | 0.6% | 0.6% |
| ***Total Paper & Board Pkg*** | 16.0% | 17.7% | 17.4% | 15.9% | 16.8% | 16.5% | 16.2% | 16.0% | 16.1% |
| **Plastics Packaging** | | | | | | | | | |
| Soft Drink Bottles | | | 0.2% | 0.2% | 0.3% | 0.4% | 0.3% | 0.3% | 0.4% |
| Milk Bottles | | | 0.2% | 0.3% | 0.3% | 0.3% | 0.3% | 0.3% | 0.3% |
| Other Containers | 0.1% | 0.8% | 0.6% | 0.7% | 1.1% | 1.2% | 1.3% | 1.3% | 1.4% |
| Bags and Sacks | | | 0.3% | 0.5% | 0.7% | 0.7% | 0.7% | 0.7% | 0.7% |
| Wraps | | | 0.6% | 0.7% | 1.1% | 1.1% | 1.2% | 1.1% | 1.1% |
| Subtotal Bags, Sacks, and Wraps | | | 0.8% | 1.2% | 1.8% | 1.9% | 1.9% | 1.8% | 1.8% |
| Other Plastics Packaging | 0.1% | 1.0% | 0.5% | 1.0% | 1.5% | 1.5% | 1.8% | 1.8% | 1.8% |
| ***Total Plastics Packaging*** | 0.1% | 1.7% | 2.2% | 3.4% | 5.0% | 5.3% | 5.6% | 5.5% | 5.7% |
| **Wood Packaging** | 2.3% | 1.7% | 2.6% | 4.0% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% |
| **Other Misc. Packaging** | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 0.2% |
| ***Total Containers & Pkg*** | 31.1% | 36.0% | 34.7% | 31.4% | 31.9% | 31.8% | 31.5% | 31.2% | 31.7% |
| ***Total Product Wastes†*** | 62.0% | 68.8% | 71.8% | 71.4% | 74.3% | 73.8% | 73.9% | 73.3% | 73.2% |
| **Other Wastes** | | | | | | | | | |
| Food Scraps | 13.8% | 10.6% | 8.6% | 10.1% | 11.4% | 11.7% | 11.9% | 12.3% | 2.4% |
| Yard Trimmings | 22.7% | 19.2% | 18.1% | 17.1% | 12.8% | 13.0% | 12.7% | 12.9% | 12.9% |
| Miscellaneous Inorganic Wastes | 1.5% | 1.5% | 1.5% | 1.4% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% |
| ***Total Other Wastes*** | 38.0% | 31.2% | 28.2% | 28.6% | 25.7% | 26.2% | 26.1% | 26.7% | 26.8% |
| ***Total MSW Generated – %*** | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

http://www.epa.gov/epaoswer/non-hw/muncpl/pubs/06data.pdf
Generation before materials recovery or combustion.
Details may not add to totals due to rounding.
† Other than food products.
Neg. = Less than 5,000 tons or 0.05 percent.
*Source: Franklin Associates, A Division of ERG*

## Fact Sheet 2

| MARKET VALUE OF RECYCLED MATERIALS | |
|---|---|
| **Market Value** | **$$ per lb** |
| **Aluminum Cans** (Soft Drink & Beer) | **$1.02/lb** http://www.recycle.net/specs/gr050328.html |
| **PET** (Soft Drink Bottles) | **$0.12/lb** http://www.recycle.net/specs/gr100105.html |
| **Glass Containers** (Soft Drink & Beer) | **$0.003/lb** http://www.recycle.net/specs/gr090107.html |

*Source: www.recycle.net*

**FACT:** The average cost for trash to be put into a landfill (also called a tipping fee) is $0.02/lb.

**FACT:** In 2006, U.S. residents, businesses, and institutions produced more than 251 million tons of MSW, which is approximately 4.6 pounds of waste per person per day on average!

*Source: http://www.epa.gov/msw/recycle.htm*

**RECYCLING RATES OF SELECTED MATERIALS 2006**

*Source: www.epa.gov/msw/facts.htm*

## Teacher Market Value Information

**Source:** www.recycle.net
**Date:** Thursday December, 2006 – 12:20 PM EST;
**Amount:** TL prices refer to sorted and prepared materials, packaged and ready for shipment in typical Truck Load quantity weights of 40,000 lbs. unless otherwise stipulated.
All are "Market Average" prices for the date and time given.

### Aluminum

**Market name:** Briquetted UBC (biscuit or bale)
**Market definition:** Magnetically separated aluminum Used Beverage Cans compressed into briquettes with a minimum weight density of 50 lb. per cubic foot.
Briquettes sizes should be uniform and range from 12" to 24" x 12" to 24" x 8" to 48".
Briquettes should be stacked and banded together to form uniform bundles with a maximum height of 48" and a maximum weight of 4,000 lb.
**Market Average:** $ 1.02 / lbs (USD $) for TL quantity
**Web URL:** http://www.recycle.net/specs/gr050328.html

### PET

**Market name:** Baled Mixed PET (Polyethylene Terephthalate plastics' code #1) Scrap
**Market definition:** Assorted PET bottles or containers compacted into secure bundles with a minimum weight density of 10 lb./cubic foot May contain Post Consumer PET Soda Bottles of mixed colors
**Market Average:** $ 0.12 / lbs (USD $) for TL quantity
**Web URL:** http://www.recycle.net/specs/gr100105.html

### Glass

**Market name:** Scrap Post-Consumer Container Glass (beverage bottles — beer, wine and soft drink, teas, fruit), jars for food and cosmetics)
**Market definition:** Scrap Post-Consumer Container Glass shall consist of mixed colors of broken or whole container glass, (free of non-container glass & foreign materials)
**Market Average:** $ 6.00/ ton (USD $) for TL quantity = $0.003 / lb (USD $) for TL quantity
**Web URL:** http://www.recycle.net/specs/gr090107.html

## The Value of What's *Not* Getting Recycled Chart

The environmental impact of recycling can be felt in many ways. Rising gas prices and electricity bills put one environmental impact at the top of the list: energy. The table below summaries the energy and dollars lost by not recycling.

| Recyclable material | National recycling rate | Total available lbs. | Lbs. recycled | Un-recovered lbs. | Value of Un-recovered lbs. |
|---|---|---|---|---|---|
| Aluminum Cans | 52.0% | 2,905,769,231 | 1,511,000,000 | 1,394,769,231 | $1,269,240,000 |
| Fiber | 51.5% | 199,200,000,000 | 102,588,000,000 | 96,612,000,000 | $2,792,086,800 |
| Steel Cans | 63.0% | 2,109,634,551 | 1,329,069,767 | 780,564,784 | $48,316,960 |
| PET Bottles | 21.6% | 4,637,000,000 | 1,001,592,000 | 3,635,408,000 | $1,090,622,400 |
| HDPE Bottles | 16.7% | 3,310,000,000 | 552,770,000 | 2,757,230,000 | $882,313,600 |
| Glass Bottles | 22.0% | 97,090,909,091 | 21,360,000,000 | 75,730,909,091 | $189,327,273 |
| TOTAL | 40.4% | 309,253,312,873 | 128,342,431,767 | 180,919,881,106 | $6,271,907,033 |

*Source: www.productstewardship.net/powerpoints/productsContainersCaurbsideValue.ppt#8*
**Per John Skinner, E.D. of SWANA in* Resource Recycling *magazine, September 2005*

# LESSON 5 ECONOMIC VALUE OF RECYCLING

## Indianapolis Articles

August 28, 2006
**Indy will urge increased recycling**
**http://www.indystar.com/apps/pbcs.dll/article?AID=2006608280429**
*By Brendan O'Shaughnessy*

The city will launch an education and awareness campaign Tuesday to boost recycling efforts. Kumar Menon, director of the Department of Public Works, said today that he believes the city can become more environmentally friendly and economical by increasing participation in its curbside, drop-off and other recycling programs. He said a new contract with collection companies could turn a money-losing operation into a cost-neutral one.

For that to happen, city residents would have to make recycling a habit so that a higher volume of material helps pay for collecting it. Currently, the city collects curbside recycling bins from 31,000 of about 250,000 households and a larger amount of material through 28 drop-off bins located throughout the city. Last summer, the department considered dropping recycling altogether to cut costs. It costs the city $8.57 per week to collect a participant's curbside bins, while the homeowner pays about $5 per month, according to Margie Smith-Simmons, the department's spokeswoman.

Smith-Simmons said the city will begin an education campaign aimed at schools and businesses. It will include billboards, radio spots, inserts in utility bills, a new website, school programs, and even recycling rap and rock songs. The department will also launch a year-long series of town-hall forums to learn from the public how to increase participation in recycling through options ranging from pricing to mandatory separation from trash.

