

POLICY SERIES



Environmental policy and the law of unintended consequences

**Eight case studies from
around the world**

**By Ben Eisen, M.P.P.
and Kenneth P. Green, D.Env.**

About the Authors



Ben Eisen is a policy analyst with the Frontier Centre for Public Policy. His undergraduate degree is from the University of Toronto where he specialized in history and political science. He also holds a Masters Degree in Public Policy from the University of Toronto's School of Public Policy and Governance. Ben completed a public policy internship with the federal government, and he worked as a researcher for the CBC. Ben's policy columns have been published in the *National Post*, the *Winnipeg Free Press*, the *Calgary Herald*, *The Gazette* and the *Toronto Sun*. He is the co-author of *The Environmental State of Canada: Thirty Years of Progress*.



Kenneth P. Green, D.Env., is a member of the Frontier Centre Advisory Board and Project Director of *The Environmental State of Canada-30 Years of Environmental Progress*. An environmental scientist by training, Mr. Green has authored numerous policy studies, magazine articles, newspaper columns, authored encyclopedia entries, book chapters, and a textbook for middle-school students entitled *Global Warming: Understanding the Debate*. Currently a Resident Scholar with the American Enterprise Institute, Mr. Green has studied environmental policy at the state level in California, and studied Canadian environmental policy for three years at The Fraser Institute.

The Frontier Centre for Public Policy is an independent, non-profit organization that undertakes research and education in support of economic growth and social outcomes that will enhance the quality of life in our communities. Through a variety of publications and public forums, the Centre explores policy innovations required to make the prairies region a winner in the open economy. It also provides new insights into solving important issues facing our cities, towns and provinces. These include improving the performance of public expenditures in important areas like local government, education, health and social policy. The authors of this study have worked independently and the opinions expressed are therefore their own, and do not necessarily reflect the opinions of the board of the Frontier Centre for Public Policy.

Copyright © MMX by the Frontier Centre for Public Policy.

Date of First Issue: May 2010.

Reproduced here with permissions of the authors. Any errors or omissions, and the accuracy and completeness of this paper, remain the responsibility of the authors.

ISSN 1491-78

**FRONTIER CENTRE
FOR PUBLIC POLICY**

www.fcpp.org

MB: 203-2727 Portage Avenue,
Winnipeg, Manitoba Canada R3J 0R2
Tel: 204 957-1567

SK: 2353 McIntyre Street,
Regina, Saskatchewan Canada S4P 2S3
Tel: 306 352-2915

AB: Ste. 1280-300, 5th Avenue SW
Calgary, Alberta Canada T2P 3C4
Tel: 403 230-2435

FCPP Policy Series No. 87 • May 2010

Environmental policy and the law of unintended consequences

Eight case studies from around the world

**By Ben Eisen, M.P.P.
and Kenneth P. Green, D.Env.**

Table of Contents

Executive Summary	4
Preface: Case Study 1: An environmental disaster on Macquarie Island	7
Introduction: The law of unintended consequences	9
Case Study 2: The great golf cart boom of 2009	11
Case Study 3: Biofuel subsidies	14
Case Study 4: How energy-efficiency appliance subsidies create GHG emissions	18
Case Study 5: The ban on DDT and the resurgence of malaria	20
Case Study 6: Perverse incentives and the <i>Endangered Species Act</i>	23
Case Study 7: How forest fire prevention policies backfired	26
Case Study 8: Fuel economy standards, highway fatalities and increased driving	28
Conclusion	31
Endnotes	32

Executive summary

The “law of unintended consequences” describes the well-documented fact that actions often have adverse, unpredicted and even unpredictable consequences. Government actions are particularly prone to producing unintended consequences because they use relatively simple, blunt-force interventions to control hugely complicated social, economic or environmental systems. Because these systems are so complex, it is generally impossible to predict in advance how all of the actors contained within them will react to the new set of circumstances that they face as a result of the government’s intervention with a new rule, policy or regulation.

Even relatively simple regulatory interventions in complex social, economic and environmental systems will often create unintended consequences because governments cannot predict how everyone will react to the new set of circumstances they face. The unintended reactions of the various actors are often harmful, and in some cases result in outcomes that are the exact opposite of what the government sought to bring about through the intervention.

The law of unintended consequences can not be entirely circumvented by “smarter” government that tries to implement “smart regulation.” In many cases, the systems involved are so complicated that it is simply *beyond the capacity of human intelligence and organizational capabilities* to fully understand their workings and the likely consequences of an intervention. The law of unintended consequences will therefore always be with us, and will often frustrate the efforts of policymakers to achieve their objectives through regulation.

This paper examines a series of case studies drawn from around the world which demonstrate how the law of unintended consequences has often frustrated policymakers in the area of environmental policy. Specifically, these case studies will examine how well-meaning efforts by governments to protect the environment have backfired, resulting in severe harm to human beings and, in some instances, to the natural environment regulators sought to protect.

Sometimes, these consequences have been a distortion of economic incentives leading to lost economic production or wasted government resources. In other cases, the consequences were much more severe, leading to illness and death for thousands of human beings. By discussing the ways in which some past environmental protection measures backfired, this paper will illustrate the importance of the law of unintended consequences to the development of environmental policy, and demonstrate the need for humility and caution on the part of policymakers when they consider interventions in enormously complex social, economic and ecological systems for the sake of environmental protection.

This study will review eight case studies:

1 • An environmental disaster on Macquarie Island

The Australian government’s effort to protect local vegetation by destroying the rabbit population on an island near Antarctica backfired terribly, bringing the island to the brink of an “ecosystem meltdown” and threatening local bird species with extinction.

The unintended reactions of the various actors are often harmful, and in some cases result in outcomes that are the exact opposite of what the government sought to bring about through the intervention...

- 2 • The great golf cart boom of 2009**
An American subsidy designed to promote the purchase of electric vehicles for the sake of energy conservation was exploited by clever golf cart salesmen who recognized that their products fit under the government's definition of an electric car. The salesmen began to give away "free" golf carts to consumers, with the entire bill being passed along to the government.
- 3 • Biofuel subsidies**
The subsidization of biofuels such as ethanol have led to the destruction of rainforests, increases in greenhouse gas emissions, wasteful use of freshwater resources, and drastic increases in the price of food which have hurt the world's poor.
- 4 • How energy-efficiency appliance subsidies create GHG emissions**
Rebates and subsidies that encourage the purchase of new, energy-efficient refrigerators often lead to increased energy consumption, as many consumers keep the older machine as a "beer fridge" and run two refrigerators in their homes rather than one.
- 5 • The ban on DDT and the resurgence of malaria**
A ban on DDT has had tragic unintended consequences in poor countries, leading to the resurgence of malaria and thousands of unnecessary deaths.
- 6 • Perverse incentives and the Endangered Species Act**
The presence of endangered animals on one's property can greatly restrict an individual's freedom to use that property for commercial purposes. Some landowners go to great lengths to prevent the animals from coming onto the property in the first place—including destroying any habitat that may be suitable for them.
- 7 • How forest fire prevention policies backfired**
Aggressive fire management policies in the United States led to the rapid build-up of "forest fuel," causing bigger and more destructive forest fires.
- 8 • Fuel economy standards, highway fatalities and increased driving**
How fuel economy standards increased driving, created the SUV boom and killed thousands on our highways.

Preface

Case Study 1:

An environmental disaster on Macquarie Island

By the late 1960s, it had become clear that there was an environmental conservation problem on Macquarie Island, a small possession of Australia located halfway between New Zealand and Antarctica. The island's population of rabbits—introduced over a century before—had become quite large, and authorities feared the rabbits were causing ecological problems by eating too much of the island's vegetation. Macquarie Island had hosted rabbits for about one hundred years, as well as feral cats and rats, both of which were introduced into the environment at about the same time. The ecosystem was not in a state of crisis in the 1960s, as the survival of the island's major species was not threatened,¹ but the situation was undesirable from a conservationist point of view.

In response to the problem, the Australian government decided to drastically reduce the population of rabbits by exposing the population to the myxomatosis virus, an extremely efficient bunny killer. The plan achieved its narrow objective: in just over ten years, the rabbit population had dropped from 100,000 to just 10,000. However, in terms of the broader objective of the policy—strengthening the ecosystem of Macquarie Island—the rabbit extermination was a disaster. It turned out that the rabbits had been the primary food source for the island's population of feral cats, and with the rabbits all but

eliminated, the cats began to aggressively hunt the island's population of seabirds. The cats quickly began to decimate the seabird population, hunting the native bird species to the brink of extinction.²

Desperate to save the remaining seabirds, the Australian government authorized a \$500,000 program to remove the island's cat population. The scientists once again succeeded in their narrow objective; the last cat was removed from the island in the year 2000. But once again, the best-laid plans of the conservation scientists wrought havoc on the broader ecosystem they were trying to preserve. With the cats eliminated, the island's population of rats exploded. As the rats' diet included the eggs and chicks of the native seabirds, the huge growth in the rat population quickly posed as big a threat to the native bird species as had the feral cats.

What's more, with the cats gone, the small fragment of the rabbit population that had survived the initial extermination attempt were uncontrolled by predation. The rabbits that survived the initial cull were the strongest and healthiest of the initial population, and by the time the cats were removed these surviving rabbits had developed immunity to the myxomatosis virus and were therefore much more difficult for humans to cull.³ Without a predator, the rabbit population once again thrived, growing back to and actually surpassing the numbers that had



The picture on the left was taken in 2007, when this slope still had significant vegetation. The picture of the same slope taken in 2009 shows that it has been stripped bare by rabbits, whose population exploded after the removal of feral cats. Published in *The New York Times*, Feb 17, 2009.



Photographs: Australian Antarctic Division. Published in *The Guardian*, January 12, 2009.

prompted the initial response. Within just six years, the rabbit population rebounded from a low of 10,000 to a new high of 130,000.⁴ The rabbits once again began to devour the local vegetation even more aggressively than before, stripping huge swaths of the island bare. Today, the island's ecosystem is in worse condition than ever, and the Australian government has allocated \$25 million to attempt to address the catastrophe by killing off the island's rats and rabbits.

