ENERGY JUSTICE AND FOUNDATIONS FOR A SUSTAINABLE SOCIOLOGY OF ENERGY

by

HANNAH ANN HOLLEMAN

A DISSERTATION

Presented to the Department of Sociology
and the Graduate School of the University of Oregon
in partial fulfillment of the requirements
for the degree of
Doctor of Philosophy

June 2012

DISSERTATION APPROVAL PAGE

Student: Hannah Ann Holleman

Title: Energy Justice and Foundations for a Sustainable Sociology of Energy

This dissertation has been accepted and approved in partial fulfillment of the requirements for the Doctor of Philosophy degree in the Department of Sociology by:

John Bellamy Foster	Chairperson
Richard York	Member
Jill Harrison	Member
Joseph Fracchia	Outside Member

and

Kimberly Andrews Espy	Vice President for Research & Innovation/Dean of the Graduate School

Original approval signatures are on file with the University of Oregon Graduate School.

Degree awarded June 2012

DISSERTATION ABSTRACT

Hannah Ann Holleman

Doctor of Philosophy

Department of Sociology

June 2012

Title: Energy Justice and Foundations for a Sustainable Sociology of Energy

This dissertation proposes an approach to energy that transcends the focus on energy as a mere technical economic or engineering problem, is connected to sociological theory as a whole, and takes issues of equality and ecology as theoretical starting points. In doing so, the work presented here puts ecological and environmental sociological theory, and the work of environmental justice scholars, feminist ecologists, and energy scholars, in a context in which they may complement one another to broaden the theoretical basis of the current sociology of energy. This theoretical integration provides an approach to energy focused on *energy justice*. Understanding energy and society in the terms outlined here makes visible *energy injustice*, or the interface between social inequalities and ecological depredations accumulating as the social and ecological debts of the modern energy regime. Systems ecology is brought into this framework as a means for understanding unequal exchange, energy injustice more generally, and the requirements for long-term social and ecological reproduction in ecological terms. Energy developments in Ecuador and Cuba are used here as case studies in order to further develop the idea of *energy justice* and the theory of unequal ecological exchange. The point is to broaden the framework of the contemporary critical sociology of energy, putting energy justice at its heart.

This dissertation contains previously published and unpublished co-authored material.

CURRICULUM VITAE

NAME OF AUTHOR: Hannah Ann Holleman

GRADUATE AND UNDERGRADUATE SCHOOLS ATTENDED:

University of Oregon, Eugene
Oklahoma State University, Stillwater
University of Vermont, Burlington

DEGREES AWARDED:

Doctor of Philosophy, Sociology, 2012, University of Oregon
Master of Science, Sociology, 2011, University of Oregon
Bachelor of Science, Sociology, 2005, Oklahoma State University
Bachelor of Arts, English, 2002, Oklahoma State University

AREAS OF SPECIAL INTEREST:

Environmental Sociology
Social Inequality
Sociological Theory
Political Economy

PROFESSIONAL EXPERIENCE:

Assistant Professor of Sociology, Amherst College, 2012-

Graduate Teaching Fellow, University of Oregon, 2005-2012

Graduate Teaching Fellow, University of Vermont, 2002-2003

GRANTS, AWARDS, AND HONORS:

Carolyn M. Stokes Memorial Scholarship, University of Oregon, 2011

Wasby-Johnson Sociology Dissertation Research Scholarship, Energy Justice and Foundations for a Sustainable Sociology of Energy, University of Oregon, 2011

Public Impact Fellowship honorable mention, University of Oregon, 2010

Oregon Young Scholar's Program and Office of Institutional Equity and Diversity Service Award, University of Oregon, 2009

Multi-Cultural Center Ally Award, University of Oregon, 2009

Oregon Young Scholar's Program and Office of Institutional Equity and Diversity Service Award, University of Oregon, 2008

Department of Sociology O.D. Duncan Award for Outstanding Scholarship at the Undergraduate Level, Oklahoma State University, 2005

PUBLICATIONS:

Foster, John Bellamy and Hannah Holleman. Forthcoming, 2012. "Weber and the Environment: Classical Foundations for a Postexemptionalist Sociology." *American Journal of Sociology* 117 (6).

Holleman, Hannah. 2012. "Energy Policy and Environmental Possibilities: Biofuels and Key Protagonists of Ecological Change." *Rural Sociology* 77 (2): 280-307.