**City trying to save recycling**
*By Brendan O'Shaughnessy and Tammy Webber*
August 29, 2006

Indianapolis officials will launch a year-long effort to persuade residents to set recyclables at the curb rather than throw them in the trash, in an all-out bid to salvage the city's struggling recycling program. The public awareness campaign, which officials planned to announce today, will include billboards, radio ads, utility-bill inserts, a new website, and even rock and rap songs about recycling. The campaign will also target recycling at schools and businesses, and promote the city's 27 recycling drop-off sites.

In addition, the Department of Public Works will hold town-hall forums across Marion County on whether recycling should remain voluntary or become mandatory and whether the city should use a pay-as-you-throw incentive in which recycling is free but residents are charged for each bag of trash they toss.

"Our goal is to put the options out there," Public Works Director Kumar Menon said. "One of the fundamental things that contributes to a greener city is what we do with our trash."

Now, most of Marion County's trash is burned in an incinerator on the Southside. About 12% of the roughly 255,000 households within the county participate in a voluntary curbside recycling program, which costs local government far more than it generates. Of the 115,000 homes from which the city collects trash, fewer than 1,000 participated in recycling last year. Recycling costs the city about $8.57 per week per participant, while participants pay only $5.25 a month, officials said. Contractors picking up trash from the other 140,000 households also offer curbside recycling, and about 30,000 of their customers participate. Recycling fees are capped by the city at $5.25 a month, though some contractors charge less.

Last summer, the city considered dropping curbside recycling but decided to give it another try after a public outcry. Participation has increased about 20% since then, officials said, but it's still not good enough. "We want to have (residents) help us determine the future of (the) program," said Margie Smith-Simmons, public information officer for public works. "We want to make sure any program is viable and productive. If (people say), 'We're not going to pay for it, and we don't want pay-as-you-throw,' then we will probably take a real hard look and determine if this is something we can continue offering." Officials declined to release a participation target but said the volume of material recycled needs to increase if the program is to become anything close to self-sufficient. The timing is right for the initiative, at least in one sense. Recycling markets remain strong, waste haulers and recycling officials said.

Recycling reduces the amount of raw materials needed to make products — it's easier to make plastic from plastic, rather than from petroleum, for example — and lowers energy consumption. It also preserves landfill space and reduces the amount burned in incinerators. Steve Benham, who lives in the city's Glendale neighborhood, said he is disappointed that only two other residents on his street set recycling bins at the curb every Thursday. "As a citizen of Earth, I don't see how you could not want to eliminate trash," Benham said. "People always complain about government telling us what to do, but at a certain point, if we do not act (on our own), government has to tell us what to do.

"There is just a staggering amount of trash."

***Additional Sources of Information:***

1. Cutting the Waste Stream in Half — Community Record-Setters Show How
   **http://www.ilsr.org/pubs/cuttingwastefs.pdf**
2. Program Files of Recycling Record-Setters
   **www.ilsr.org/recycling/wrrs/profiles.html**
3. U.S. Environmental Protection Agency
   **http://www.epa.gov/osw/**

# LESSON 5 ECONOMIC VALUE OF RECYCLING

## San Francisco Article 1

November 25, 2002
**Can NYC Learn Recycling Lessons from San Francisco?**
**http://www.wnyc.org/news/articles/38899**
WNYC – New York City Public Radio
*By Amy Eddings*

When the city suspended plastic and metal recycling last summer, Mayor Michael Bloomberg argued that the programs were an expensive failure. But recycling advocates wonder why New York City has failed where other cities have succeeded. Today and tomorrow, recycling advocates are hosting a roundtable in lower Manhattan to discuss the future of recycling here. WNYC's Amy Eddings visited San Francisco's recycling operations — considered a model by many advocates — to find any lessons New York City could learn.

San Francisco's Department of the Environment recently set a new standard for its sanitation officials to meet: recycle 75% of its commercial, residential, and construction waste by 2010.

*JARED BLUMENFELD: And the additional part of the legislation, which kinda makes it even more visionary, is when San Francisco reaches 50% diversion, which should be this year or next, we'll be able to set a time, a deadline, for getting to zero waste. Zero waste. That's 100% recycling.*

And environment department director Jared Blumenfeld wants to reach this by 2020.

*New York sanitation officials hate being compared to other cities, even one like San Francisco, with a population density and diversity that comes closest to New York's. Our 20% recycling rate only reflects residential recycling, officials point out. Cities like Portland, with a 57% recycling rate, or Seattle, with 54%, or San Francisco, at 50, include bottle returns, and commercial and construction recycling — programs that New York City, by law, doesn't count. But San Francisco's residents divert 25% of their trash away from landfills, its sanitation officials are expanding their programs, not suspending them and they're setting goals for zero waste.*

Mark Murray, head of Californians Against Waste, is impressed.

*MARK MURRAY: San Francisco is doing a terrific job, particularly given the challenges of that city. It's the most densely populated city in California. And so San Francisco has had to be more creative to get to high diversion rates.*

That creativity starts here, at the corner of Union and Laguna, in San Francisco's Marina district. Dan Cocilova works for NorCal, the private company that handles San Francisco's residential and commercial waste.

*DAN COCILOVA: Everything's in plastic bins with wheels. It's basically automated — hook it up — dumps in. We have a two-chambered truck, one side for recycling, one side for garbage. So it keeps everything separated.*

But not separated the way residents do it here in New York, with paper and metal set out separately. In order to get more people to recycle, and to recycle more stuff, San Francisco changed its system two years ago. Metal, glass, plastic, and paper all go together in one blue bin. Food and yard waste go into a green bin to be composted. And everything else — trash — goes into a black bin.

Recycling and composting is free, but residents pay NorCal to take their trash. Service for a standard 32-gallon black bin costs about $17 a month. Smaller bins cost less. So, there's an incentive to recycle and compost — the less garbage you throw out, the less you pay. Bob Besso heads NorCal's residential recycling program. He peers into a black bin.

*BOB BESSO: This is a reduced volume garbage container. Our standard size is 32. This happens to have an insert that reduces the volume to 20 gallons. This is what we call our success story. This is what we want people to do: smaller garbage, more recycling.*

NorCal's new program will be city-wide by 2004, but already, the company says its "throw it all in one bin" service for metal, glass, plastic, and paper has made it easier for people to recycle, cheaper for NorCal to collect, and has doubled recycling rates in some neighborhoods. Since separation isn't done at the curb, by residents, NorCal is spending $34 million dollars to add five new sorting lines at its recycling center at Pier 96.

Papers bounce along rubber-coated rollers and into a big hopper; plastic jugs, metal cans, and glass bottles drop through the rollers and onto another belt for more sorting.

*BESSO: A lot of the bottles that're coming over here that are whole, stay whole. Our process, when we mix in the compaction trucks, when you mix it with the paper and the plastic, everything else kinda crunches up, but the glass don't, if you don't overcompress it.*

Glass is the big bugaboo for recyclers. Broken and mixed together, like it is in New York, it's practically worthless, and contaminates other recyclables, reducing their value. Kept whole, and sorted by color, like it is in San Francisco, glass sells for around $20 to $30 a ton. Besso says NorCal experimented nine times with its trucks and collection process before it found a way to minimize broken glass. New York also looked into the issue, once. Its conclusion? Don't even try it. Steven Lawitts is a Deputy Commissioner in New York's Sanitation Department.

*STEVEN LAWITTS: We did a pilot many years ago to test the economics of completely co-mingled collection, where we mixed paper, metal, glass, and plastic all in a single truck. And we subjected that paper to market analysis as we had expected, it had degraded significantly and commanded a much lower price because of the presence of glass.*

But San Francisco found a way to make co-mingled collection work so much so, that at $180 a ton, it's cheaper for NorCal to recycle than it is to take trash to a landfill, at $200 a ton. It's the reverse in New York. Picking up and processing metal, glass, and plastic was projected to cost $240 a ton, almost double the price of collecting and exporting garbage. And until the local market changes, the future of recycling glass and plastic in New York seems gloomy. New York Sanitation Commissioner John Doherty spoke recently at a panel at the New School.

*JOHN DOHERTY: One can take different positions on recycling in New York City, and criticize the department or anyone else about whether it works or not. But the fact of the matter is, it is very, very expensive. So when you look at it purely from a dollar-and-cents point of view, it's hard to justify some of the recycling that goes on in this city.*

Many recycling advocates think the city could do a lot to change that dollars-and-cents picture through tax incentives for recycling industries, longer contracts with processors collecting garbage and recycling together, greater

community outreach, even charging New Yorkers for their garbage service. But advocates feel their views fall on deaf ears. Emily Miggins says San Francisco is different. She used to work in NorCal's recycling department.