The results of this latest intervention remain to be seen. It's clear the Australian scientists and government acted with the best of intentions throughout this debacle, as they sought to address a real conservation problem posed by the rabbit population. But their efforts brought the island to the brink of an "ecosystem meltdown,"⁵ a cure much worse than the disease they set out to address.



Introduction

The law of unintended consequences

Why did the conservation efforts on Macquarie Island backfire so terribly? The answer lies in one of the most important principles in public policy: the law of unintended consequences. Simply put, the law of unintended consequences refers to the fact that the actions taken by governments often have adverse, unpredicted and even unpredictable results. The case of Macquarie Island illustrates why this is so often true: the island ecosystem that the government sought to improve was an extremely complicated system, comprised of numerous different organisms interacting with one another. It was impossible to predict how all of these different interactions would be impacted by the sudden removal of the rabbit population. Each of the remaining creatures on the island faced a different environment than they had before; they reacted to the rabbit removal in ways that would give them the best chance to survive. Unfortunately, in the case of the cats, this meant turning to rare birds for food, setting off the need for a new intervention which brought its own unintended consequences.

In short, unintended consequences occurred in this situation because the government used a simple intervention in an effort to control the development of a hugely complicated ecosystem. It was impossible to predict in advance how all of the actors in this complex system would react to their new situation, and in this case, the results were disastrous.

The same thing often happens when governments impose regulations in an attempt to regulate the behaviour of human beings

or markets. The economic and social networks that comprise human society constitute a massive social system that is at least as complicated as any natural ecosystem. When a new rule is introduced forbidding certain kinds of behaviours and exchanges, it is impossible to know how all of the affected actors will respond, how it will impact their decisions and how it will alter their social and economic interactions with other people. This uncertainty is proportional to the scale and scope of the intervention; small interventions have lesser ramifications and more predictable consequences. Government interventions, because they often act at scales unconceivable for the private entities, are particularly susceptible to large unintended consequences. This knowledge is not new. When Lao Tsu, a record-keeper for the 6th Century Zhou Dynasty, recorded his accumulated wisdom in the Tao Te Ching, he wrote that "Ruling a country is like cooking a small fish." By this, he suggested that interventions in the natural processes of society should be tiny and gentle to avoid having the society fall apart.

But even relatively simple regulatory interventions in complex social, economic and environmental systems will often create unintended consequences because governments cannot predict how everyone will react to the new set of circumstances they face. This is not a problem that can be solved completely through "smarter" government that tries to think through likely unintended consequences. In many cases, the systems involved are so complicated that it is simply *beyond the capacity of human intelligence and organizational capabilities* to fully understand their

workings and the likely consequences of an intervention.

The law of unintended consequences will therefore always be with us, and will often frustrate the efforts of policymakers to achieve their objectives through regulation.

The law of unintended consequences is often important in the area of environmental policy. Regulations which forbid the use of certain kinds of products, outlaw specific technologies or heavily subsidize the use of other technologies can often have counterproductive results because of the unintended consequences that they generate.

“The law of unintended consequences will therefore always be with us...”

The outline of this paper

This paper will examine a series of case studies drawn from around the world to illustrate how past efforts by governments to protect the environment have backfired, resulting in severe harm to human beings and, in some instances, to the natural environment regulators sought to protect. Sometimes, these consequences have been a distortion of economic incentives leading to lost economic production or wasted government resources. Such cases can even be humorous or ironic, as the next case study shows. In other cases, the consequences were much more severe, leading to illness and death for thousands of human beings. By discussing the ways in which some past environmental protection measures backfired, this paper will illustrate the importance of the law of unintended consequences to the development of environmental policy, and demonstrate the need for humility and caution on the part of policy-makers when they consider interventions in enormously complex social, economic and ecological systems for the sake of environmental protection.

FREE ELECTRIC CAR

HURRY!
Ends December 31, 2009
Take Advantage of the Federal Tax Credit Today!

DRIVE ELECTRIC
"Get a Charge Out of Driving"
877-900-ECAR (3227)

FAQ **SHARE** **CARS** **BUY NOW**

NEV-48 EX [white, 4 passenger]
MSRP ~~\$9,495.00~~
Sale Price \$6,496.53
Federal Tax Credit - \$6,496.53
Your Cost = \$0*
*plus shipping

Case Study 2: The great golf cart boom of 2009

In many cases, the unintended consequences of government actions designed to protect the environment are tragic; this paper will discuss several examples that led to enormous human suffering. However, sometimes the unintended consequences are less severe. Some results are actually somewhat humorous—if you disregard the wasted money and resources that could have been used for important, worthwhile projects. The “Great Golf Cart Boom of 2009” provides an example of an unintended consequence of government policy that is more comedy than tragedy.

Though much of this paper will focus on more severe unintended consequences of environmental protection measures, this case study very clearly illuminates the principle of unintended consequences and is a useful starting point for this analysis of the phenomenon.

Early in 2009, the American federal government created a tax credit to be given to anybody who purchased an electric vehicle. The rationale for the law was that electric cars are “clean and green,” emitting neither conventional air pollutants such as particulate matter

(soot) nor greenhouse gases such as carbon dioxide. The government hoped that by providing a tax credit to make it cheaper to purchase electric vehicles, new car buyers would be more likely to purchase them as opposed to a conventional automobile which would, of course, burn gasoline for fuel, emitting the usual air pollutants and greenhouse gases. By creating an incentive to purchase electric cars instead of gas-powered ones, the government hoped to slightly reduce total greenhouse gas emissions in the United States, thereby, in theory, lessening the American economy's contribution to man-made global warming.

This was a classic example of government attempting to intervene in the market to "pick a winner and pick a loser" between competing technologies. Producers of electric cars are in competition with producers of conventional automobiles, as well as each other. To date, the competition has been one-sided as most individuals prefer to buy gas-powered cars. Some actors within the American government, however, did not like this result because they feared it contributed to global warming. So they decided to put a thumb on the scale, by offering to use taxpayer dollars to reduce the cost of new electric cars, thereby making it more attractive to choose electric over gas-powered cars.

As is often the case when governments attempt to pick technological winners and losers in the marketplace, this policy created unintended consequences.

Although later sections of this paper will demonstrate how unintended consequences of government actions can be tragic, in this case they were mostly comical.

Upon hearing about the tax credit, several clever individuals who were in the business of selling golf carts realized that their products qualified as electric vehicles under the definition created by the new law. What's more, the size of the tax credit was only slightly smaller than the *list* price of the golf carts (this is the price of the cart including profit for the seller). By slightly reducing the list price, the salesmen realized they could get the federal government to cover the *entire* cost of their customers' golf carts, and still make a profit on the sales.⁶

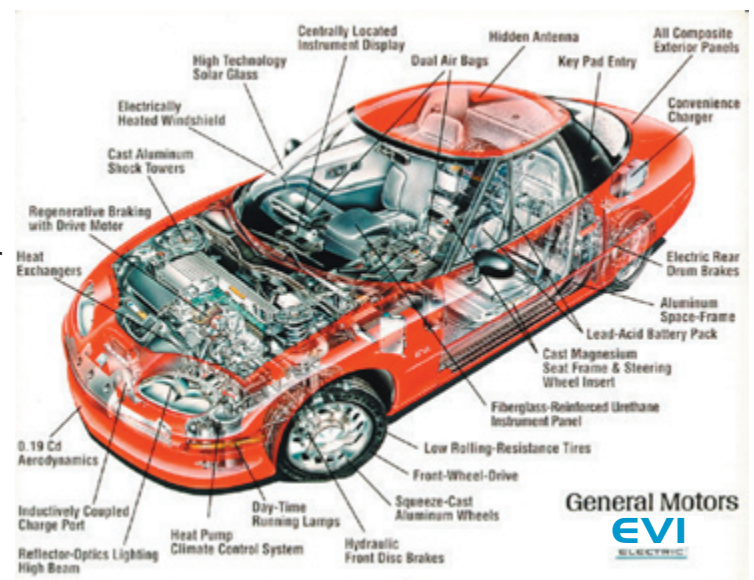
What ensued, of course, was the sale of the millennium, as golf cart salesmen began to advertise "free" golf carts, an offer which thousands of people, including journalist John Stossel (who exposed this loophole) predictably took up. As a result, the market for golf carts spiked in late 2009, as thousands of people raced to obtain their "free" golf carts before local dealers ran out of stock.⁷

The 2009 golf cart boom, in which thousands of individuals obtained recreational vehicles purchased by the taxpayer at no cost to themselves clearly shows the potential for absurd and harmful unintended consequences as a result of well-intentioned environmental policies.

In addition to being a massive waste of taxpayer dollars, the golf cart scam resulted in the emission of many tonnes of greenhouse gasses that would not have been produced in the absence of the rebate. Although they do not burn fuel when they are in operation, energy is used in the production of these vehicles which results in greenhouse gas emissions. Furthermore, the electricity that they run on largely comes from coal and other fossil fuels. The tax credit may have also led to emission reductions elsewhere in the economy, but as a result of the golf cart scam it enabled, the tax credit had the perverse effect of creating new greenhouse gas emissions that would not have otherwise occurred.

What is also amusing is that this wasn't the first time regulators were shocked by trying to force electric cars onto the market. When California tried in the 1990s, the result was the production of a vehicle by GM, the EV1, which was clearly not ready for the market in terms of either performance or cost. As a result, GM only leased the vehicles to well-off hobbyists, those earning over \$100,000 per year, and who owned at least one gasoline vehicle as well. The state also offered significant subsidies to owners for the installation of charging stations in their garages, and the state constructed charging stations for use when EV owners found they were running out of juice. After a few years, in which GM lost money selling and maintaining the vehicles, the project was shelved, and the vehicles were recalled and destroyed. Again, the unintended consequences of California's intervention into the electric car market was the creation of additional car manufacture and disposal, and subsidization by poorer Californians to wealthier Californians.⁸

The electric car subsidy resulted in the golf cart boom of 2009 because the economic systems in which the regulators sought to intervene were too complex for them to fully understand. They therefore failed to recognize that many recreational vehicles run on electric power, and that the tax credit they designed would therefore greatly distort the market for those vehicles. The great golf cart boom of 2009 is a humorous example of what can go wrong when governments intervene in complex economic systems for the sake of environmental protection.