McChesney, Robert W., Inger L. Stole, John Bellamy Foster, and Hannah Holleman. 2011. "Advertising and the Genius of Commercial Propaganda." In *The Propaganda Society: Promotional Culture and Politics in Global Context*, edited by Gerald Sussman, 27-44. New York: Peter Lang Publishing, Inc.

Foster, John Bellamy and Hannah Holleman. 2010. "The Financialization of Wealth and the Crisis of 2007-2009." In *Imperialism, Crisis and Class Struggle: The Enduring Verities and Contemporary Face of Capitalism*, edited by Henry Veltmeyer, 191-202. Boston: Brill Publishers.

Foster, John Bellamy and Hannah Holleman. 2010. "The Financial Power Elite." *Monthly Review* 62 (1): 1-19.

Holleman, Hannah, John Bellamy Foster, Robert W. McChesney and R. Jamil Jonna. 2009. "The Penal State in An Age of Crisis." *Monthly Review* 61 (2): 1-17.

Foster, John Bellamy, Robert W. McChesney, Inger L. Stole, and Hannah Holleman. 2009. "The Sales Effort and Monopoly Capital." *Monthly Review* 60 (11): 1-23.

Holleman, Hannah and R. Jonna. 2009. "Barack and Biofuels: The Honeymoon is Over." *Environment, Technology and Society* (Winter): 1-3.

Foster, John Bellamy, Hannah Holleman and Robert McChesney. 2008. "The Imperial Triangle and U.S. Military Spending." *Monthly Review* 60 (5): 1-20.

Holleman, Hannah and R. Jonna. 2008. “The War for Control of the Periphery.” *Monthly Review* 59 (9): 54-62.

Clausen, Rebecca, Eric Edwards, Hannah Holleman, R. Jonna, Stefano Longo, and Philip Mancus. 2008. “Can Sociologists Be Neutral on a Moving Train?” *Environment, Technology and Society* (Winter): 1-2.

Holleman, Hannah and Rebecca Clausen. 2008. “Biofuels, BP-Berkeley and the New Ecological Imperialism.” *MRzine.org*, January 15. http://mrzine.monthlyreview .org/2008/hc160108.html.

ACKNOWLEDGEMENTS

If any case represents a team effort toward the completion of a degree it is mine. It is inconceivable that I so happily or successfully would have completed my dissertation and doctoral degree without the love, mentoring, and support of multiple communities and families spanning two countries, and U.S. states from coast to coast. It is impossible to list here all the individuals that made the difference at various times between success and failure for me, or between my experiencing tasks as mundane and agonizing or with delight and pleasure. Friends and my extended family in Oklahoma, and the Okies in Oregon, have kept me grounded and reminded me constantly what life is all about. My Oregon family has nurtured me away from home and challenged me to better engage the world as it is, while always struggling for the world as we want and need it. The Monthly Review family is a constant source of material and intellectual support and encouragement while I have been in graduate school. The women of Klein Lewis Productions have been there and supported my work in numerous ways. The Oregon Young Scholar's Program inspired my work on campus and beyond. Friends in the Multi-Cultural and Women's Centers, among others, made campus a better place for all of us. My students have made me a better person, teacher, scholar, and activist. I have old friends in Vermont, and new friends in Cuba, that have had an enormous impact on my thinking and inspired elements of my dissertation. To all of these folks and so many more, I am completely indebted.

There are a few people who are very directly responsible for my degree completion. My mom, dad, sister, brothers, aunts, uncles, nephews, niece, cousins, and grandmas have talked me through graduate school and offered all their support, sometimes on a daily basis. While in Oregon I have made many friends. Because this is a difficult group to list in its

entirety I can only mention here those that during my dissertation phase in particular kept me going daily (in alphabetical order): Christina Ergas, Theresa Koford, Sandra Lozano, Carrie Ann Naumoff, Ann South, Tania Triana, and Ryan Wishart. In the graduate community in sociology there are many others who helped me and made life intellectually and socially satisfying. I thank all of you. Jeff Humphrey made life more livable during our time in Oregon and no matter what else was happening, every single day, he's made me laugh. His love and kindness, as well as his general mode of existence, of seeing and treating people, of participating in the community, and thinking through things, has always challenged me to grow and go forward, and just really made all the difference in the world.