*EMILY MIGGINS: It wasn't that they were proactive in saying, "Hey, Greenpeace, come sit at my table." But I think what they really have done differently at NorCal is really work with the city coordinators who are hired to execute better ideas and plans for the city.*

Miggins now lives in New York, and is a board member of the Grassroots Recycling Network. She's attended many council hearings, and has come to the conclusion that New York's sanitation officials lack the vision and brawn to make recycling work.

*MIGGINS: I can't believe that the most powerful city in the world — I mean, what an honor that the commissioner has to be asked to execute this program for the city of New York; and every time he gets up there, he sounds like a victim. A victim! It's a victim mentality.*

Sanitation officials say they've worked very hard, and have spent lots of money to educate the public, and they say New York's 20% recycling rate is a big achievement for a city full of tough customers. Even so, San Francisco's director of the Department of the Environment, Jared Blumenfeld, says New York's arguments don't hold much water.

*JARED BLUMENFELD: I mean, I don't think anyone buys it. I think there's many different options that New York can pursue. There are a lot of different pilot programs that they should be looking at. They shouldn't just say, this isn't possible. They should work out how it IS possible.*

The roundtable on the future of New York City's recycling, hosted by advocates, begins today at Pace University. New York's sanitation department is sending someone to observe the conference. A recycling official from San Francisco will be there.

For WNYC, I'm Amy Eddings.



© Copyright 2002, WNYC

# LESSON 5 ECONOMIC VALUE OF RECYCLING

## San Francisco Article 2

December 12, 2002
**S.F. turns greener**
**City reaches state-mandated goal of recycling 50% of its waste**
**http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2002/12/12/BA78174.DTL**
*By Jane Kay, San Francisco Chronicle*

At a time when many major U.S. cities are reusing less and throwing away more, San Franciscans are stuffing recycling bins like never before.

As of today, San Francisco can brag that it has surpassed the state's mandate that cities recycle more than they dump in landfills, and city officials are crediting modern recycling facilities and economic incentives that make recycling pay for consumers.

"We've created a system that works," said Jared Blumenfeld, director of the San Francisco Environment Department. "The city gets money from the program, the scavengers make a profit, and ratepayers pay less than the Bay Area average for service. That's the hallmark of a well-run program."

While recycling rates have grown nationwide over the last 15 years, that growth is beginning to lose steam. New York, for example, temporarily halted the collection of plastics and glass, calling it "labor intensive" and "inefficient." Dallas and Denver are considering cutbacks.

Not so in San Francisco and other cities in California, which are forging ahead with zeal. The city joins some 35 other Bay Area cities in meeting the state's goal of recycling 50% of the garbage that would otherwise end up in landfill.

Faced with fears that California was running out of space in landfills, the Legislature passed a law in 1990 that gave cities 10 years to cut their landfill dumping by half. Cities that failed to reach the 50% reduction face fines of up to $10,000 a day, although most have received extensions of up to five years.

San Francisco has brought its rate to 52% from 46% a year ago because of a near doubling of commercial waste recycling and smaller increases in household and construction waste recycling.

The city now recycles food waste from 1,500 restaurants and households in most neighborhoods. The waste is used to make compost that is snapped up by Sonoma and Napa vineyards, nurseries, landscapers, orchards, and some farms that return to the Farmer's Market to sell produce. City officials hope to reach 75% by 2012 and one day eliminate all waste. In the end, they say, the goal is to save trees, precious metals, water, energy, and landfill space.

At the heart of the city's success, experts say, is San Francisco's ability to provide economic incentives for customers and the city's for-profit scavenger companies.

"About 10 years ago, San Francisco and New York (recycling rates) were about equal with 25%," Blumenfeld said. "But San Franciscans have a philosophical commitment to make recycling work, and that's reflected in city government.

"At the end of the day, New Yorkers want to recycle, but New York at the government level doesn't have that commitment."

In San Francisco, there's no charge for recycling, but if households reduce their garbage can size to 20 gallons from 32 gallons, they pay a lower collection fee. Collection companies receive money for hitting recycling benchmarks.

Blumenfeld noted that there are no economic incentives to recycle for New Yorkers, who don't pay extra for garbage collection. Moreover, in New York, the collection is done by a public agency and not private companies, and so economic incentives would be inappropriate.

In addition, the resale value of San Francisco's recyclables is high because it does an exceptional job of collecting and separating them, experts say.

At the city's recycling separation center at Pier 96, state-of-the-art conveyer belts move the materials along so the heavier cans and glass containers fall to the bottom and paper floats up. Air jets suck up the separated paper to balers. Magnets capture steel cans and tops, and others grab aluminum. Plastic containers are flipped into giant cages. A worker sorts glass bottles by color — green for Heineken and amber for Budweiser.

Plastic is the biggest problem to recycle. Caps to water bottles, TV dinner trays, green plant pots, plastic bags, and broken VCR cassettes and compact discs have to be culled out and dumped in the landfill.

New York took the unusual step this summer of ending pickup of glass and plastic, saying it would save the city $40 million a year. Since then, the household recycling dropped to a dismal 11% from 20%. In New York, there is no modern sorting equipment.

Steven Lawitts, deputy commissioner of the New York Department of Sanitation, says it's hard to get out the recycling message.

"New York is very dense, with many high-rise buildings and many languages," he said. They keep leaving out materials inappropriate for recycling. "We've heard from many people very passionate about recycling. But part of the passion is misdirected. New York doesn't have a state law similar to California's that requires jurisdictions to meet a recycling goal. But New York is considering newer collecting and sorting technology that would increase the value of the materials," Lawitts said.

"That's something that might work in New York. Maybe we'll come out to San Francisco and take a look."

# BIBLIOGRAPHY


Anonymous. *About Landfilll Methane Outreach Program (LMOP).* U.S. Environmental Protection Agency. April 14, 2008 retrieved from www.epa.gov/lmop/overview.htm#converting

Anonymous. *Aluminum For Future Generations—Sustainability.* The International Aluminum Institute. April 14, 2008 retrieved from http://www.world-aluminum.org/Sustainability

Anonymous. *Aluminum for Future Generations Sustainable Update 2005.* The International Aluminum Institute. April 14, 2008 retrieved from http://www.world-aluminum.org/iai/publications/documents/update_2005.pdf

Anonymous. *Aluminum Industry of the Future.* (February 2001). Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, Office of Industrial Technologies Program. April 14, 2008 retrieved from http://www1.eere.energy.gov/industry/aluminum/partnerships.html

Anonymous. *Aluminum Industry Technology Roadmap.* February 2003. The Aluminum Association and U.S. Department of Energy. April 14, 2008 retrieved from www.1.eere.energy.gov/industry/aluminum/pdfs/al_roadmap.pdf

Anonymous. *Aluminum – Just the Facts.* U.S. Environmental Protection Agency, Office of Municipal Solid Waste. April 14, 2008 retrieved from http://www.epa.gov/msw/alum.htm

Anonymous. *Aluminum Industry Vision – Sustainable Solutions.* (November 2001). Prepared by Energetics for The Aluminum Association and U.S. Department of Energy. April 14, 2008 retrieved from http://www1.eere.energy.gov/industry/aluminum/pdfs/alum_vision.pdf

Anonymous. *Aluminum Packaging.* Alupro. April 14, 2008 retrieved from http://www.alupro.org.uk/aluminium%20packaging.htm

Anonymous. *Aluminum Smelting.* Alcoa. April 14, 2008 retrieved from http://www.alcoa.com/global/en/about_alcoa/pdf/Smeltingpaper.pdf

Anonymous. *America's Recycling "Perception Gap" Leaves Millions in Landfills.* Alcan News Release. April 14, 2008 retrieved from http://www.recycle.alcan.com/NR/rdonlyres/ECB89725-DBA1-4643-B1A1-6AA8CA17295D/O/WasteAgeArticle.pdf

Anonymous. *Basic Aluminum Facts and Extractive Metallurgy, Aluminum Extruders Council.* April 14, 2008 retrieved from http://www.aec.org/exbasics/aluminum.html

Anonymous. *Bauxite Geology—Composition.* International Aluminum Institute. April 14, 2008 retrieved from http://www.world-aluminum.org/production/mining/geology.html

Anonymous. *Benefits of LFG Energy.* U.S. Environmental Protection Agency. April 14, 2008 retrieved from http://www.epa.gov/lmop/benefits.htm