Case Study 3:

Biofuel subsidies

The heavy subsidization of the production of biofuels—defined as fuel obtained from plants or other renewable biological resources—has been a major component of environmental policy in most developed countries including the United States, Australia, Canada, Germany, France and the Netherlands. The objective of these biofuel subsidies is to promote the use of “green” energy as opposed to fossil fuels. By giving taxpayer dollars to producers of biofuels, the most important of which is corn-based ethanol, governments hoped to lower the price of these fuels so that more individuals and businesses would use them as opposed to petroleum-based sources of energy.

Biofuels were attractive to governments and environmentalists concerned with global warming because they are theoretically “carbon neutral.” This means that the carbon dioxide released when they are burned for energy is cancelled out by the carbon dioxide that plants absorb while they were growing.⁹

Unfortunately, biofuels are only “carbon neutral” if one does not include the emissions caused by the energy used in processing the crops, which is significant.¹⁰ In addition, substantial evidence has emerged that their production can create a host of other environmental problems. For example, the heavy fertilization required to grow biofuels entails environmental costs which were not adequately considered during the formulation of this policy.¹¹

Some methods for growing and processing biofuels generate particularly serious environmental problems. One of the worst

cases was revealed in 2007 when the Netherlands announced it would stop subsidizing its primary biofuel, palm oil, because it was discovered the crops were grown on plantations in Asia created from drained peatland.¹² Peatland is a natural “sink” for carbon dioxide, and draining it has the effect of releasing huge amounts of carbon dioxide into the atmosphere. An analysis by the Joint Nature Conservation Committee found that where peatlands are drained for biofuel production, carbon savings associated with their use are usually *more than 100 per cent offset* by the loss of the carbon sink. In the specific case of palm oil, the commission found that biofuel produced from Asian palm oil grown on drained peatland actually emits five times as much carbon during its entire life cycle than conventional diesel!¹³ This means that the Netherlands’ biofuel subsidy had the perverse effect of causing *more* greenhouse gasses to be emitted into the atmosphere than if the government had simply allowed energy markets to operate without interference. A similar pattern has led to the destruction of tropical rainforests, another major carbon sink, as enormous tracts of forestland have been cleared to make room for the lucrative production of heavily subsidized biofuels.¹⁴

Biofuel subsidies have often generated a net increase in greenhouse gasses in the atmosphere. But there are other unintended environmental consequences that result from the increased biofuel production caused by subsidies.

For example, burning ethanol has been found to contribute to local air pollution.

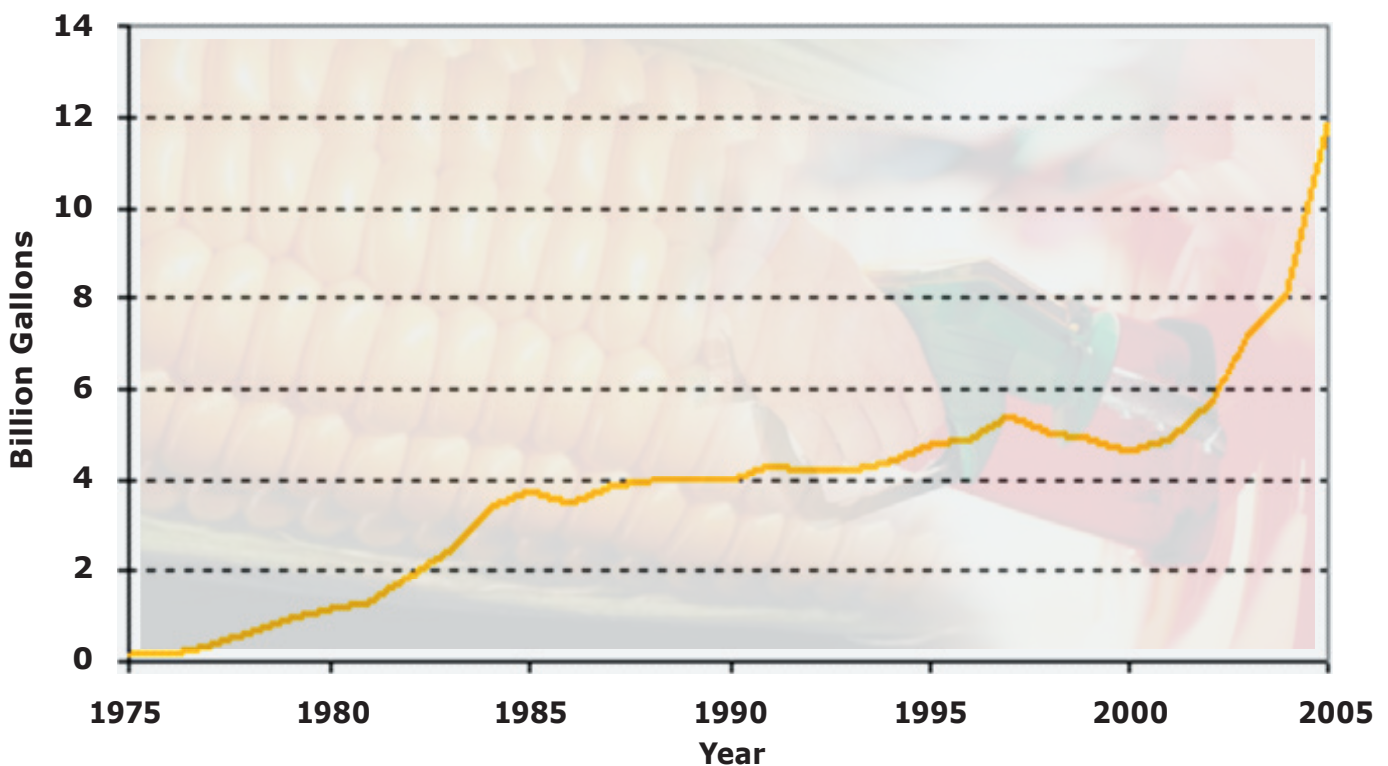
Some high-quality research suggests that using ethanol for energy actually creates significantly more local air pollution than conventional gasoline. Mark Jacobson at Stanford University performed an analysis that suggested that if the United States switched to a blend of 85 percent ethanol and 15 percent conventional gasoline to power automobiles, there would consequently be a spike in respiratory illness. In fact, Jacobsen estimates that a switch to ethanol-based fuel to power cars might significantly increase pollution-related mortality and asthma rates.¹⁵

Furthermore, ethanol production requires massive water consumption by agricultural producers. One American study found that it requires 140 gallons of water to grow and refine a gallon of corn ethanol. This means that 756 million gallons of fresh water were used to produce the 5.4

million gallons of corn ethanol that were produced in the United States in 2006.¹⁶ In countries where fresh water resources are even somewhat scarce, this level of water consumption for energy production could place significant strain on the sustainability of local freshwater supplies.

Although the environmental problems caused by biofuel subsidies are important, the most serious unintended consequences generated by biofuel subsidies has been their impact on food prices around the world. Because of biofuel subsidies, huge amounts of farmland previously used to produce crops for food consumption are now being used to grow crops as alternative sources of energy. As Chart 1 shows, global ethanol production has more than doubled since the year 2000, and today stands at approximately 12 billion gallons per year.

Chart 1: Global ethanol production



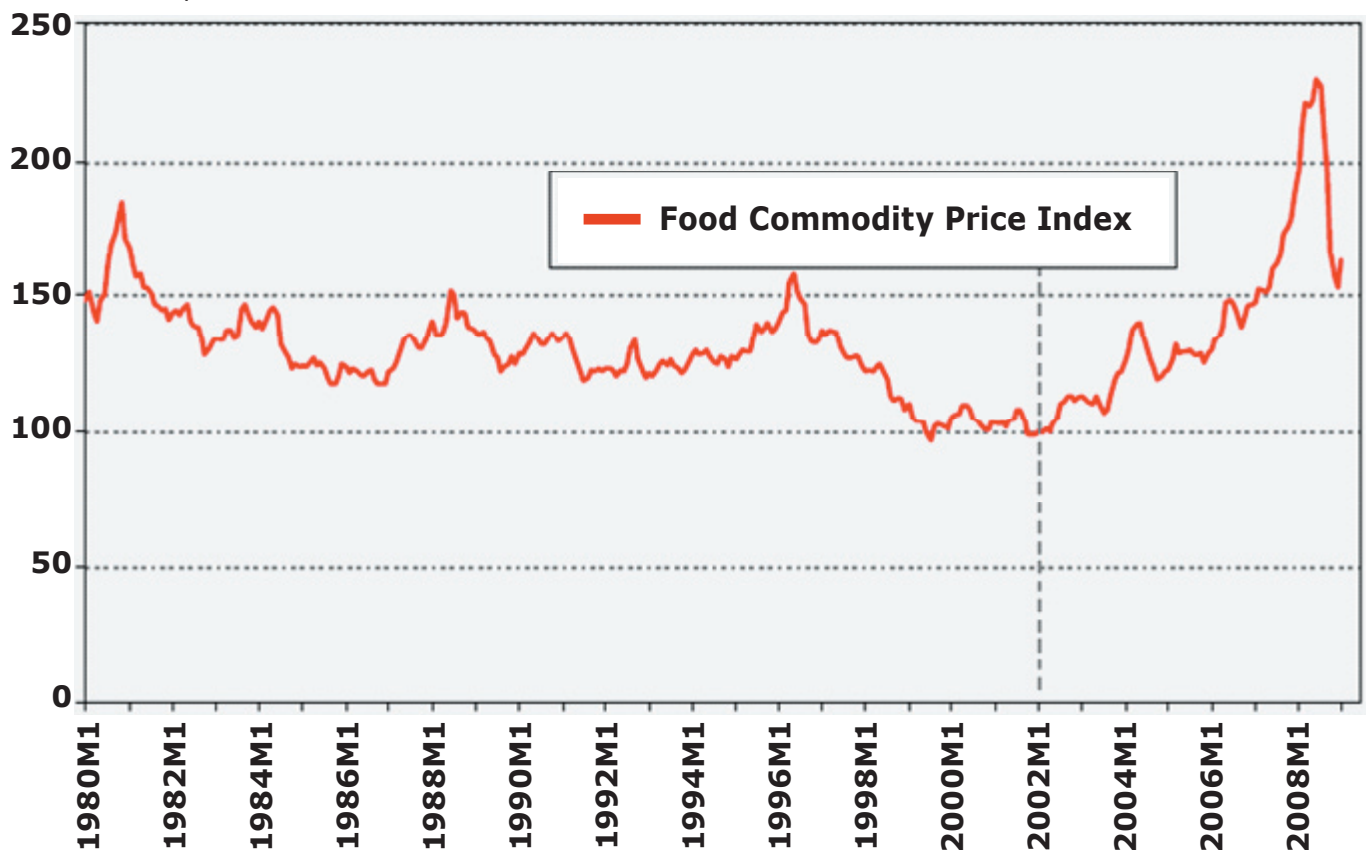
Source: World Resources Institute.