Finally, my dissertation committee members comprise the most amazing and supportive group of people and have gone above and beyond to improve and encourage my work. Joe Fracchia talked me through difficult stages of my dissertation, provided resources, and gave me confidence going forward with my project. Jill Harrison provided excellent advice and helped me think through ways of connecting global processes and the everyday experiences of people. Richard York and John Bellamy Foster deserve special thanks because it is with these two extraordinary mentors that I have spent the most time trying to figure out how to study the world, survive and thrive in our profession, and remember the broader purposes of all of our efforts. Richard is a constant friend and mentor and his work on energy and society early on in my graduate career inspired my whole course of study. Without John I literally wouldn't be here. His work and broader commitments made me want to be a sociologist. His encouragement and support made it possible for me to finish, to do well, and to feel like one of the most fortunate students on earth.

My dissertation is dedicated to my grandmother, Lou Ella Good, my aunt, Carla Hamm, my grandfather, Arthur Lee Holleman, and my dear friend, John Peters. These are four people that we have lost prematurely and unnecessarily, but before departing they always made me feel like I could do anything and that we truly could change the world.

TABLE OF CONTENTS

Chapter Page

Chapter Page

CHAPTER I

THE ECOLOGICAL RIFT AND ENERGY JUSTICE: TOWARD A SOCIOLOGY OF ENERGY FOR THE 21ST CENTURY

The section on Max Weber in this chapter is adapted from portions of an early version of a manuscript co-authored with John Bellamy Foster that is now published as Foster and Holleman (2012). The writing and research in the remainder of the chapter is my own.

Climate change and environmental justice: The call for sociological convergence

The near global recognition of climate change has led in the past twenty years especially to a renewal of sociological attention to the energy/society nexus. Also during this period environmental sociologists, assessing the field, have called for more integrated theoretical approaches bridging ecology and radical sociology while drawing lessons from global movements. As the social and ecological dislocations of capitalism increase and the resistance has yet to keep pace with the growth in crises, broader publics, activists, and academics are seeking ways to understand these developments as a whole. Recently, critical environmental sociologists, in tune with the environmental justice movement and broader environmental sociological theory, have started working out the theoretical connections between these issues by moving between, and to some extent synthesizing, sociological, ecological and movement perspectives. The ecological rift theory in environmental sociology, it is suggested here, provides a context in which such a synthesis is possible as the basis for a critical sociology of energy for the twenty-

first century with energy justice at its heart. The development of this integrated framework is the task of this thesis.

This thesis thus represents an attempt to expand the theoretical basis for the sociology of energy, transcending the focus on energy as a mere technical economic or engineering problem, and integrating issues of race, class, gender, and international inequality. The goal is to build on previous work, putting theoretical developments in a context in which they can complement one another. An attempt is made, in particular, to forge links between critical environmental sociology, environmental justice research, and the work of ecologists focused on energy. This approach emphasizes the biophysical realities of energy developments and inequality by bringing the work of systems ecologist, Howard T. Odum, into environmental sociology. Odum's work is used to develop a method of analyzing ecological unequal exchange with a focus on energy. However, the possibilities for integrating systems ecology extend beyond this application.

The theoretical development of this dissertation, expanding our understanding of the ecological rift, is used to introduce an "energy justice" framework, which I argue is the heart of a critical sociology of energy for the 21st century. To ground this theoretical work empirically, I studied systems ecology's contributions to understanding trade inequalities in ecological terms, using recent and historical developments in Ecuador as a case study to further advance the idea of *energy justice* and the theory of ecological unequal exchange. I also carried out fieldwork in Cuba, studying ongoing changes in the Cuban political economy, what these changes mean for their energy system and environmental goals, and the implications for our understanding of environmental justice and ecological transformation. These two countries were chosen as case studies because

of their environmental efforts, proximity in the World Wildlife Fund's measures of national sustainable development, colonial histories, and divergent paths toward de-colonization and addressing oppression. Both of these countries' efforts have included the assertion of environmental sovereignty, which is a necessary step toward overcoming the historical burdens of ecological unequal exchange and colonial oppression. In addition, Cuba and Ecuador are both common reference points in the literature on environmental justice.

The sociology of energy: An opportunity for integrated theory

In developing a sociology of energy for the twenty-first century we have an opportunity to illustrate the links between theoretical perspectives that makes explicit the social and ecological stakes of current crises, like climate change, while pointing toward the kinds of change for which we must strive. Energy practices are an especially useful social and ecological indicator as these practices delimit society's engagement in ecologically oriented change and expose its true social, environmental, and economic commitments. Sociologists, Rosa, Machlis, and Keating (1988), write that "energy plays a crucial role, perhaps the crucial role, in the link between societies and their biophysical environments" (155).