Anonymous. *BinBuzz — What Five Years Has Taught Us.* (Winter 2008). Curbside Value Partnership. April 14, 2008 retrieved from http://www.recyclecurbside.org/docs/binbuzz/BINBUZZ.FINAL.pdf

Anonymous. *Can-Making and Filling.* Alupro. April 14, 2008 retrieved from http://www.alupro.or.uk/aluminum%20packaging-can.htm

Anonymous. *Clean Energy.* U.S. Environmental Protection Agency. April 14, 2008 retrieved from http://www.epa.gov/cleanenergy/index.html

Anonymous. *Cutting the Waste Stream in Half—Community Record-Setters Show How.* (October 1999). U.S. Environmental Protection Agency. April 30, 2008 retrieved from http://www.epa.gov/epaoswer/non-hw/reduce/r99-13.pdf

Anonymous. *Decision Maker's Guide to Solid Waste Management, Volume 2.* U.S. Environmental Protection Agency. April 14, 2008 retrieved from http://www.p2pays.org/ref%5C03/02021.htm

Anonymous. *Electricity from Municipal Solid Waste.* U.S. Environmental Protection Agency. April 14, 2008 retrieved from http://www.epa.gov/solar/energy-and-you/affect/municipal-sw.html

Anonymous. *Energy Technology Solutions: Public-Private Partnerships Transforming Industry.* (October 2007). U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. April 14, 2008 retrieved from http://www1.eere.energy.gov/industry/bestpractices/pdfs/itp_successes.pdf

Anonymous. *Environmental Benefits of Recycling One Ton of Aluminum.* Novelis. April 14, 2008 retrieved from http://www.novelis.com/Internet/en-US/Sustainability/Recycling/default.htm

Anonymous. *For Your Information…Municipal Solid Waste Landfills—All You Wanted to Know but Were Afraid to Ask.* July 2007. South Carolina DHEC, Office of Solid Waste Reduction and Recycling. April 14, 2008 retrieved from www.scdhec.gov/recycle

Anonymous. *General Accountability Office Report to Congressional Requesters: Recycling: Additional Efforts Could Increase Municipal Recycling Extensions* (December 2006). April 14, 2008 retrieved from www.gao.gov/new.items/d0737.pdf

Anonymous. General Attitude and Behavior Survey Baseline Findings (November 2007) by Gomez Research for California Integrated Waste Management Board. April 14, 2008 retrieved from http://www.ciwmb.ca.gov/Publications/General/53008001.pdf

Anonymous. *Growing Participation in Curbside Programs Nationwide.* Curbside Value Partnership. April 14, 2008 retrieved from http://www.recyclecurbside.org/

Anonymous. *Health, Safety, Security and Environment: Commitment to Conducting its Business in an Ethical and Environmentally Responsible Manner.* ARCO Aluminum, Inc. April 14, 2008 retrieved from www.arcoaluminum.com/sectiongenericarticle.do?categoryId=9004057&contentId=7008374

Anonymous. *How Products Are Made: Volume 2*, "Aluminum Beverage Can," April 14, 2008 retrieved from http://www.madehow.com/Volume-2/Aluminum-Beverage-Can.html

Anonymous. *It All Starts with Dirt—The Making of Aluminum at Alcoa.* April 14, 2008 retrieved from http://www.alcoa.com/global/en/about_alcoa/dirt.asp

Anonymous. *Laws, Regulations, Guidance and Dockets.* U.S. Environmental Protection Agency. April 14, 2008 retrieved from http://www.epa.gov/lawsregs/

Anonymous. *Landfill Methane Outreach Program.* U.S. EPA. April 14, 2008 retrieved from http://www.epa.gov/landfill/

Anonymous. *Measuring Recycling—A Guide for State and Local Governments.* (September 1997) U.S. Environmental Protection Agency. April 30, 2008 retrieved from http://www.epa.gov/recycle.measure/docs/guide.pdf

Anonymous. *Minerals Zone—Bauxite.* World Mineral Exchange. April 14, 2008 retrieved from http://www.mineralszone.com/minerals/bauxite.html

Anonymous. *MSW (Subtitle D) Landfills.* (November 8, 2006). Wastec Group for National Solid Wastes Management Association. April 14, 2008 retrieved from http://wastec.isproductions.net/webmodules/webarticles/anmviewer.asp?a=1127

Anonymous. *Municipal Solid Waste (MSW) State Data.* U.S. Environmental Protection Agency. April 30, 2008 retrieved from http://www.nrc-recycle.org/localresources.aspx

Anonymous. *Municipal Solid Waste—Electricity from Municipal Solid Waste.* U.S. Environmental Protection Agency. April 14, 2008 retrieved from http://www.epa.gov/cleanenergy/energy-and-you/affect/municipal-sw.html

Anonymous. *Municipal Solid Waste Generation, Recycling and Disposal in the United States: 2006 Facts and Figures.* (October 18, 2006). U.S. Environmental Protection Agency, Municipal and Industrial Solid Waste Division, Office of Solid Waste. April 14, 2008 retrieved from http://www.epa.gov/garbage/msw99.htm

Anonymous. *Novelis Joins EPA Climate Leaders Program* (August 9, 2006). April 14, 2008 retrieved from http://www.novelis.com/Internet/en-US/Sustainability

Anonymous. *Packaging's Contribution to Sustainable Production, Distribution and Consumption.* Industry Council for Packaging and the Environment retrieved from http://www.incpen.org/pages/userdata/incp/Vision.pdf

Anonymous. *Production.* The International Aluminum Institute. April 14, 2008 retrieved from http://www.world-aluminum.org/About+Aluminum/Production

Anonymous. *Program Files of Recycling Record-Setters* (November 1998). U.S. Environmental Protection Agency. April 14, 2008 retrieved from http://www.ilsr.org/recycling/wrrs/profiles.html

Anonymous. *Primary Metals.* U.S. Environmental Protection Agency Office of Pollution Prevention & Toxics and Northwest Management Officials Association. April 14, 2008 retrieved from www.p2pays.org/ref/01/text/0078/chapter4.htm

Anonymous. *Report to Congressional Requesters: Recycling—Additional Efforts Could Increase Municipal Recycling* (December 2006). U.S. Government Accounting Office (GAO). April 30, 2008 retrieved from http://www.gao.gov/new.items/d0737.pdf

Anonymous. *Report on Post Consumer PET Container Recycling Activity* (2006). National Association for Plastic Container Recovery. April 14, 2008 retrieved from http://www.napcor.com/pdf/2006PET_Report.pdf

Anonymous. *Recycling Calculator—What if Everyone in Your Neighborhood Recycled All Their Aluminum Cans.* Novelis. June 12, 2008 retrieved from http://www.novelis.com/Internet/recyclingcalculator/recycleCalculator.aspx

Anonymous. *Recycling Processes.* Alupro. April 14, 2008 retrieved from http://www.alupro.org.uk/recycling.htm

Anonymous. *Recycle Today: The American Consumers' Viewpoint* (December 2002) by Leger Marketing for Alcan. April 14, 2008 retrieved from http://www.forester.net/mw_electronic/mw0304recycling.pdf

Anonymous. *Recycling Works! State and Local Solutions to Solid Waste Management Problems.* (April 1999) U.S. Environmental Protection Agency. April 30, 2008 retrieved from http://www.epa.gov/epaoswer/non-hw/recycle/recycle.pdf

Anonymous. *Report on Post Consumer PET Container Recycling Activity.* North America PET Plastics Organization. April 12, 2008

Anonymous. *Safety—Safely Or Not At All.* Institute of Scrap Recycling Industries. April 16, 2008 retrieved from http://www.isri.org/AM/Template.cfm?Section=Safety2&Template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=96&ContentID=5451

Anonymous. *Scrap Safety Blueprint.* Institute of Scrap Recycling Industries. April 14, 2008 retrieved from http://www.isri.org/AM/Template.cfm?Section=Safety2&Template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=96&ContentID=5451

Anonymous. *Saskatchewan Solid Waste Management Strategy—Stakeholder Consultation Document.* June 2005. Saskatchewan Environment, Environmental Protection Branch, Waste Management Unit, April 14, 2008 retrieved from http://www.se.gov.sk.ca/

Anonymous. *Scrap Specifications Circular—Guidelines for Nonferrous, Ferrous Scrap, Glass Cullet, Paper Stock, Plastic Scrap, Electronics, Tire Scrap* (2007). Institute of Scrap Recycling Industries. April 14, 2008 retrieved from http://www.isri.org/AM/Template.cfm?Section=Home1&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=13683

Anonymous. *Size of the U.S. Solid Waste Industry Executive Summary.* R.W. Beck. April 14, 2008 retrieved from http://www.erefdn.org/sizeofindustryreport.html