Not surprisingly, this ethanol boom—caused in large part by heavy subsidies and renewable fuel standards—has had a depressing impact on the global supply of food, causing prices for corn and other staples to increase. This is because land that was previously being used to grow food is now being used to grow biofuel, which can be sold at very high prices because of the subsidies. C. Ford Runge and Benjamin Senaur, professors of Economics at the University of Minnesota, clearly illustrate the nature of the problem in an article entitled “How Biofuels Could Starve the Poor” by pointing out that filling the tank of a single SUV with pure ethanol requires 450 pounds of corn—enough calories to feed one person for an entire year.¹⁷

By diverting huge amounts of food and cropland to the biofuel industry, these government subsidies reduced the global food supply and contributed to an artificial spike in food prices. This increase in food prices has caused what some call a “food crisis” in the third world, as many poor people are now simply unable to afford sufficient food to adequately nourish themselves and their families. Chart 2 shows that, after falling steadily for about twenty years, food prices began to shoot up around the year 2002, just as the global, subsidy-driven ethanol boom was beginning. Prices peaked in 2008 and have dropped substantially since then, but they are still far above where they were at the beginning of this decade, before the ethanol boom.¹⁸

Chart 2: Food commodity prices since January 2002

Index: January 2002 = 100



16 Source: Ron Trostle, US Department of Agriculture.

Between 2002 and 2008, average food prices around the world increased by more than 140 per cent.¹⁹ Exactly how much of this increase was caused by the biofuel boom is impossible to determine, and is thus the subject of considerable controversy. Some very credible estimates rank increased biofuel production as the single most important cause of the food price spike. For example, a World Bank study estimated that biofuel production was responsible for more than half of this increase. In fact, biofuels alone were estimated to be responsible for a 75 per cent increase in the price of food between 2002 and 2008.²⁰ Others argue that biofuels were not the primary cause of the food price spike, but even these analysts concede that dramatic increases in biofuel production were a contributing factor to the growth in food prices that occurred in the middle part of this decade.²¹

What is undisputed is that the biofuel boom was in part responsible for this growth in food prices, which has created a tragic food crisis in less-developed countries over the past few years. The food crisis in poor countries has caused terrible hardship for the people who live there. Millions of children have received inadequate nutrition, which in many cases will cause health problems that will plague them throughout their lives. Disease, hardship and even premature death have resulted from the food crisis. This crisis was created at least in part by a booming market for biofuels, which itself was caused largely by government subsidies and mandates.

The food crisis is a tragic example of how unintended negative consequences can result from government actions. In an effort to conserve fossil fuels and reduce greenhouse gas emissions, governments around the world created a huge market for biofuels by massively subsidizing their production. Unfortunately, in many instances the policy backfired terribly, with destroyed rainforests and peatlands resulting in unexpected increases in greenhouse gas emissions. Furthermore, by diverting land that had been used for food production to fuel production, these governments created an artificial spike in food prices that caused hardship for millions of people. The story of the “free golf carts” shows that the unintended consequences of environmental interventions can be wasteful but somewhat humorous; the story of biofuel subsidies shows how these unintended consequences can be tragic and deadly.

Unfortunately, in many instances the policy (of subsidization) backfired terribly, with destroyed rainforests and peatlands resulting in unexpected increases in greenhouse gas emissions.

Case Study 4:

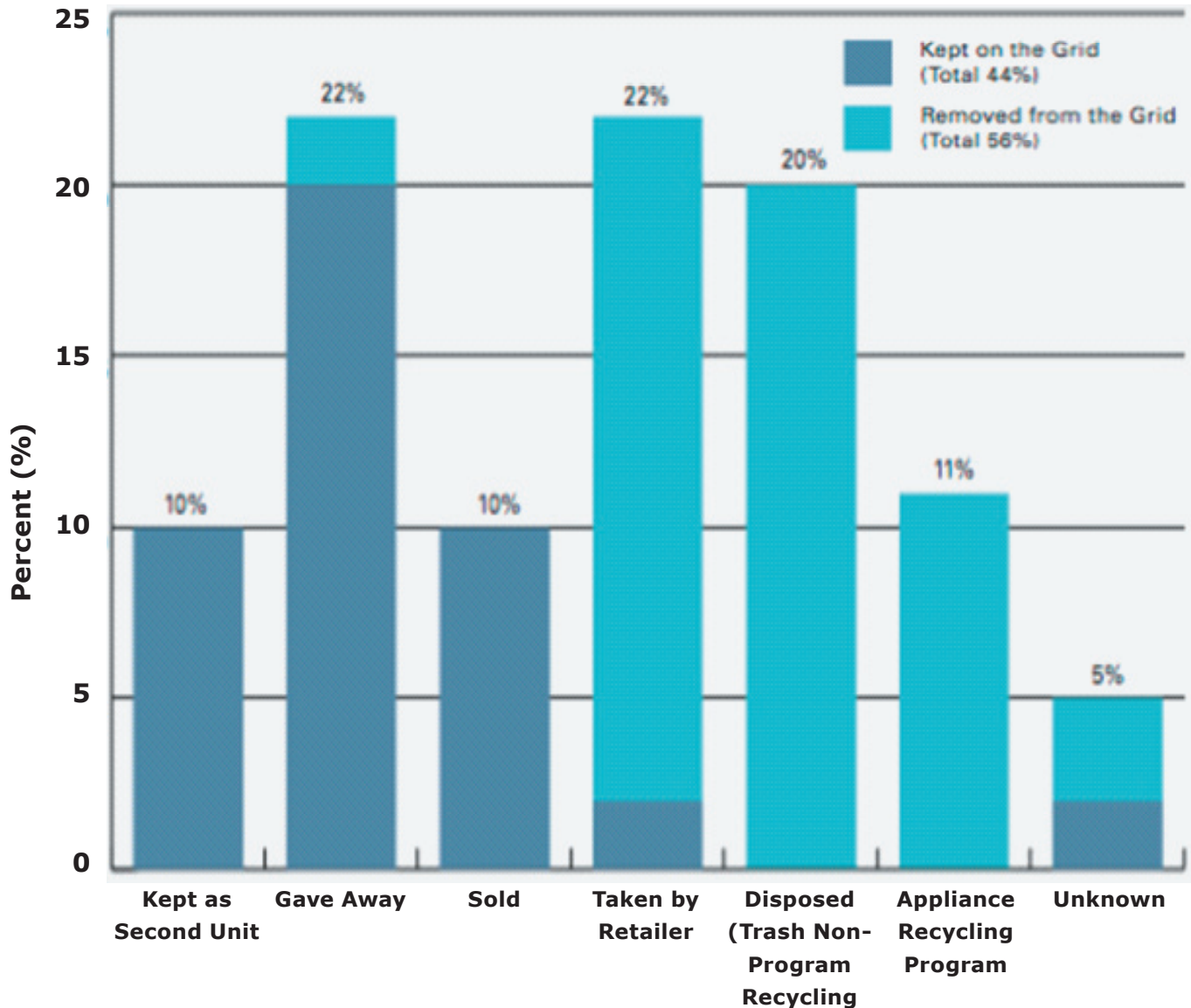
How energy-efficiency appliance subsidies create GHG emissions

Over the course of the past thirty years, technological advances have made refrigerators significantly more energy efficient. The average refrigerator today is 20 percent larger than it was in 1975, but uses only 25 per cent as much energy.²² The desire to conserve energy, along with concern about global warming as a result of greenhouse gas emissions, has prompted policy-makers in many jurisdictions to offer subsidies to consumers who purchase newer, energy-efficient refrigerators (and other appliances). The theory behind this sort of policy is that if it is cheaper for consumers to buy new appliances, they will do so, and discard their older appliances, thereby creating a net decrease in energy consumption and greenhouse gas emissions.

However, the impact of these rebates and subsidies have been ambiguous. These policies have encouraged many consumers to purchase new refrigerators, as the policy-makers intended. However, many consumers have decided not to discard their old refrigerators—as the policy-makers expected them to—and have either kept them in the home as a second fridge, given them away to a friend or sold them. In these instances, where a consumer takes advantage of a subsidy to buy a refrigerator that they would not have otherwise bought, but keeps the old fridge plugged in, the net effect of the subsidy is to add a refrigerator to the electricity grid, thereby *increasing* total energy consumption and greenhouse gas emissions.

A recent analysis of data collected in California and Vermont strongly suggests that when a new refrigerator is purchased, a consumer's old fridge actually stays on the grid almost half of the time. As the following graphic, published on the New York Times website, shows, approximately 44% of older refrigerators remained on the grid after consumers purchased a new one.

As the graphic shows, in one out of every ten instances, consumers simply keep their old fridge plugged in at home when they buy a new one. As a result, 26% of American homes now have a second refrigerator, a number that is growing at approximately 1% annually.²³ Clearly, the trend towards two-refrigerator homes is not a benefit for energy conservation or environmental protection, but this trend has been accelerated by the existence of subsidies that make it cheaper for consumers to buy additional appliances. This trend, along with the increase in the average size of refrigerators, have combined to largely offset the energy savings that have been created by improved efficiency in appliances. Chris Calwell of Ecos, a firm that advises government agencies on energy efficiency programs, goes so far as to state "the growth in refrigerator size, number of refrigerators in use and the prevalence of second refrigerators is swamping much of the gains we've achieved by improving efficiency."²⁴

Chart 3: What happens when consumers buy new refrigerators?