Climate change, along with other ecological problems, is now on the domestic and foreign policy agendas of nearly every government and recognized by every major scientific body in the world (Foster 2002; Oreskes 2004; Hansen 2010; Waugh 2011). Since the 1990s, the world's largest corporations also have changed tack publicly both to acknowledge, and posture themselves as part of the solution to, climate change while continuing to fund activities undermining large-scale reform and detracting from

environmental science (Pulver 2007; Domhoff 2009; McCright and Dunlap 2010). Regardless of the actual environmental impact of governmental policies, or firm behavior, the widespread acknowledgement that environmental problems require human action represents a major political shift over the past two decades. These events led to a renewed call for attention to the human drivers and environmental and social consequences of the modern energy regime.

In spite of these calls, in the 1990s significant barriers remained a sustained attention to energy in sociology:

> Over the past twenty years, a variety of devices have been successfully used in interdisciplinary energy analysis to diminish the importance of the social, and to marginalize the contributions of the social sciences. This is unfortunate because insights from sociological studies of the energy system are of considerable value in both disciplinary theory-building and interdisciplinary environmental policy-making. These external limits on sociological analysis are only part of the story.
>
> Sociology's own theoretical unease with technology and the physical/natural world, and its insular tendencies in regard to other disciplines, have significantly contributed to a decline of sociological work on energy-environment topics over the past decade. Given growing interest by natural scientists in the human dimensions of global environmental change, the time now seems right for a renewal of energy research by sociologists-although the initiative must come from within the discipline. (Lutzenhiser 1994, 58)

As Lutzenhiser helps explain above, attention to energy in the discipline of sociology up until the 1990s was characterized by "a pattern of successive intellectual paroxysms" that came and went with supply-side energy crises (Rosa, Machlis, and Keating 1988, 168).

While energy studies remain dominated by technical economic and engineering problems, the amount of sociological work on energy and climate change has grown

significantly the past ten years. The number of articles with "energy" or "climate change" in their titles listed in *Sociological Abstracts* quintupled between the 1990s and 2000s. The real jump, however, has occurred just in the past six years. In 2005 there were 71 such titled articles. In 2010 there were 467. Overwhelmingly these articles have climate change as their subject and are classified as dealing with "issues of sustainable development." This dwarfs any reference to energy alone, or any other related subject listing or classification. While this is a big change in the attention of social scientists, it has occurred outside of the main sociology journals. From 2005 till today, not a single article with "energy" or "climate change" in the title appears in the top-ten ranked sociology journals. This signals that energy has yet to make headway into the broader discipline of sociology. These changes also reflect the greater focus in contemporary sociology on climate change than the development of the sociology of energy "as a distinct sub-area of investigation" (Rosa, Machlis, and Keating 1988, 168).

Sociological work on climate change generally falls into three categories (Nagel, Broadbent, and Dietz 2009): sociological analyses of the causes of global climate change, sociological approaches to climate change mitigation and adaptation, and sociological perspectives on the impacts of global climate change. Sociologists study everything from personal energy consumption and political views to broad socio-ecological patterns of development and their implications. The report on a workshop held in 2008 assessing *Sociological Perspectives on Climate Change* (Nagel, Broadbent, and Dietz 2009) offers a useful overview of developments in the field to that point.

All work on energy, society, and climate change may be divided into two broader theoretically significant categories based on its main underlying assumptions. On the one

hand, there are sociologists whose proposals to solve global issues like climate change involve tweaking the system through policy, personal consumption choices, or technological change. On the other hand, you have sociologists calling for system-wide social and ecological change. In other words, some sociologists limit their studies to changes that are possible within the capitalist system, while others document the ways in which capitalism is incompatible with ecological and social justice goals and call for a more significant transformation of the world system.

One reason this central divide is so relevant to energy studies is that climate change has been driven by the economic growth inherent to capitalism. The key conflict that arises in climate negotiations, and which is constantly alluded to in environmental negotiations between nations, is that between ecological, social, and economic priorities (Clark and York 2005; Bazilian 2009; York 2010). Energy developments are conditioned by these competing priorities. The U.S. Energy Information Administration (EIA 2008) puts the issue plainly: "Energy use is largely driven by economic growth." Problems with energy developments are thus in large part problems of scale related to the level of economic throughput. And the scale of energy consumption remains coupled in capitalist economies with economic growth in spite of efficiency gains, as critical sociologists of energy have demonstrated (York 2010; York, et al. 2011). For this reason, energy debates, like other issues in environmental sociological theory, often center on the tension between economic growth and ecological change. There are striking differences in how this tension and the possibility of overcoming it are understood by various theoretical positions. The most influential approach to energy issues in the broader society and policy circles is mirrored in environmental sociology in the ecological modernization

perspective. It is the most optimistic that the tension between economic growth and ecological change may be transcended (social justice is not integrated in their analysis.)