Anonymous. *Solid Waste Combustion/ Incineration.* U.S. Environmental Protection Agency, Office of Solid Waste. April 14, 2008 retrieved from http://www.epa.gov/garbage/landfill/sw_combst.htm

Anonymous. *State Recycling Resources.* National Recycling Coalition. April 30, 2008 retrieved from http://www.nrc-recycle.org/localresources.aspx

Anonymous. *Stock Market Savvy: Investing for Your Future, New York Stock Exchange and Lifetime Learning Systems.* April 13, 2008 retrieved from http://www.nyse.com/pdfs/TG_Mech.pdf

Anonymous. *Story of Aluminum.* The International Aluminum Institute. April 14, 2008 retrieved from http://www.world-aluminum.org/About+Aluminum/Story+of

Anonymous. *Sustainability.* U.S. Environmental Protection Agency. April 14, 2008 retrieved from http://www.epa.gov/sustainability/

Anonymous. *Technology Advancement.* The Aluminum Association. April 14, 2008 retrieved from http://www.aluminum.org/Content/NavigationMenu/TheIndustry/TechnologyAdvancement/default.htm

Anonymous. *The Aluminum Federation Fact Sheet 11—Aluminum Recycling.* April 14, 2008 retrieved from http://www.alfed.org.uk/templates/alfed/content.asp?PageID=108

Anonymous. *The Canadian Aluminum Industry and the Environment.* (2007). Aluminum Association of Canada. April 14, 2008 retrieved from http://www.aac.aluminium.qc.ca/frameset/top_content_bottom_en.html

Anonymous. *The Consumer's Handbook for Reducing Solid Waste.* U.S. Environmental Protection Agency. April 14, 2008 retrieved from http://www.epa.gov/epaoswer/non-hw/reduce/catbook/index.htm

Anonymous. *The National Waste Minimization Program.* U.S. Environmental Protection Agency. Retrieved from http://www.epa.gov/minimize/

Anonymous. *The Recycling Loop.* Alupro. April 14, 2008 retrieved from http://www.alupro.org.uk/continuous%20loop.htm.

Anonymous. *UBC Specifications and Guidelines* (July 2006). Novelis. April 14, 2008 retrieved from http://www.novelis.com/NR/rdonlyres/72030193-07EB-4408-A5ED-FA28D5CE8EA4/4031/UBCSpecificationsandGuidelinesforNovelisNorthAmeri.pdf

Anonymous. *U.S. EPA Climate Change Site.* April 14, 2008 retrieved from http://epa.gov/climatechange/index.html

Anonymous. *U.S. Recycling Economic Information Study* (July 2001), Prepared by R.W. Beck for the National Recycling Coalition. April 14, 2008 retrieved from http://www.epa.gov/jtr/econ/rei-rw/rei-rw.htm

Anonymous. *Voluntary Aluminum Industrial Partnership.* U.S. Environmental Protection Agency. April 14, 2008 retrieved from http://www.epa.gov/highgwp/aluminum-pfc/

Anonymous. *What is Aluminum?* Alupro. April 14, 2008 retrieved from http://www.alupro.org.uk/mining%20and%20production.htm

Anonymous. "World's Best R&D Companies," (October 2007). *R&D Magazine.* May 15, 2008 retrieved from http://www.rdmag.com/pdf/RD0710_cos.pdf

Bellis, Mary. *Charles Martin Hall (1863–1914) — Aluminum.* About, Inc., New York City, New York. April 14, 2008 retrieved from http://inventors.about.com/library/inventors/blaluminum.htm

Bush, George W. *Executive Order 13149 — Strengthening Federal Environmental, Energy, and Transportation Management.* Office of the Federal Environmental Executive, The White House. April 14, 2008 retrieved from http://www.whitehouse.gov/news/releases/2007/01/20070124-2.html

Choate, William and Green, John. *U.S. Energy Requirements for Aluminum Production: Historical Perspective, Theoretical Limits, and New Opportunities* (February, 2003). Prepared by BCS, Inc. for the U.S. Department of Energy. April 12, 2008 retrieved from http://www1.eere.energy.gov/industry/aluminum/pdfs/al_theoretical.pdf

Cogan, Douglas G. *Corporate Governance and Climate Change: Making the Connection—Summary Report.* (March 2006). Ceres Publication, Boston, MA. April 14, 2008 retrieved from http://www.earthinstitute.columbia.edu/grocc/documents/Ceres_corp_gov_and_climate_change_sr_0306.pdf

Das, Subodh. *In Light Metals* (pp. 1131–1140). Projects of the Sloan Industry Center for a Sustainable Aluminum Industry Promoting Aluminum Recycling. (2007). Lexington, KY. April 14, 2008 retrieved from http://www.secat.net/docs/resources/Sloan_Industry_Projects07.pdf

Eddings, Amy. *Can NYC Learn Recycling Lessons from San Francisco?* (November 25, 2002) WNYC–New York City Public Radio. April 14, 2008 retrieved from http://www.wnyc.org/news/articles/38899

Freudenrich, Craig. *How Landfills Work.* April 14, 2008 retrieved from http://www.howstuffworks.com/landfill.htm

Fehrenbach, Peter, *Waste News*, "InBox," April 29, 2008 retrieved from news@wastenews.compopcan.html

Gilardeau, Jean-Pierre (June 18, 2007) *Sustainability in Business—Three Challenges to Leadership in Moving Toward Sustainable Development.* Speech before the International Forum on Applied Sustainable Development, Quebec, Canada at the Universite de Sherbrook. April 14, 2008 retrieved from http://www.alcoa.com/global/en/about_alcoa/commitment_to_sustain/pdfs/Gilardeau_Sustainability_Challenges_07_17-07.pdf

Glenn, Jim. "The State of Garbage in America, Part 1." *BioCycle.* April 1998, pp.32–43.

Guzzone, Brian; Goldstein, Rachel; Fanjoy, Joe (January 24, 2007). *Landfill Methane Partners and Projects Receive EPA Awards, MSW Management.* April 14, 2008 retrieved from www.gradingandexcavation.com/mw_0705_methane.html

Kachan, Dallas (November 3, 2006). *Delaware Now Generating power from Landfill Methane.* April 14, 2008 retrieved from http://media.cleantech.com/274/Delaware-now-generating-power-from-land

Kay, Jane. *S.F. Turns Greener—City Reaches State-Mandated Goal of Recycling 50% of its Waste* (December 12, 2002). San Francisco Chronicle. April 13, 2008 retrieved from http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2002/12/12/BA78174.DTL

Kiser, Jonathan V. L. (May/June 2003). "Recycling and Waste-To-Energy: The Ongoing Compatibility Success Story," *MSW Management.* May/June 2003. April 14, 2008 retrieved from http://www.mswmanagement.com/mw_0305_recycling.html

Leith, Angie. *US EPA 3R Portfolio Good Practices to Promote the 3 Rs – Country: United States of America* retrieved June 23, 2008 http://www.env.go.jp/recycle/3r/en/info/05_17.pdf

Leyland, Jo. *Renew America Success Stories — Imperial City Recycling Project.* April 30, 2008 retrieved from http://www.smartcommunities.ncat.org/success/imperial_recycling.shtml

McNealy, P.R. (October 10, 2000) *Contaminants: What they Are and Why They're an Issue.* Alcoa, Inc. April 14, 2008 retrieved from http://www.alcoa.com/rigid_packaging/en/docs/quality_rating_procedures.doc

Munford, Chris. "The Story on Specs." *Scrap Magazine*, Sept.Oct., 2005 pages 69–72. April 14, 2008 retrieved from http://www.isri.org/AM/Template.cfm?Section=Commodity_Specifications&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=9645

O'Shaughnessy, Brendan. "Indy will Urge Increased Recycling" (August 28, 2006), *Indy Star*. April 14, 2008 retrieved from http://www.indystar.com/apps/pbcs.dll/article?AID=2006608280429

Petroski, Henry. *The Evolution of Useful Things*, "Closure Before Opening", Knopf Publishers, New York, New York. 1992. Pages 196–201. April 14, 2008 retrieved from http://www.eiu.edu/~scienced/3290/science/discrepant/popcan.html

Pignataro, Maria. *Jersey City to Implement Evening Trash & Recycling Pick Up Beginning in the New Year.* Media Advisory (December 15, 2006). April 12, 2008 retrieved from http://www.jciaonline.org/FINALRELEASEVENINGSWRCYCPU.pdf

Sturgell, Brian. *Measuring the Challenge to Aluminum, Alcan and The Aluminum Association* (May 5, 2003). April 14, 2008 retrieved from http://www.aluminum.org/ANTemplate.cfm?IssueDate=05/01/2003&Template=ContentManagement/ContentDisplay.cfm&ContentID=7150

Tyson, Neil deGrasse. "The Periodic Table of the Cosmos"(July/August 2002). *Natural History Magazine*, American Museum of Natural History. April 14, 2008 retrieved from http://research.amnh.org/~tyson/18magazines_periodictable.php

Walsh, Rebecca. "Recycling Bins are Not for Boa Constrictors" (June 10, 2008). *The Salt Lake Tribune.* June 11, 2008 retrieved from http://www.sltrib.com/news/ci_9537080

Walton, Sam. *Running a Successful Company: Ten Rules that Worked for Me.* April 12, 2008 retrieved from http://dfll.fudan.edu.cn/CollegeEnglish/DocFile/Second/new/0402-0406/OnlineAssignments/BK2Unit2reading.doc

www

# RESOURCES

For information relevant to recycling nationally and locally, below are links to help you start.