Source: US Dept. of Energy. Graphic originally published in *New York Times* online.

Clearly, some consumers have used energy efficiency rebates and subsidies to augment their existing collection of appliances rather than to replace old ones. Just as some people took advantage of the rebate for electric cars to buy a recreational vehicle, some consumers have used energy-efficient appliance subsidies to supply their home with a “beer fridge.”

When this happens, the net result is an increase in energy consumption, not a decrease, meaning that the policy has precisely the opposite of its intended effect.

Case Study 5:

The ban on DDT and the resurgence of malaria

The fact that biofuel subsidies have contributed to a world food crisis and hunger in poor countries demonstrates that environmental protection policies can have tragic unintended consequences. However, even the suffering caused by that ill-fated intervention pales in comparison to the almost unimaginable death and destruction that was caused by the ban on DDT use in poor countries, a policy which caused millions of deaths due to malaria.

Malaria is a disease carried by mosquitos. Malaria causes terrible suffering in its victims and is often fatal. Over the past decade, malaria has killed approximately 500,000 people per year. But 50 years ago, the disease had been almost completely eliminated as a threat to human beings.

The widespread use of the chemical compound DDT had dramatically reduced worldwide deaths from malaria, particularly in Africa where the disease is most common. The impact of DDT on malaria was so great that the National Academy of Sciences wrote "to only a few chemicals does man owe as great a debt as to DDT. In little more than two decades, DDT has prevented 500 million human deaths, due to malaria, that otherwise would have been inevitable."²⁵

In the 1960s, however, the nascent environmental movement would mobilize against DDT, ultimately leading to severe restrictions on its use, and terrible human suffering. In 1962, Rachel Carson published *Silent Spring*, in which she argued that DDT posed a threat to the natural environment and held the potential to cause deadly cancers in wild animals and human beings. *Silent Spring* described the harmful effects of pesticides on the environment, focusing particularly on the impact of DDT on local bird populations.

The environmentalist movement was attracted to Carson's argument that this man-made chemical compound was destructive to the natural environment and

began a concerted campaign to ban DDT. In particular, the environmentalists were concerned by evidence that high levels of DDT use in agricultural processes can interfere with the reproductive capacities of certain large birds, such as the American Eagle, by causing their eggshells to become thinner and more likely to crack before a chick can hatch.²⁶ In 1969, the Environmental Defense Fund and the Sierra Club submitted a petition to the United States government demanding a ban on DDT in the United States.

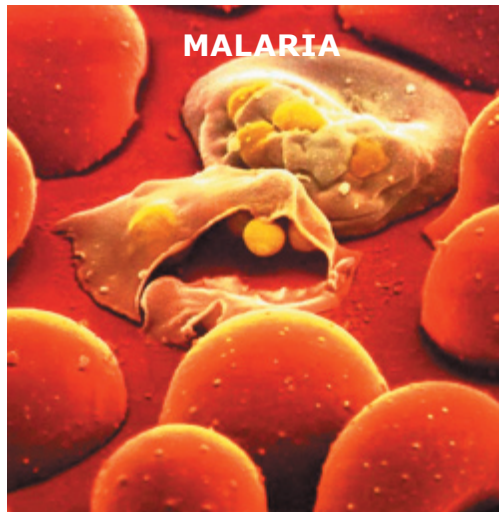


The United States banned DDT in the 1970s. Since malaria had been eradicated in the United States, this ban did not have unintended consequences for human health, however, many prominent environmentalist groups were unsatisfied with the national ban, and began to press the US government to use its influence to pressure poor countries around the world to stop using DDT. Under pressure from a lawsuit filed by the Audubon Society and the Natural Resources Defense Council, the United States agreed to do so.

The American government threatened to withdraw foreign aid from countries that refused to ban DDT.²⁷ Because many poor countries are highly reliant on foreign aid, particularly American aid, this action had a practical effect similar to a worldwide ban on DDT, which was quickly phased out in the developing world.²⁸

With DDT removed, and governments around the world employing less effective strategies for controlling malaria, the disease re-emerged in large numbers in many tropical countries. Sri Lanka, a country which had almost completely eliminated malaria, abandoned the use of DDT in reaction to *Silent Spring*. A few years after banning the chemical compound, malaria rates almost immediately jumped back up to 2.5 million cases.²⁹

Similarly, many South American countries banned DDT in the 1970s under pressure from the United States government, only to see their malaria rates shoot up in 1993.



Ecuador decided that the human cost of the DDT ban was simply too high and resumed using the compound. Malaria rates predictably dropped by 61%.³⁰

Some medical historians believe that malaria has killed more people than any other disease in history.

When DDT use was common, between 1950–1970, malaria rates around the world plunged, and some experts even believed that this scourge was on the brink of extermination. The importance of DDT as a lifesaver was recognized by the Nobel Prize Committee, which gave the Nobel Prize in Medicine to Dr. Paul Myller, the man who discovered the fact that DDT could be utilized to kill malarial mosquitos. All told, conservative estimates place the number of lives saved by DDT at approximately 100 million.³¹ It is impossible to precisely state the human cost of the DDT ban over the past thirty years, but many credible estimates place it in the millions of lives.³²

What makes the DDT ban most tragic is that the supposed carcinogenic effects resulting from exposure turned out to be wildly overstated. Despite years of study, no compelling evidence has been presented that the widespread DDT use in agriculture during the 1950s and 1960s caused an increase in cancer rates anywhere in the world.³³

Several studies performed in the United States have cast further doubt on the notion that DDT is highly carcinogenic. From 1956 to 1958, prison volunteers actually ingested large amounts of DDT

in pill form. The prisoners ate up to 35 milligrams per day for almost two years. This represented approximately 1,000 times as much DDT as was ingested by the average American during the period when DDT was most widely used. The subjects did not report any complaints, and no adverse health effects were detected. Five years later, a follow-up examination was conducted and once again, no negative effects from the DDT ingestion were observed.³⁴ Two additional observational studies were performed, which examined the health outcomes of workers employed by DDT manufacturers, and who were frequently exposed to the chemical. In both cases, the workers were found to have very high levels of DDT in their bodies, but in both cases the researchers were unable to find negative effects as a result of the DDT exposure.³⁵ Some researchers have claimed to discover a link between DDT exposure and breast cancer. However, these findings have been reviewed by the U.S. Government's Agency for Toxic Substances and Disease Registry, which concluded that there still exists no clear link between DDT exposure and cancer levels in human beings.³⁶ In light of the lack of evidence that DDT is carcinogenic in human beings, the World Health Organization has stated that "the only confirmed cases of injury" from DDT "have been the result of massive accidental or suicidal ingestion."³⁷

There is some evidence that DDT can be harmful to bird populations when it has been used in massive amounts for agricultural purposes. But there is no strong evidence that DDT used in smaller amounts inside of homes—the effective way to combat malaria—has ill effects on the health of nearby bird populations.³⁸ In short, there is very little evidence that limited DDT use inside of homes causes harm to human beings, bird species or the environment in general. The DDT ban was undertaken to protect the environment from the ill effects of DDT, but the unintended consequence was the resurgence of malaria and many unnecessary deaths. This is a striking and tragic example of how well-intended policies can create unintended consequences that result in terrible human suffering.

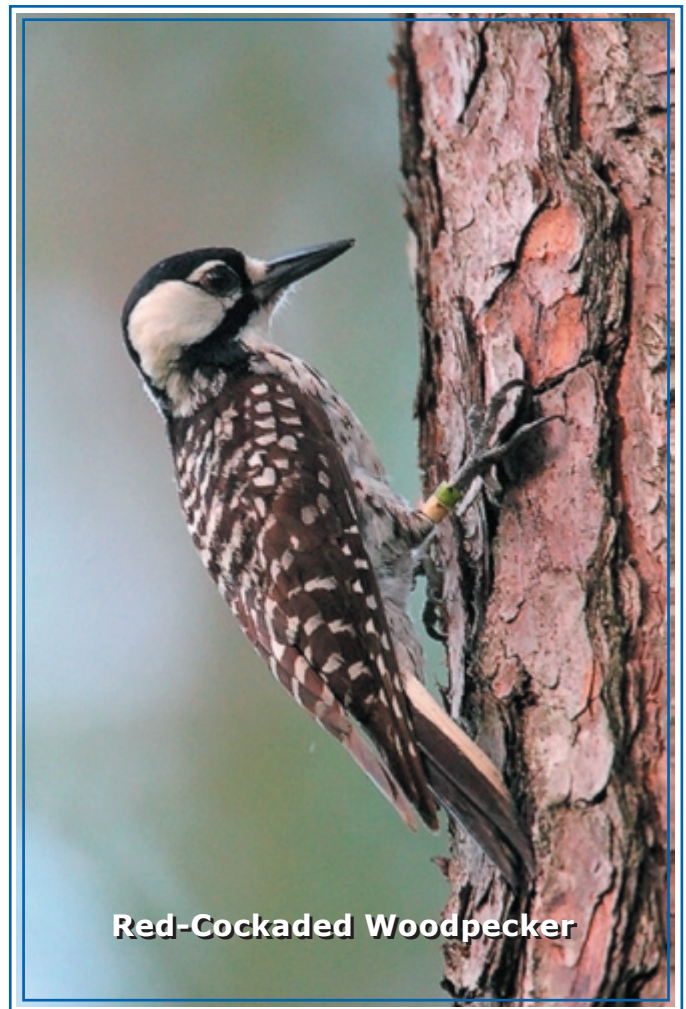
Case Study 6:

Perverse incentives and the *Endangered Species Act*

The *Endangered Species Act* is an American law that was passed in 1973. The objective of this law is to ensure the survival of species whose population is in some way threatened, and particularly protect species facing extinction. Similar laws exist in many different jurisdictions, including several Canadian provinces. The law makes it illegal to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect” any species that has been designated “endangered.” Furthermore, it is illegal under the *Endangered Species Act* to damage the habitat of an endangered species in any way that makes it less hospitable to those creatures. This rule severely limits many types of commercial activity in areas where a member of an endangered species is found to be living. Logging and mining are just two commercial activities that are often severely restricted in areas that become inhabited by endangered species.