Ecological modernizationists emphasize "the possibility, actuality and desirability of a green Capitalism" (Mol and Jänicke 2009, 23). They claim there is a "growing independence of ecological rationality vis-à-vis other (e.g. economic and political) rationalities" (22) in the governance of society and institutions. "The basic premise of ecological modernization theory is…[that there is a] centripetal movement of ecological interests, ideas and considerations in social practices and institutions of modern society" (Mol 2002, 93). The authors see "continued industrial [and technological] development as offering the best option for escaping from the ecological crises of the developed world" (Fisher and Freudenburg 2001, 702). This new breed of modernizers suggest "we have entered a new industrial revolution, one of radical restructuring of production, consumption, state practices and political discourses along ecological lines" (Sonnenfield 2009, 372).

Ecological modernization began as "essentially a political program" (Mol and Jänicke 2009, 18) and remains geared toward influencing policy (Mol, Sonnenfield, and Spaargaren 2009, 11). That this perspective might be popular in a world where those in power suggest capitalism will solve the climate crisis it created is not surprising. Ecological modernization theorists themselves have represented the significance of their ideas via the extent to which they share the perspective of those in power, and by the taming of the environmental movement, which was forced into an establishment mold (Spaargaren and Mol 2009, 72–75).

Though it integrates popular assumptions, the ecological modernization perspective actually is in conflict with over a hundred years of sociological and ecological analyses (starting with that of the classical theorists, like Marx and Weber, and early energy scholars developing the study thermodynamics). This insidious perspective also is in conflict with the founding principles of environmental sociology, based on the New Ecological Paradigm, which include "recognition of: (1) limits to growth, (2) non-anthropocentrism, (3) fragility of nature's balance, (4) untenability of exemptionalism, and (5) ecological crisis" (Foster 2012). Therefore, Foster (2012) refers to the ecological modernization perspective as the new exemptionalism and the third stage of denialism hindering necessary and urgent scientific development and change:

> The third stage of denial has the look and feel of greater realism, but actually constitutes a more desperate and dangerous response. It admits that capitalism is the problem, but also contends that capitalism is the solution. This general approach emphasizes what is variously referred to as "sustainable capitalism," "natural capitalism," "climate capitalism," "green capitalism," etc. In this view we can continue down the same road of capital accumulation, mounting profits, and exponential economic growth -- while at the same time miraculously reducing our burdens on the planetary environment. It is business as usual, but with greater efficiency and greater accounting of environmental costs. (Foster 2011a)

Ecological modernization is a way then to avoid any significant challenge to the status quo. Because of this it ignores the seriousness and scale of ecological degradation (York and Rosa 2003), but also the inequalities necessarily embedded in the social relations of capitalism. There is no real gender, race, class, or any kind of social justice analysis there, even if justice is mentioned in passing in their work (usually in response previous criticisms).

Despite all of these problems, the penetration of the assumptions undergirding this perspective is clear in the sociology of energy and climate change. The conscious and unconscious adoption of the main tenets of the modernization framework stands out in the sociology articles published since the boom in climate change research starting in 2005. A key term search in *Sociological Abstracts* of the 1,734 peer-reviewed articles published since 2005 with "climate change" or "energy" in the title yields the following results: many more mention technology (424), technological change (96), alternative energy (110), or renewable energy (160) than mention energy conservation (120), economic growth (96), or capitalism (35). Shockingly, only 22 mention inequality and only 9 equality.

The blinders imposed by perspectives such as ecological modernization in the sociological work on energy and climate change, and broader environmental sociological theory, means that

> environmental sociology today is therefore faced with a double challenge, emanating both from without and within: developing means to combat the planetary rift, and confronting the new exemptionalism, which threatens to overthrow environmental sociology as a critical tradition. With respect to the latter challenge, the problem is to be found not in the concept of ecological modernization itself, which is obviously useful in limited contexts, and reflects real-world processes, but rather the elevation of ecological modernization into an overall environmental *theory* resurrecting the basic postulates of human exemptionalism. (Foster 2012)

This makes the theoretical perspective proposed in this thesis all the more important and urgent, for the sociology of energy and for environmental sociology as a whole. Because the sociology of energy is taking off, the climate crisis is only worsening, and new scholars are being trained *en masse*, it is a crucial moment in the theoretical development

of what will now be sustained sociological attention to energy. As bad as things are, they are only expected to get worse. Energy increasingly will be forced onto the broader sociological agenda (Dunlap 2010; Webler and Tuler 2010). If energy justice is not at the heart of the sociology of energy that takes root, our formulations will necessarily impose blinders that make it impossible to understand, or propose meaningful changes to address, the interpenetrating depredations of social inequality and environmental destruction associated with the modern energy regime.