## Can Manufacturers Institute

www.cancentral.com

## State Environmental Agencies and Recycling Organizations

(For state agency solid waste management, state environmental education, state recycling association, and U.S. EPA Region websites and those with an educational component, please go to "Resources" in the *Talkin' Trash with ABCs curriculum*.)

### Alabama

Pollution Prevention Division
Department of Environmental Affairs
http://www.adem.alabama.gov/Education%20Div/P2%20Program/P2MainPage.htm
Keep Alabama Beautiful
http://www.kab.org/site/PageServer?pagename=Affiliate_State_Alabama

### Alaska

Solid Waste Program
Division of Environmental Health
Department of Environmental Conservation
http://www.dec.state.ak.us/eh/sw/index.htm
Alaskans for Litter Prevention and Recycling
http://www.alparalaska.com/

### Arizona

Waste Programs Division
Department of Environmental Quality
http://www.azdeq.gov/environ/waste/index.html
Arizona Recycling Coalition
http://arizonarecyclingcoalition.com/

### Arkansas

Solid Waste Management Division—Recycling Branch
Department of Environmental Quality
http://www.adeq.state.ar.us/solwaste/branch_recycling/default.htm
Regional Recycling Coordinators
http://www.adeq.state.ar.us/solwaste/branch_recycling/coord.htm
Arkansas Recycling Coalition
http://www.recycleark.org/
Keep Arkansas Beautiful
http://www.keeparkansasbeautiful.com/

### California

Division of Recycling
Department of Conservation
http://www.conservation.ca.gov/dor/Pages/Index.aspx
California Integrated Waste Management Board
http://www.ciwmb.ca.gov/
Local Government Agencies and Curbside Programs
http://www.conservation.ca.gov/dor/lgacp/Pages/index.aspx
California Resource Recovery Association
http://www.crra.com/
Keep California Beautiful
http://www.keepcaliforniabeautiful.com/

### Colorado

Hazardous Materials/Waste Management Division
Department of Public Health & Environment
http://www.cdphe.state.co.us/hm/index.htm
Colorado Association for Recycling
http://cafr.org/

### Connecticut

Bureau of Material Management Compliance
Department of Environmental Protection
http://www.ct.gov/dep/cwp/view.asp?a=2718&q=325464&depNav_GID=1639
Connecticut Recyclers Association
http://www.ctrecyclers.org/

### Delaware

Air & Waste Management
Department of Natural Resources and Environmental Control
http://www.awm.delaware.gov/Pages/default.aspx
Delaware Solid Waste Authority
http://www.dswa.com/

### District of Columbia

Department of the Environment
http://ddoe.dc.gov/ddoe/site/default.asp?ddoeNav=|31003|
Metropolitan Washington Council of Governments
http://www.mwcog.org/environment/recycling/

### Florida

Department of Environmental Protection
http://www.dep.state.fl.us/waste/categories/recycling/pages/recyclingstaff.htm
http://www.dep.state.fl.us/waste/categories/solid_waste/default.htm
Local Recycling Coordinator Contacts:
http://www.dep.state.fl.us/waste/quick_topics/publications/shw/recycling/CountyRecyclingCoordinators.pdf
Recycle Florida Today
http://www.recyclefloridatoday.org/

### Georgia

Pollution Prevention Assistance Division
Department of Natural Resources
http://www.p2ad.org/documents/p2ad_sitemap.html
Keep Georgia Beautiful
http://www.keepgeorgiabeautiful.org/
County KAB Affiliates
http://www.keepgeorgiabeautiful.org/local_affiliate.asp
Georgia Recycling Coalition
http://www.georgiarecycles.org/resources/links.asp

### Guam

Environmental Protection Agency
http://www.guamepa.govguam.net/

### Hawaii
Solid and Hazardous Waste Branch
Department of Health
http://hawaii.gov/health/environmental/waste/p2wastemin/index.html
List of County Solid Waste Divisions
http://hawaii.gov/health/environmental/waste/sw/index.html
Recycle Hawaii
http://www.recyclehawaii.org/
Keep Hawaii Beautiful
http://www.cwdhawaii.org/

### Idaho
Division of Environmental Quality
http://www.deq.idaho.gov/waste/recycling/recycling.cfm
Association of Idaho Recyclers
http://www.idahorecyclers.org/

### Illinois
Bureau of Land
Environmental Protection Agency
http://www.epa.state.il.us/land/
Illinois Recycling Association
http://www.illinoisrecycles.org/
Keep Illinois Beautiful
http://www.keepillinoisbeautiful.org/

### Indiana
Pollution Prevention & Technical Assistance
Department of Environmental Management
http://www.in.gov/idem/programs/oppta/index.html
Association of Indiana Solid Waste Management Districts
http://www.aiswmd.org/
Indiana Recycling Coalition
http://www.indianarecycling.org/

### Iowa
Waste Management Division
Department of Natural Resources
http://www.iowadnr.com/waste/index.html
Recycle Iowa Program
Department of Economic Development
http://www.iowalifechanging.com/business/recycle.html
Iowa Recycling Association
http://www.iowarecycles.org/

### Kansas
Bureau of Waste Management
Department of Health and Environment
http://www.kdheks.gov/waste/index.html
Kansas Organization of Recyclers
http://www.kskor.org/

### Kentucky
Division of Waste Management
Department of Environmental Protection
http://www.waste.ky.gov/
Kentucky Pride Southeast
http://www.kypride.org/
Kentucky Pride Bluegrass
http://www.kentuckypride.com/

### Louisiana
Division of Environmental Assistance
Department of Environmental Quality
http://www.deq.louisiana.gov/portal/tabid/87/Default.aspx
Keep Louisiana Beautiful
http://www.keeplouisianabeautiful.org/

### Maine
Bureau of Remediation & Waste Management
Department of Environmental Protection
http://www.maine.gov/dep/rwm/
Maine Resource Recovery Association
http://www.mrra.net/

**Maryland**
Solid Waste Administration
Department of the Environment
http://www.mde.state.md.us/Programs/LandPrograms/Solid_Waste/home/index.asp
http://www.mde.state.md.us/Programs/LandPrograms/Recycling/index.asp
Maryland Recyclers Coalition
http://www.marylandrecyclers.org/

**Massachusetts**
Department of Environmental Protection
http://www.mass.gov/dep/recycle/
http://www.nerc.org/
Massachusetts Recycling Coalition
http://www.massrecycle.org/

**Michigan**
Waste Management Division
Department of Environmental Quality
http://www.michigan.gov/deq/0,1607,7-135-3312---,00.html
Michigan Recycling Coalition
http://www.michiganrecycles.org/

**Minnesota**
Pollution Control Agency
Department of Natural Resources
http://www.pca.state.mn.us/p2/index.html
County Solid Waste Offices
http://www.pca.state.mn.us/oea/lc/county.cfm
Recycling Association of Minnesota
http://www.recycleminnesota.org/

**Mississippi**
Recycling and Solid Waste Reduction Program
Office of Pollution Control
Department of Environmental Quality
http://www.deq.state.ms.us/MDEQ.nsf/page/Recycling_AboutOurProgram?OpenDocument
Mississippi Recycling Coalition

**Missouri**
Solid Waste Policy, Planning and Grants Division
Department of Natural Resources
http://www.deq.state.ms.us/MDEQ.nsf/page/Recycling_AboutOurProgram?OpenDocument
Keep Missouri Beautiful
http://www.kmbpal.com/
Missouri Recycling Association
http://www.mora.org/