The *Endangered Species Act* is different from most zoning laws because it is only applicable if a listed species is present on a given individual or corporation’s property, whereas most zoning laws apply to a clearly defined geographical area.³⁹ This means that landowners are subject to the act’s restrictions only if a listed animal is present on their land.

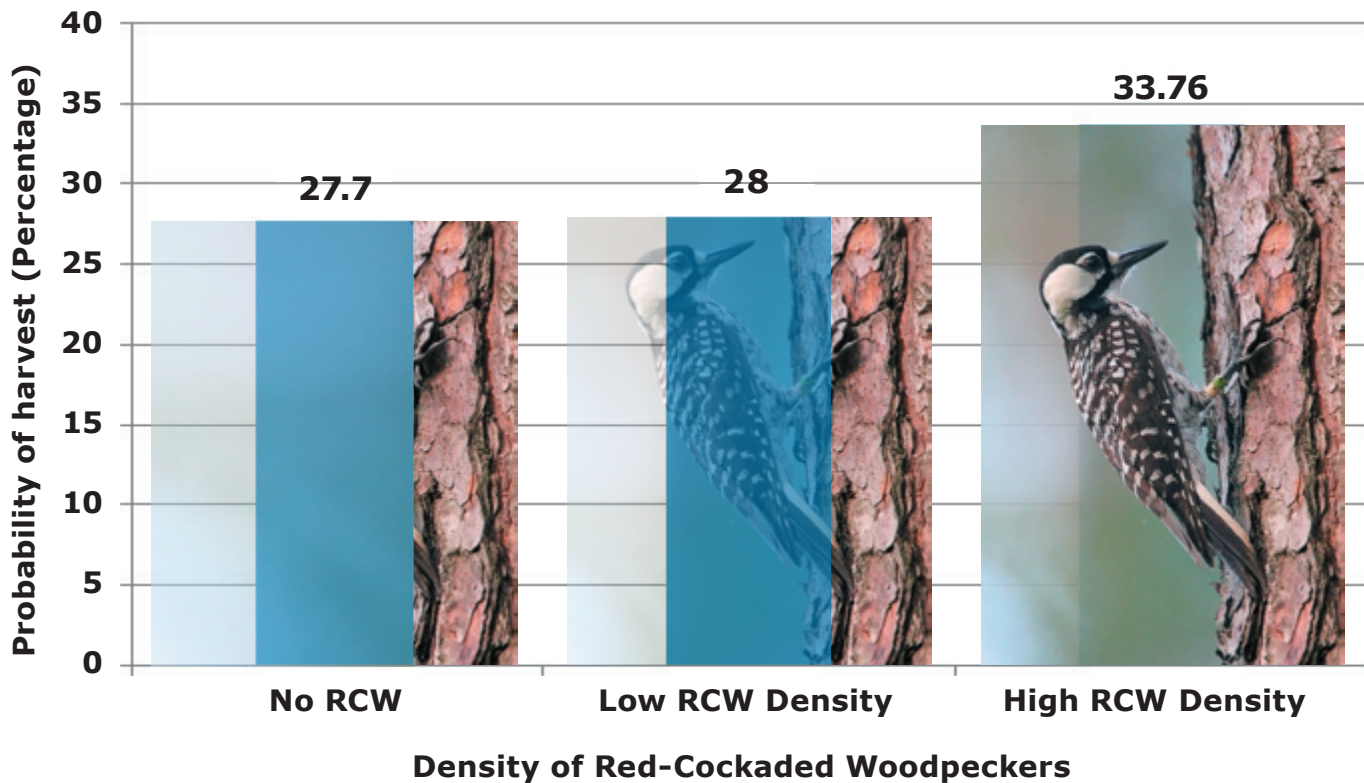
The *Endangered Species Act* places severe land-use restrictions on areas found to be inhabited by protected animals. Landowners who are close to populations of these animals—though they may not yet have



Red-Cockaded Woodpecker

them on their property—face an extremely strong incentive to stop these animals from entering their land, as their presence could severely restrict land-use options and diminish its productive potential and value. The temptation to pre-emptively alter territories to prevent the arrival of an endangered species can therefore be very strong.

Chart 4: Probability of harvest for 30 year old timber stands depending on density of R-C Woodpecker colonies



In a 2003 paper published in the *Journal of Law and Economics*, economists Dean Lueck and Jeffrey A. Michael published the results of an empirical study in which they examined the prevalence of pre-emptive habitat destruction designed to evade EPA restrictions. Specifically, they examined the extent to which landowners pre-emptively destroyed the habitat of the red-cockaded woodpecker that lives in North Carolina. Land in this area was used predominantly for logging, and the *Endangered Species Act* severely limited—or even prohibited—timber harvest activity in areas where the woodpeckers lived. The temptation for landowners was therefore very strong to harvest their land more aggressively to obtain what profits they could while making their land less attractive to the endangered birds.

Unsurprisingly, the economists found that in an examination of over 1,000 individual forest plots in the region, plots located close to known populations of the endangered birds were managed very differently from areas located further away from known bird populations. Specifically, they found that close proximity of a plot to dense woodpecker populations significantly increased the likelihood that the plot was harvested during the course of the six-year study, and significantly decreased the age at which the forest was harvested. In other words, they found strong evidence that landowners were pre-empting potential regulatory losses by destroying potential woodpecker habitat before the birds might migrate onto their property, thereby avoiding *ESA* land-use restrictions.

Specifically, the authors produce an estimate of the likelihood that particular, relatively young (thirty years old) timber stands would be harvested during the period of study depending on whether the stand was within 15 miles of territory densely populated by the relevant woodpecker. As Chart 4 shows, 27.7 per cent of these timber stands that were not located near dense woodpecker populations were harvested during this period, compared to 33.76 per cent of timber stands located near high-density areas. A follow up study by Daowei Zhang, published in *Economic Inquiry*, similarly found that landowners are “25 percent more likely to cut forests when he knows or perceives that a red-cockaded woodpecker cluster is within a mile of the land than otherwise.”⁴⁰

In other words, timber stands located in close proximity to dense woodpecker populations were 22 per cent more likely to be harvested than timber stands that were not located close to the woodpeckers. This represents striking evidence that landowners were pre-emptively harvesting their timber stands in order to avoid becoming subject to *ESA* land-use regulations.

The authors conclusively demonstrate that the well-intentioned *Endangered Species Act* actually had a significant negative impact on the well-being of the woodpecker population in North Carolina by reducing the amount of suitable land available for them to live in. In a more recent paper, economists John List, Michael Margolis and Daniel Osgood studied the effect of the *Endangered Species Act* on a particular owl species that lives in the United States.

The authors of this study, “Is the *Endangered Species Act* Endangering Species,” similarly found that the pre-emptive destruction of habitats was common in the case of these owls.⁴¹ Anecdotal evidence suggests that these two rigorous studies of the *ESA*’s impact on two particular species’ habitats is likely applicable for many other species as well.

The *Endangered Species Act* severely weakens the property rights of individuals and companies when listed species appear on their property, causing those property rights to lose substantial value. The pre-emptive destruction of woodpecker and owl habitats shows that firms and individuals will respond rationally to such a threat, and work to protect the value of their property, often in ways that may not be compatible with the original intention of the regulators. In this case, the landowners’ response to the threat of property devaluation as a result of the *ESA* was to aggressively remove suitable woodpecker habitats, resulting in a severe harm to the very species that the regulators had sought to protect.

Case Study 7:

How forest fire prevention policies backfired

Throughout the past century, the government of the United States has pursued a forest-management strategy based on the aggressive suppression of forest fires. In 1935, the policy of putting out all wildfires as quickly as possible was firmly established by the enactment of the “10 AM Policy,” which stated that all wildfires must be brought under control by 10 AM the following day.⁴²

At first glance, such a policy seems like no more than an application of common sense. Timber is a valuable natural resource, forest ecosystems provide a habitat for a wide range of flora and fauna, and forest fires can cause damage to property and even jeopardize human lives. A policy of aggressive fire suppression also (at first) seemed to make sense from an economic point of view, as it is far easier and cheaper to put out forest fires when they are small than when they grow larger. The clearest evidence of this fact is that just 1% of wildfires in the United States grow to 120 hectares in size, whereas 97.5% of the suppression costs are incurred by putting out large fires.

Unfortunately, forest ecosystems are complicated, and the policy-makers who initiated the “10 AM Policy” did not recognize that forest fires play an important role in maintaining the health of those ecosystems. As a result, the aggressive suppression of forest fires has brought about a number of serious unintended consequences.

The policy of rapid forest fire suppression brought about several destructive ecological changes to the nation’s forests.⁴³ Of particular importance, the near-elimination of forest fires causes the density of many forest stands to increase. This has thickened the canopy cover of the forests, causing fundamental changes to the ecosystem. The increased canopy cover inhibited the growth of certain types of ground-level plants, thereby impacting the bottom level of the food chain. As a result of the changes to the natural system, the forests became less suitable as a habitat for a number of animal species.⁴⁴ For example, research in Arizona suggests that wildfire suppression was responsible for dramatically reducing the biodiversity and overall abundance of local butterfly populations.⁴⁵

The most serious unintended consequence of the aggressive fire suppression, however, was huge build-ups of “forest fuel,” as less forest fuel was burned off by the small, regularly-occurring forest fires that were being aggressively suppressed.⁴⁶ As a result of the forest fuel build-ups, fires that could not be immediately controlled spread extremely quickly. As a result, the Western United States now has far more large-scale forest fires than was the case in the early part of the 20th century.