While the dominant ideological response of the establishment to environmental crises is clearly reflected in much of the work on energy and climate change in sociology, there are strong foundations for a critical sociology of energy integrated with broader theoretical developments starting with classical ecological and social theory.

As was developed in classical theory, today the strongest critical approaches to energy integrate attention to biophysical and sociological realities shaping the structure and consequences of the modern energy regime (York, Rosa, and Dietz 2003a, 2003b; Foster, Clark, and York 2010; York 2010, 2012; Ergas and York 2012). However there is still work to be done in fully developing energy justice as the heart of a distinct sociology of energy. The following sections will explain the classical antecedents and contemporary theoretical developments informing this thesis. Put in a context in which they may complement one another, the perspectives developed here provide great insights for contemporary critical sociologists of energy.

Antecedents for this work: The physical properties of energy and implications for social science

In human societies energy resources are used to extend the power of labor, which in the capitalist system, along with nature, is exploited for the sake of accumulation by a tiny proportion of wealthy individuals, or what is now called the "1%" (within which white men play a predominant role). Theoretically, energy resources can be used to meet social justice goals, to make life easier and more fulfilling for everyone, or can be used in processes that increase inequality—making life easier for some and not others, with energy monopolized to maintain power economically and militarily. Modes of extraction and distribution of energy resources can attend to the needs of ecological reproduction, or, as is currently the case, create globally toxic environments causing environmental and human degradation that is unequally distributed. Understanding energy sources extending both the power of labor and the reach of those with access, helps explain the significance of energy for social justice struggles and the difficulty of socially addressing pressing problems like climate change.

Energy and entropy: The queen of the world and her shadow

It is important here to explain the way in which this analysis integrates and is based in an understanding of the biophysical properties of energy resources and their role in the open energy system of the biosphere. "Energy" is used in this thesis usually to refer to concentrated energy sources, such as fossil fuels used for fuel or the generation of power, more dispersed energies such as solar, and the energy represented by all human labors. However, it is based on a broader understanding of the properties of energy and matter and energy flows within ecosystems, society, and the larger biosphere. These

properties make concentrated energy resources, like fossil fuels, unique materials and help explain the environmental consequences of their exploitation in society, as well as their sociological importance.

In common usage and in what we call "the sociology of energy," the term "energy" typically refers to resources harnessed to generate power and fuel human activities. Available energy, or potential energy, in the stricter scientific sense, is most often defined as "the ability or capacity to do work" (Odum 1997, 79). This scientific meaning relates to "energy as *the generalized attribute of physical transformation and change*" (Peet 1992, 144). Social scientists' understanding of the ecological consequences of various "energy" (fuel and power) systems (whether they are solar, biomass, or fossil-fuel based), are the result of centuries of philosophical and scientific inquiry into the nature of energy itself and energy transformations that make all of life possible. Modern ecology was shaped by investigations into the behavior of energy, the cumulative understanding of which is formalized in the laws of thermodynamics. Subsequently, ecology influenced the environmental movement and the development of environmental sociology.

While concern with the role of energy in human life predates Western science and is pervasive in cultures around the world, contemporary scientists' notions depend upon important discoveries made in the mid-nineteenth century. "With the discovery, between 1845 and 1847, of the principle of the conservation of energy during its transformations, the importance of energy in human life and progress was fully recognized, and scientists gave energy the romantic name of the 'Queen of the World'…[S]cholars discovered entropy, a measure of the degradation of energy, twenty years later" (Alekseev [1978]

1986, 10). Energy and entropy, or "The Queen of the World and her Shadow," "came out of darkness full of uncertainty into broad daylight only about the second half of the nineteenth century, after centuries of work by talented philosophers, researchers, and engineers" (13).