**Montana**
Air, Energy & Pollution Prevention Bureau
Department of Environmental Quality
http://www.deq.state.mt.us/Recycle/index.asp
Recycle Montana
http://recyclemontana.org/

**Nebraska**
Waste Diversion Programs
Department of Environmental Quality
http://www.deq.state.ne.us/
Keep Nebraska Beautiful
http://www.knb.org/
Nebraska State Recycling Association
http://nerecycles.org/
Keep Nebraska Beautiful
http://knb.org/

**Nevada**
Division of Environmental Protection
Department of Conservation & Natural Resources
http://ndep.nv.gov/bwm/solid.htm
Nevada Recyclers Association
http://werecyclenevada.org/

**New Hampshire**
Waste Management Division
Department of Environmental Services
http://www.des.state.nh.us/waste_intro.htm

**New Jersey**
Bureau of Recycling and Planning
Department of Environmental Protection
http://www.nj.gov/dep/dshw/recycling/index.html
Association of New Jersey Recyclers
http://anjr.com/

**New Mexico**
Solid Waste Bureau
Environment Department
http://www.nmenv.state.nm.us/SWB/
New Mexico Recycling Association
http://nmrecycle.org/

**New York**
Bureau of Solid Waste, Reduction and Recycling
Department of Environmental Conservation
http://www.dec.ny.gov/chemical/294.html
http://www.nerc.org/
Local and DEC contacts
http://www.dec.ny.gov/chemical/8511.html
New York State Association for Reduction, Reuse and Recycling
http://www.nysar3.org/

**North Carolina**
Solid Waste Management Branch
Division of Waste Management
Department of Environment, Health & Natural Resources
http://www.enr.state.nc.us/
Local Solid Waste Contacts
http://www.p2pays.org/localgov/PAYT/ncwaste.asp?choice3=Counties
Carolina Recyclers Association
http://www.cra-recycle.org/

**North Dakota**
Waste Management Division
Department of Health
http://www.health.state.nd.us/WM/
North Dakota Solid Waste Recycling Association
http://ndswra.org/

**Ohio**
Division of Recycling & Litter Prevention
Department of Natural Resources
http://www.dnr.state.oh.us/default/tabid/9394/Default.aspx
Association of Ohio Recyclers
http://www.aor-omex.com/
Ohio Association of Litter Prevention & Recycling Professionals
http://www.oalprp.org/

**Oklahoma**
Land Protection Division
Department of Environmental Quality
http://www.deq.state.ok.us/lpdnew/lpprograms.htm
Oklahoma Recycling Association
http://www.recycleok.org/
Keep Oklahoma Beautiful
http://www.keepoklahomabeautiful.com/

**Oregon**
Department of Environmental Quality
http://www.deq.state.or.us/lq/sw/index.htm
Solid Waste Program Staff
http://www.deq.state.or.us/lq/pubs/docs/sw/SWOrganizationalChart2008.pdf
Local Recycling Contacts
http://www.deq.state.or.us/lq/sw/contacts.htm
Association of Oregon Recyclers
http://www.aorr.org/

**Pennsylvania**
Recycling and Market Section
Division of Waste Minimization and Planning
Department of Environmental Protection
http://www.dep.state.pa.us/dep/deputate/airwaste/wm/RECYCLE/Recycle.htm
County Recycling Coordinators
http://www.dep.state.pa.us/dep/deputate/airwaste/wm/recycle/document/countylistnew.html
Regional Recycling Coordinators
http://www.dep.state.pa.us/dep/deputate/airwaste/wm/recycle/document/DEPCOORD.htm
Professional Recyclers of Pennsylvania
http://www.proprecycles.org/

**Puerto Rico**
De Reciclaje de Puerto Rico
http://www.reciclapr.org/

**Rhode Island**
Office of Waste Management
Department of Environmental Management
http://www.dem.ri.gov/programs/benviron/waste/index.htm
Rhode Island Resource Recovery Corporation
http://www.nerc.org/

**South Carolina**
Department of Health and Environmental Control
http://www.scdhec.net/environment/lwm/recycle/
Local Recycling Program Coordinators
http://www.scdhec.net/environment/lwm/recycle/professionals.htm
Carolina Recyclers Association
http://www.cra-recycle.org/
Keep South Carolina Beautiful
http://www.palmettopride.org/

**South Dakota**
Recycling Program
Department of Environment and Natural Resources
http://www.state.sd.us/denr/des/WasteMgn/Recycling/Recyclepage1.htm
South Dakota Solid Waste Management Association
http://www.sdswma.org/

**Tennessee**
Division of Solid and Hazardous Waste Management
Department of Environment and Conservation
http://www.state.tn.us/environment/swm/
Tennessee Recycling Coalition
http://www.trc-online.org/
Keep Tennessee Beautiful
http://www.ktnb.org/

**Texas**
Division of Solid Waste Management
Natural Resource Conservation Commission
http://163.234.20.106/nav/pollution/
Local Recycling Contacts
http://163.234.20.106/assistance/P2Recycle/RecyInfo/RecyclingContacts.html
Recycling Alliance of Texas
http://www.recycletx.com/
Keep Texas Beautiful
http://www.ktb.org/

**Utah**
Department of Environmental Quality
Division of Environmental Quality
http://www.hazardouswaste.utah.gov/
Recycling Coalition of Utah
http://www.recycleutah.org/

**Vermont**
Agency of Natural Resources
http://www.anr.state.vt.us/dec/wmd.htm
Association of Vermont Recyclers
http://www.vtrecyclers.org/

**Virginia**
Office of Pollution Prevention
Department of Environmental Quality
http://www.deq.state.va.us/p2/homepage.html
Virginia Recycling Association
http://www.vrarecycles.org/

**West Virginia**
Conservation, Education and Litter Control
Division of Natural Resources
http://www.wvdnr.gov/
West Virginia Solid Waste Management Board
http://www.state.wv.us/swmb/
Recycling Coalition of West Virginia
http://www.wvrecycles.com/RCWV%20Sponsors.htm

**Washington**
Department of Ecology
http://www.ecy.wa.gov/programs/swfa/index.html
State and Local Recycling Coordinators
http://www.ecy.wa.gov/programs/swfa/contact/recyclelinks.html
State of Washington Recyclers Association
http://www.wsra.net/
Washington Refuse & Recycling Association
http://www.wrra.org/site3.aspx

**Wisconsin**
Waste & Materials Management Program
Department of Natural Resources
http://www.dnr.state.wi.us/org/aw/wm/
Associated Recyclers of Wisconsin
http://www.arow-online.org/

**Wyoming**
Division of Solid & Hazardous Waste
Department of Environmental Quality
http://deq.state.wy.us/shwd/
Wyoming Solid Waste Recycling Association
http://www.wswra.com/

## Other Helpful Recycling and Sustainability Internet Resources

Remember when you leave the Can Manufacturers Institute Website for another site on the World Wide Web, that it does not belong to and is not controlled by the Can Manufacturers Institute or any of its affiliates. These links are provided to you for convenience only and should not be taken to imply any endorsement of such other site. The Can Manufacturers Institute is not responsible for any information outside of its domain, including any assurance of the accuracy of such information.

Ad Council
http://www.adcouncil.org/

Air & Waste Management Association
http://www.awma.org/

American Recycler
http://www.americanrecycler.com/

America Recycles Day—Nov. 15
http://www.americarecyclesday.org

American Solar Energy Society
http://www.ases.org/

American Wind Energy Association
http://www.awea.org/

Association of State and Territorial Solid Waste Management Officials
http://www.astswmo.org/

Beverage Can Makers Europe
http://www.bcme.org/

Beverage Business Insights
http://www.bevinsights.com/

Beverage Digest
http://www.beverage-digest.com/

Beverage Industry
http://www.beverage-digest.com/

Beverage World
http://www.beverageworld.com/

BioCycle
http://www.jgpress.com/biocycle.htm

Bureau of International Recycling
http://www.bir.org/

Business for Social Responsibility
http://www.bsr.org/

Business Week
http://www.businessweek.com/

Cans for Cash City Recycling Program
http://www.novelis.com/Internet/en-US/Sustainability/Recycling/CansForCash.htm

Center for Environmental Leadership in Business
http://www.celb.org/xp/CELB/partners/

Center for Sustainable Systems, The Regents of the University of Michigan
http://css.snre.umich.edu/facts/index.html

City of Dallas
www.greendallas.net

Clean Air Trust
http://www.cleanairtrust.org/

CleanTech Network
http://cleantechnetwork.com/index.cfm?pageSRC=Home

Co-op America
http://www.coopamerica.org/

C-SPAN
http://www.c-span.org/

Curbside Value Partnership
www.recyclecurbside.org

Dow Jones Sustainability Index
http://www.sustainability-index.com/

Earth 911—Area buy-back centers paying cash for aluminum cans
http://earth911.org/