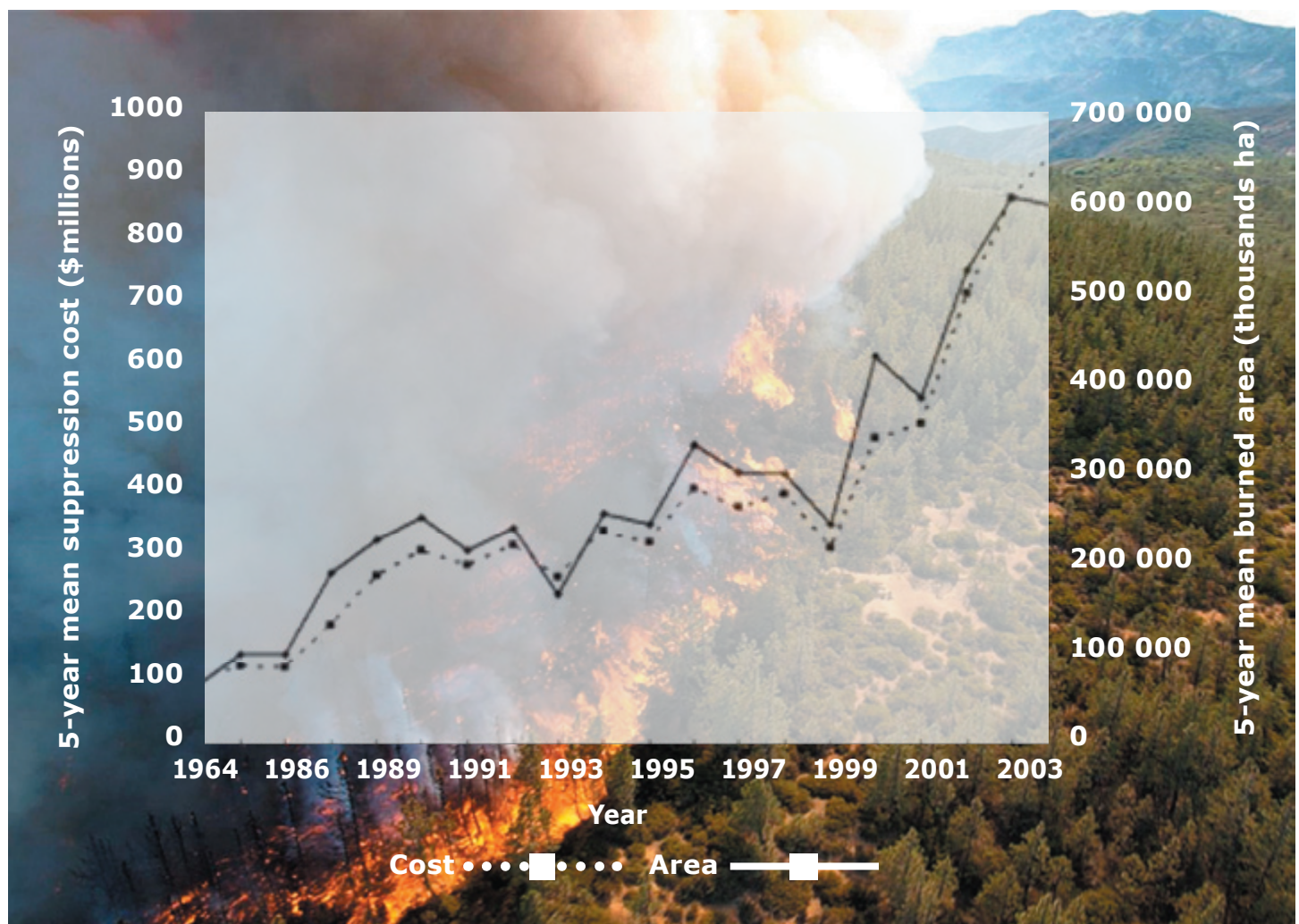
As depicted in Chart 5, the result has been a steady increase over time in the total amount of area burned by large fires, as well as the cost of fire suppression over the course of recent decades.

In short, the aggressive fire suppression policy adopted by the US government resulted in more large-scale fires, and drastically increased the cost of wildfire control—precisely the opposite of the policy’s intended effect.

In recent years, the American government has recognized the problems in its forest management policies and rescinded the “10 AM Policy.” However, the damage done by a century of forest fuel build-up will

continue to be felt for a long time to come. In many forests, huge build-ups of forest fuel continue to exist, and will continue to create massive, rapidly spreading forest fires. This example shows that the law of unintended consequences often leads public policies to bring about the exact opposite of their intended effects. It also demonstrates that the damage caused by the unintended consequences of public policy are often extremely difficult and costly to reverse.

Chart 5: Cost and area of forest fire burned by year (1965–2003)



Source: Geoffrey H. Donovan and Thomas C. Brown. *Be Careful What You Wish For: The Legacy of Smokey the Bear*.

Case Study 8:

Fuel economy standards, highway fatalities and increased driving

Since the 1970s, governments across North America have introduced laws mandating that all new cars meet government-established fuel efficiency standards. These are frequently referred to as “Corporate Average Fuel Economy” (CAFE) standards. These regulations have been imposed to conserve energy, and to protect the environment by improving air quality and reducing the amount of greenhouse gasses emitted into the atmosphere.

This policy has had a number of unintended, undesirable consequences. First, the new fuel efficiency standards may not have substantially reduced fuel consumption as desired. This is because of what economists refer to as the “rebound effect,” which is the well-documented tendency of consumers to react to greater energy efficiency by increasing their energy consumption. Each mile of automobile travel requires less energy and therefore costs less in a fuel-efficient car as opposed to a less fuel-efficient car. Because of the ironclad economic rule that demand curves slope downward, this means that heightened fuel-efficiency will lead to increased vehicle mileage. Although this rebound effect may not entirely offset the savings from energy efficiency, there is no doubt that increased vehicle mileage results from greater fuel-efficiency standards, and that this offsets some of the environmental and conservation benefits of greater fuel efficiency.⁴⁷

In addition to lending to an increase in highway mileage, the CAFE standards

actually had the perverse effect of causing some people to purchase *larger* automobiles. This phenomenon occurred because the CAFE standards effectively banned the production of family station wagons—it was impossible to mass-produce station wagons that attained the minimum fuel efficiency standards. However, a demand still existed for large cars. Automakers recognized this demand, and created the Sports Utility Vehicle (SUV), which had *significantly* worse fuel mileage than station wagons, but which were classified as light trucks by the government. Because they were classified as light trucks rather than cars, the fuel mileage standards for SUVs were considerably less stringent than they were for station wagons.⁴⁸ Ironically, the creation of government-mandated fuel efficiency standards helped create a booming market for gas-guzzling SUVs.⁴⁹



Although increased vehicle mileage and lower levels of fuel efficiency are unfortunate unintended consequences of this policy, even these negative results seem trivial when compared to the fact that CAFE standards in North America have undoubtedly led to a significant increase in the number of highway deaths over the past thirty years. This tragic unintended consequence has occurred because the regulators did not adequately think through exactly how automobile producers would change their cars to meet the new standards, or what effect these changes would have on safety.

In response to new CAFE standards, automobile producers began to produce lighter cars, which require less force to move and therefore less gasoline per mile. Unfortunately, the likelihood of dying from a car crash is substantially higher in lighter cars than in heavier ones. That's because lighter cars do not absorb the force of crashes as well as heavier ones. The less force that the car absorbs, the more is absorbed by the people inside the car. This statement is not controversial; in fact, Robert Crandall of the Brookings Institution and John Graham of the

Harvard School of Public Health—experts in this topic—have stated that the relationship between lighter weight and increased fatality risk from crashes is “one of the most secure findings in the safety literature.”⁵⁰

All else being equal, occupants of lighter cars are more likely to die if they are in a crash than occupants of heavier ones. By forcing firms to produce lighter cars, CAFE standards make cars less safe and lead to large increases in the number of highway fatalities each year. It is impossible to determine exactly how many people have died as a result of these laws. However, there is little doubt that the death count runs into the thousands. The most carefully conducted study of this topic was undertaken in 1989 by the aforementioned scholars Crandall and Graham. In this study of the effect of CAFE standards in the United States, the researchers found that the regulations were responsible for 2,200–3,900 excess deaths *that would not have occurred without the standards* over the course of a ten-year period. The study also found between 11,000 and 19,500 individuals would suffer serious but non-fatal crash injuries as a result of the CAFE standards over a ten-year period.⁵¹





Since considerable time has passed since this study was completed, and CAFE standards have since tightened in some jurisdictions, many thousands of additional people have undoubtedly died or been maimed as a result of automobile fuel efficiency standards since Crandall and Graham's study was published.

Further evidence of the deadly unintended consequences of CAFE standards was produced in 2001, when a National Academy of Sciences panel studied the impact of the regulations on highway fatalities, and found that CAFE standards had contributed to between 1,300 and 2,600 traffic deaths each year since their enactment.

It should be noted that the additional deaths caused by the development of lighter vehicles are not directly observable, because numerous other changes have simultaneously taken place in production processes of vehicles that have also influenced rates of highway fatalities. Most importantly, improvements in safety devices such as seatbelts and airbags have worked to reduce highway fatalities, and have had a greater positive impact than the negative impact caused by the CAFE standards. Understanding the impact of the CAFE standards therefore requires estimates using complicated

models of the number of highway fatalities that would have occurred in the absence of CAFE standards. As a result, complicated analyses such as those produced by Crandall and Graham are necessary to produce reasonable estimates of the impact of CAFE standards, as we cannot simply observe the impact of the regulations in isolation.

Simply put, the evidence is extremely strong that lighter cars are less safe than heavier ones, and that North American CAFE Standards are directly responsible for thousands of deaths over the past thirty years. This tragedy was caused because governments and regulators did not understand the automobile production process or the market for vehicles and did not realize that by far the most efficient way to meet the new standards was for producers to make cars lighter and therefore less safe. Responding rationally to new constraints, producers made lighter cars as ordered, leading to thousands of unnecessary deaths on North American highways.

This is one further example of how the pursuit of an objective as apparently benign as energy conservation can produce unintended consequences that can include the deaths of thousands of human beings.

Conclusion

It is impossible for regulators to predict in advance what all of the consequences of government interventions into complex social, economic and ecological systems will be—but that certainly hasn't stopped them from trying. This paper has used case studies to illustrate this fact by showing how well-meaning efforts to protect the natural environment have backfired in both the distant and recent past, leading to economic inefficiency, human suffering and, ironically, environmental despoliation.