Other scholars have traced the impact of these developments for critical social science, wherein an ecological critique of the modern social order entailed a critique of capitalist economic growth, and orthodox social science, on thermodynamic grounds (e.g. Martinez-Alier 1987; Mirowski 1988; Rosa, Machlis, and Keating 1988; Peet 1992; Burkett and Foster 2006). Perhaps the most essential implication of the laws of thermodynamics for social science is that human society, including economic processes, are not exempt from natural limits. Because we can neither create nor destroy matter or energy, only transform and degrade them through our activities, which can never be 100% efficient, we are constrained by their availability and their unique properties. These properties, and the natural laws governing the universe, such as the laws of thermodynamics, determine the ways in which matter and energy can be transformed and used, and the consequences of these transformations. While there are other ways to look at the environment/society nexus, and measure biophysical outcomes of social processes, tracing the role of energy in the earth's natural and social processes provides an especially useful means to understand the interconnections between society and the rest of nature. Odum writes, "if one were to pick out a single common denominator of life on earth, that is something that is absolutely essential and involved in every action, large or small, the answer would have to be energy" (Odum 1997, 79).

The critical sociology of energy

Today it is clear to critical scientists from multiple disciplines that societies are no more exempt from natural laws, such as the laws of thermodynamics, than are the elementary particles studied by physicists. However, this does not mean that the laws of motion of society are reducible to the laws of motion in physics (or determined by other natural processes, such as evolution). While it is absurd to study society as if it were exempt from natural laws, it is equally absurd to study society as if it were solely the product of natural forces acting without the intervention of human consciousness or purpose, as some contemporary social Darwinists still do (see for example the recent publication and praise of *The Darwin Economy*). But many social scientists, including orthodox economists and environmental sociologists influenced especially by modernization perspectives, have yet to take social or ecological science seriously in their studies. Without taking into account natural limits as determined by natural laws, as well as purposeful human action, you can neither study nor understand the effect of human choices on other humans, or their impact on the environment. You are then stuck in an epistemological trap where you cannot explain historical social change, or produce knowledge necessary to address today's social and ecological challenges.

Today, the dominant perspective in sociology remains congruent with the dominant ideology, which continues to see energy as a technical problem, or otherwise disconnected from the social relations in which our energy regime is embedded. Some of the strongest forms of social denialism with respect to ecological problems have been associated with sociology in the form of what had been called (by environmental sociologists) the dominant "human exemptionalism," which has been transformed today

into a "new exemptionalism" (Foster 2012). Even so, critical sociology, while its progress in this area has been uneven, is methodologically equipped to address the relationship between social processes and biophysical realities, without resorting to reducing one to the other. From the classical period forward, critical sociologists have addressed major ecological and social problems, without falling into either natural or social reductionism. Many sociologists have refused to take anything for granted, including the entire social system. Antecedents for the critical sociology of energy today may be found, in fact, in the classical sociological tradition.

Classical syntheses between social and natural science

Work toward uniting developments in social and ecological science, bringing together in theory what is joined in reality, falls in a long line of efforts to understand the relationship between energy, environment, and society. For sociologists, "that energy would be important to sociological concerns was recognized from the beginning of the discipline…but the subsequent history of the topic was to be punctuated with intellectual discontinuity, vast shifts in focus, and, at times, total silence" (Rosa, Machlis, and Keating1988, 149-50). Classical sociologists, for example, recognized the dependence of capitalist industrialization on increasing energy and material throughput, and understood many of the environmental and social consequences these developments. Classical sociology thus provides direction in how "a fundamentally physical variable" (149) like energy may be understood in terms of sociological theory as a whole.

Classical foundations for a critical sociology of energy

Rosa, Machlis, and Keating (1988) published their overview of scholarship on "Energy and Society," in the *Annual Review of Sociology* before much significant work

was done on the ecological insights found in the classical sociologies of Marx, Weber and Durkheim.

Karl Marx and Max Weber, writing from the mid-1800s to just after the First World War, both saw the beginning of industrial capitalism as marking a dramatic shift in human relations to each other and to the environment. Marx wrote about the alienation of humans from each other and from the earth. He recognized that capitalism initiated and pushed to all corners of the earth, via capitalist globalization, the ecological rift between human society and nature. Marx, along with Frederick Engels, did much to expose the detrimental effects of industrial agriculture. They also tied the consequences of the rift with nature to an analysis of the enclosure of the commons and inequality and exploitation at the heart of capitalism. Max Weber wrote about the disenchantment of nature, the rapacious destruction of forests and consumption of natural resources necessary for the growth of commodity production, and the loss of meaningful life in the industrializing world.