Earth Day—April 22
http://www.earthday.org

Federal Trade Commission Eco-Speak: A User's Guide to the Language of Recycling
http://www.ftc.gov/bcp/conline/pubs/alerts/ecoalrt.shtm

Environmental Literacy Council
http://www.enviroliteracy.org/subcategory.php?id=1

Environmental News Network
http://www.enn.com/

Ethisphere Magazine
http://ethisphere.com/

European Environmental Bureau
http://www.eeb.org/

Evergreen Industries & Obviously Enterprises Internet Consumer Recycling Guide
http://www.obviously.com/recycle/

Extractive Industries Transparency Initiative
www.transparency.org/

Financial Times
http://www.ft.com/home/us

Food & Beverage Packaging
http://www.foodandbeveragepackaging.com/

Forbes Magazine
http://www.forbes.com/

Fortune Magazine
http://money.cnn.com/magazines/fortune/

Global Legislators Organization for a Balanced Environment
http://www.globeinternational.org/

GovEngine
http://www.govengine.com/stategov/index.html

Grassroots Recycling Network
http://www.grrn.org/resources/sros.html

Green Biz
http://greenbiz.com/

GreenBlue
http://www.greenblue.org/about.html

Green Power Switch
http://www.tva.com/greenpowerswitch/distributors.htm

International Council on Mining and Metals
http://www.icmm.com/

International Foundation for the Conservation of Wildlife
http://www.wildlife-conservation.org/

International Institute for Sustainable Development
http://www.iisd.org/

Institute of Scrap Recycling Industries
http://www.isri.org/AM/Template.cfm?Section=Home1

Jimmy Neutron
http://www.recycleyourcans.org

Keep America Beautiful
http://www.kab.org/site/PageServer?pagename=index

Kiplinger Report
http://www.kiplinger.com/

Law Librarians' Society of Washington, DC
http://www.llsdc.org/org/sourcebook/

London Metal Exchange
http://www.lme.com/

Mineral Information Institute
http://www.mii.org/

Municipal Solid Waste Management
http://www.mswmanagement.com/msw.html

National Audubon Society
http://www.audubon.org/

National Pollution Prevention Roundtable
http://www.p2.org/

National Environmental Education Week—the week prior to Earth Day
http://www.eeweek.org/

National League of Cities
http://www.nlc.org/

National Pollution Prevention Roundtable
http://www.p2.org/about/

National Recycling Coalition
http://www.nrc-recycle.org/

National Renewable Energy Laboratory
http://www.nrel.gov/lci/

National Solid Wastes Management Association
http://www.nswma.org/

National Safety Council
http://www.nsc.org/

Northeast Recycling Council
(CT, DE, ME, MA, NH, NJ, NY, PA, RI, VT)
http://www.nerc.org/

National Wildlife Federation
http://www.nwf.org/

Occupation Safety and Health Administration
http://www.osha.gov/

Office of the Federal Environmental Executive
http://www.ofee.gov/

Our Earth (environmental information & recycling polls)
http://www.ourearth.org/links.htm

Pew Center for Global Climate Change
http://www.pewclimate.org/

Recycle Mania (College Campus Recycling)
http://www.recyclemaniacs.org/Index.htm

Recyclers World/Recycle Net
http://www.recycle.net/

Recycling Today
http://www.recyclingtoday.com/

Recycler's World Association Directory
http://www.recycle.net/assn/index.html

Refdesk (Population & Demographics)
http://www.refdesk.com/factpop.html

Resource Recycling
http://www.resource-recycling.com/

Resources for the Future
http://www.rff.org/

Scrap
http://www.scrap.org/

Sierra Club
http://www.sierraclub.org/

Social Economic Data and Application Center
http://ciesin.org/datasets/dataset-home.html

Solid Waste Association of North America
http://www.swana.org/www/default.aspx

Southeast Recycling Development Council (AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA)
http://www.serdc.org/

Sustainable Packaging Coalition
http://www.sustainablepackaging.org/

The Canmaker
http://www.canmaker.com/main/index.php

The Economist
http://www.economist.com/

The Internet Consumer Recycling Guide
http://www.obviously.com/recycle/

The Earth Day Network
http://ww2.earthday.net/

The Global 100: Most Sustainable Corporations in the World
http://www.global100.org/2008/index.asp

The Library of Congress
http://thomas.loc.gov/

The Keystone Center
http://www.keystone.org/

The Wall Street Journal
http://online.wsj.com/public/page/2_0433.html?mod=hpp_us_pageone_more

The White House
http://www.whitehouse.gov/

Transparency International
www.transparency.org/

United Nations Global Compact
www.unglobalcompact.org/index.html

University of Michigan School of Packaging (Packaging Programs)
http://packaging.msu.edu/UniversityCollegeProgramswithaPackagingInterest.php

University of Virginia (demographics)
http://fisher.lib.virginia.edu/collections/stats/;
http://fisher.lib.virginia.edu/collections/stats/ccdb/

U.S. Census Bureau
http://www.census.gov/
http://www.census.gov/statab/www/ccdb.html (demographics)

U.S. Conference of Mayors
http://www.usmayors.org/
http://www.usmayors.org/mwma/novelis/deadlines.html

U.S. Department of Energy
http://www.em.doe.gov/pages/emhome.aspx

U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response
http://www.epa.gov/swerrims/

U.S. Environmental Protection Agency, Jobs Through Recycling
http://www.epa.gov/jtr/index.htm

U.S. Environmental Protection Agency, Waste Wise Program
http://www.epa.gov/wastewise/

Voluntary Principles on Security and Human Rights
http://www.voluntaryprinciples.org/

Waste Age
http://wasteage.com/

Waste Management Inc.
www.greenopolis.com

Waste News
http://www.wastenews.com/headlines.html

WasteWise
http://www.epa.gov/wastewise/

Women in Packaging
http://www.womeninpackaging.org/womenlinks.html

World Business Council for Sustainable Development
www.wbcsd.org

University of Virginia, EcoWeb factoids
EcoWeb handy recycling factoids—How much are you saving? (From: University of Virginia)

USA Recycling Prices—See what that stuff is worth on the commodities market! (From: Recycling Manager)

U.S. Green Building Council
http://www.usgbc.org/

United Nations Environmental Programme
http://www.unep.org/

United Kingdom EPA Waste Watch
http://www.wastewatch.org.uk/Homepage

World Bank
http://www.worldbank.org/

World Business Council for Sustainable Development
http://www.wbcsd.ch/templates/TemplateWBCSD5/layout.asp?MenuID=1

World Environmental Center
http://www.wec.org/

World Resources Institute
http://www.wri.org/

Worldwatch Institute
http://www.worldwatch.org/

World Wildlife Federation
http://www.wwf.org/

## ACC Member Listing

The internet is a valuable resource for researching and staying current in a fast paced, continually changing world. For information regarding aluminum suppliers and can manufacturers, you can assess companies and learn about the industry by visiting these two websites:
http://www.cancentral.com
http://www.aluminum.org
or by going to directly to our member company web pages:

### Aluminum Can Council Members

**Can Manufacturers**

Ball Corporation
http://www.ball.com/page.jsp?page=1

Metal Container Corporation
http://www.anheuser-busch.com/

Rexam
http://www.rexam.com/index.asp?pageid=1

**Aluminum Suppliers**

ALCOA, Inc.
http://www.alcoa.com/global/en/home.asp

ARCO Aluminum, Inc.
http://www.arcoaluminum.com/modularhome.do?categoryId=4500

Novelis Inc.
http://www.novelis.com/Internet/en-US

The Aluminum Can Council (ACC) is a joint effort between the Can Manufacturers Institute's Beverage Can Marketing Committee and the Aluminum Association's Can Committee. The vision of the ACC is to be the voice of the aluminum can industry, to promote and foster recycling solutions, to educate consumers and customers about the aluminum beverage can's positive attributes and encourage environmentally and socially responsible behavior for a sustainable, bright future.

## For More Information, Contact The Aluminum Can Council or The Keystone Center

**Aluminum Can Council**
1730 Rhode Island Ave., NW
Suite 1000
Washington, DC 20036-3101
202.232.4677
E-mail: jday@cancentral.com
www.cancentral.com

**The Keystone Center**
1628 Sts. John Road
Keystone, CO 80435
970.513.5800
www.keystone.org

Curriculum participants expressly waive all liability for accident or injury from lessons or experiments derived from this kit or supplemental worksheets.

CANS: INFINITELY RECYCLABLE