Of course, the fact of unintended consequences does not mean that governments should never use their power to encourage resource conservation and protect the environment. The law of unintended consequences, however, should cause us to be wary of heavy-handed government interventions into complex systems. The problem of unintended consequences can never be solved, but the likelihood that this problem will create serious problems for human beings and environment can be reduced if governments adhere to the following three principles in the area of environmental policy:

- As cost-benefit analysis is performed to evaluate the wisdom of proposed new regulations. We should factor the risks associated with unintended consequences into the calculations, and accept new laws only if their predicted benefits **dramatically** outstrip their predicted costs, since we know that there are likely to be other costs that we are unable to predict in advance. In other words, there should be a **bias against intervention** built into the policy process.
- When they do act, governments should be extremely humble in the design and implementation of new regulations. Large, sudden interventions are more likely to cause severe unintended consequences than smaller, incremental policy approaches. Governments should therefore take a cautious approach to environmental regulation wherever possible, using pilot programs and **incremental reforms** to help identify possible unintended consequences of proposed interventions before they are introduced on a large-scale basis.
- When possible, governments should structure environmental interventions so that **incentives align with positive outcomes**, using market-based measures where possible.

Due to the complexity of the systems involved, governments will never be able to predict all of the consequences of environmental regulations and interventions in advance. This means that the problem of unintended consequences cannot be fully solved through “smarter” regulations, or by thinking through the design of ambitious regulations more rigorously. Instead, the law of unintended consequences will always be with us. These case studies illustrate just how serious these unintended consequences can be, and shows the need for caution, humility and incrementalism in the development of environmental policy.



Endnotes

1. David Adam. "Macquarie Island faces 'ecosystem meltdown' after conservation efforts backfire." *The Guardian*, January 12, 2009. Available online: <http://www.guardian.co.uk/environment/2009/jan/13/macquarie-cats-conservation>
2. Convict Creations Website. "Environmental Problems in Australia". Accessed Feb 21, 2010. Available online: <http://www.convictcreations.com/animals/environment.htm>
3. Elizabeth Svoboda. "The Unintended Consequences of Changing Nature's Balance" *The New York Times*. January 12, 2009. Available online: <http://www.nytimes.com/2009/02/17/science/17isla.html>
4. David Adam. "Macquarie Island faces 'ecosystem meltdown' after conservation efforts backfire." *The Guardian*, January 12, 2009. Available online: <http://www.guardian.co.uk/environment/2009/jan/13/macquarie-cats-conservation>
5. Convict Creations Website. "Environmental Problems in Australia". Accessed Feb 21, 2010. Available online: <http://www.convictcreations.com/animals/environment.htm>
6. The Wall Street Journal Editorial Board. "Cash for Clubbers." *The Wall Street Journal*. October 17, 2009. Available online: <http://online.wsj.com/article/SB10001424052748704107204574473724099542430.html>
7. Ibid.
8. Kenneth Green. "The Road to Energy Hell is Paved with Good Intentions." American Enterprise Institute. June 1, 2007. Available online: <http://www.aei.org/article/26353>
9. Elizabeth Rosenthal. "Europe, Cutting Down Biofuel Subsidies." *The New York Times*. January 22, 2008. Available online: <http://65.181.175.195/component/content/article/212-environment/45357.pdf>
10. Science Daily Website. "Biofuels Ignite Food Crisis Debate." *Science Daily*. Available online: <http://www.sciencedaily.com/releases/2009/01/090128074830.htm>
11. Ibid.
12. Elizabeth Rosenthal. "Europe, Cutting Down Biofuel Subsidies." *The New York Times*. January 22, 2008. Available online: <http://65.181.175.195/component/content/article/212-environment/45357.pdf>
13. Joint Nature Conservation Committee. "Transport Biofuels and Biodiversity: Jncc Position Statement." *Joint nature Conservation Committee Website*. Available online: <http://www.jncc.gov.uk/page-4201>
14. Chelsea Anne Young. "Biofuels boom could fuel rainforest destruction." *Stanford Review*. February 17, 2009. Available Online: <http://news-service.stanford.edu/news/2009/february18/biofuels-rainforest-destruction-gibbs-021809.html>
15. Kenneth Green. "The Ethanol Delusion." American Enterprise Institute. August, 2008. Available online: <http://www.aei.org/article/28452>
16. Ibid.
17. C. Ford Runge and Benjamin Senauer. "How Biofuels Could Starve the Poor." *Foreign Affairs*. May/June 2007. Available online: <http://www.foreignaffairs.com/articles/62609/c-ford-runge-and-benjamin-senauer/how-biofuels-could-starve-the-poor>
18. Ron Trostle. "Factors Contributing to the sharp rise, and then fall, in food commodity prices: 2002-2009." Economic Research Service. U.S. Department of Agriculture. Available online: http://www.usda.gov/oce/forum/2009_Speeches/Presentations/Trostle.pdf
19. Aditya Chakraborty. "Secret report: biofuel caused food crisis." *The Guardian*. July 3, 2008. Available online: <http://www.guardian.co.uk/environment/2008/jul/03/biofuels.renewableenergy>
20. Ibid.
21. For example, even the Biotechnology Industry Organization concedes that ethanol production is responsible for a "small part" of food inflation in the United States. Biotechnology Industry Organization. "Bush is Right on Biofuels." Biotechnology Industry Organization Website. Available online: http://bio.org/news/pressreleases/newsitem.asp?id=2008_0501_03&p=yes
22. Leora Broydo Vestel. "Consumers Buy More Efficient Refrigerators, but Keep the Old Ones Humming." *The New York Times Green Inc. Blog*. March 19, 2010. Available online: <http://greeninc.blogs.nytimes.com/2010/03/19/consumers-buy-more-efficient-refrigerators-but-keep-the-old-ones-humming/>
23. Ibid.
24. Ibid.
25. Gerald Sirkin and Natalie Sirkin. "DDT, Fraud and Tragedy" *The American Spectator*. February, 2005. Available online: <http://spectator.org/archives/2005/02/25/ddt-fraud-and-tragedy/>

26. Kendra Okonski. "When Politics Kills: Malaria and the DDT Story." The Competitive Enterprise Institute. January, 2001. Available online: http://www.igreens.org.uk/malaria_and_ddt.htm
27. Gerald Sirkin and Natalie Sirkin. "DDT, Fraud and Tragedy" *The American Spectator*. February, 2005. Available online: <http://spectator.org/archives/2005/02/25/ddt-fraud-and-tragedy/>
28. Ibid.
29. Ibid.
30. Ibid.
31. Tod Seavey. "The DDT Ban Turns 30 Millions Dead Because of Malaria Because of Ban, More Deaths Likely." American Council on Science and Health. June, 2002. Available online: http://www.acsh.org/healthissues/newsID.442/healthissue_detail.asp
32. Ibid.
33. Gerald Sirkin and Natalie Sirkin. "DDT, Fraud and Tragedy" *The American Spectator*. February, 2005. Available online: <http://spectator.org/archives/2005/02/25/ddt-fraud-and-tragedy/>
34. Aaron Wildavsky. *But is it True? A citizen's guide to environmental health and safety issues*. Harvard University Press. Cambridge: 1997.
35. Ibid.
36. Roger Bate. "Science in Environmental Policy Making" *Testimony Before U.S. Senate Environment and Public Works Committee*. American Enterprise Institute: September 2005. Available Online: <http://www.aei.org/speech/23259>
37. Ibid.
38. Kendra Okonski. "When Politics Kills: Malaria and the DDT Story." The Competitive Enterprise Institute. January, 2001. Available online: http://www.igreens.org.uk/malaria_and_ddt.htm
39. Dean Lueck and Jeffrey A. Michael. "Preemptive Habitat Destruction under the Endangered Species Act." *Journal of Law and Economics*. April 2003.
40. Daowei Zhang, "Endanged Species and Timber Harvesting: The Case of Red-Cockaded Woodpeckers" *Economic Inquiry*. (2004).
41. John A. List, Michael Margolis, Daniel E. Osgood. "Is the Endangered Species Act Endangering Species?" *NBER Working Paper No. W1277*. December, 2006.
42. Geoffrey H. Donovan and Thomas C. Brown. "Be careful what you wish for: the legacy of Smokey Bear." The Ecological Society of America. 2007. Available online: http://www.fs.fed.us/rm/pubs_other/rmrs_2007_donovan_j001.pdf
43. Ibid.
44. Ibid.
45. Ibid.
46. Alison Berry. "Forest Policy Up in Smoke: Fire Suppression in the United States" *Property and Environment Research Centre*. September 2007. Available online: <http://www.perc.org/pdf/Forest%20Policy%20Up%20in%20Smoke.pdf>
47. Charli E. Coon, "Why the Government's CAFE Standards for Fuel Efficiency Should be Repealed, Not Increased." The Heritage Foundation. July 11, 2001. Available online: <http://www.heritage.org/Research/EnergyandEnvironment/BG1458.cfm>
48. Ken Adelman. "Road Regs: Wrongs that don't make rights." *National Review*. January 2002. Available online: <http://old.nationalreview.com/comment/comment-adelman011702.shtml>
49. Michael Lynch. "Cafe Standard Insanity." Centre for Individua Freedom. May, 2005. Available online: http://www.cfif.org/htdocs/freedomline/current/guest_commentary/lynch-cafe-standard-insanity.htm
50. Ryan Balis. "CAFE Standard Kill: Congress' Regulatory Solution to Foreign Oil Dependence Comes at a Steep Price." National Center for Policy Analysis. July, 2006. Available online: <http://www.nationalcenter.org/NPA546CAFESTandards.html>
51. Robert Crandall and John Graham. "The Effect of Fuel Economy Standards on Automobile Safety." *Journal of Law and Economics*. April, 1989.

Further Reading



June 2009

The Environmental State of Canada: Thirty Years of Progress

Ben Eisen and Kenneth Green

[http://www.fcpp.org/images/publications/
63.%20The%20Environmental%20State%20of%20Canada.pdf](http://www.fcpp.org/images/publications/63.%20The%20Environmental%20State%20of%20Canada.pdf)

June 2009

Conversations on the Frontier with Kenneth Green

<http://www.fcpp.org/publication.php/2854>

For more see
www.fcpp.org