The ongoing influence of the legacies of Marx and Weber on sociology as a whole, and the possibility of learning from the ways in which they integrated ecological insights, including those on energy and society, into macro-sociological frameworks, necessitates an overview of their work. Unlike many historical studies of energy, both of them avoided teleological views of the role of energy in social development, and the mistaken notions that increased energy use, or efficiency, equals increased social well-being or maturity—ideas that plague social scientists even today.

Marx's theory of metabolic rift, expropriation, and breaking the solar energy budget

Classical foundations for a Marxian sociology of energy are suggested by Foster and Burkett (2006) in their article analyzing Marx and Engels' response to Podolinsky's outline of energetic foundations for a labor theory of value. Marx and Engels, these writers demonstrate, "relied on an open-system, metabolic-energetic model that adhered to all of the main strictures of ecological economics—but one that also (unlike ecological economics) rooted the violation of solar and other environmental-sustainability conditions in the class relations of capitalist society" (109). Capitalist development is predicated upon the forced expropriation of the masses, "of the agricultural producer, of the peasant, from the soil" with "conquest, enslavement, robbery, murder, briefly, force, play[ing] the greatest part." This separation/expropriation/alienation is maintained and reproduced "on a continually expanding scale" (Marx [1867] 1990, 874, 668-69). The alienation of human society from the land, the subsequent and ongoing polarization of town and country, and the tendency toward ever-expanding capitalist accumulation, are social conditions for the growing metabolic rift between human society and nature. This rift is a product of capitalist expansion, driven by fossil fuel exploitation, or what Engels referred to as the colossal "squandering of past solar heat."

Marx and Engel's understanding of the relationship between the ecological rift of capitalism, human exploitation and immiseration, and the role of energy in these processes is in sharp contrast to many energetic theories of society that developed around the turn of the century, such as that represented by Herbert Spencer's "energetic sociology" (Rosa, Machlis, and Keating 1988; McKinnon 2010). Many mainstream

scientists from a variety of disciplines and backgrounds, contra Marx, came to believe that increased energy use was indicative of "progress" and greater societal well-being. As in the case of mainstream political economy, the ability to make use of energy resources justified, in the eyes of many scientists, the extraction of resources from external lands through imperial domination. The exploitation of energy workers (like coal miners) both in England and Europe and abroad was both necessary for capitalist expansion and justified in terms of expediency, despite the forms of domination and exploitation that it entailed.

In contrast, Marx's "analysis of capitalist mechanization provides a structural, class-based explanation as to how and why human production definitively 'broke the budget constraint of living on solar income and began to live on geological capital.'" His approach "helps explain the unprecedented growth in labor productivity and matter-energy throughput generated by the capitalist system" (Burkett and Foster 2006, 110). Unlike reductionist energetic theories of society or value, Marx maintained the historical primacy of social relations and analyzed "the crucial enabling role of power supply and transmission in the industrial revolution…[which grew] in response to the energy demands of increasingly complex and large-scale machine-tool systems" resulting from the centralization and growth of the means of production facilitating ever-increasing (capitalist) efficiency in the accumulation process (131-32). Along with the insatiable appetite for increasing quantities of resources under capitalism, Marx emphasized the qualitative transformation energy and matter undergo in the production process and the irreversibility of this transformation—overcoming mechanical models at the heart of much of energetics—respecting "the arrow of time."

Marx wrote about energy in every volume of *Capital* (e.g. *Capital* vol. 2, ch. 6; vol. 3, ch. 5) and in other works, and current writers have drawn out the implications of Marx and Engel's contributions to our understanding of the energy regime of capitalism (e.g. Burkett 1999, 2006; Foster 1999, 2000, 2009; Foster and Burkett 2004, 2006). For Marx and Engels, the energy regime of capitalism reflected broader systemic dynamics, especially the growth imperative. The ecological consequences of endless accumulation in a finite environment are summarized as a rift in the earth's natural metabolism. The sum of Marx's insights on this topic are first presented by Foster (1999) as Marx's theory of metabolic rift. This is developed further in the contemporary theory of the ecological rift (Foster, Clark, and York 2010), which is the overarching framework for the sociology of energy proposed in this thesis.

Max Weber, the disenchantment of nature, energy depletion and the inorganic era, and response to energetic theories of culture[1]

Within ecological economics Weber's contributions to the sociology of energy are well recognized (Martinez-Alier 1987, 183-92), though this has only rarely penetrated into sociology itself (for an exception see Foster 1999, 370). Modern industrial capitalism, for Weber, was "the age of iron," but it was just as much the age of coal, "the most valuable and most crucial of all products peculiar to the western world" (Weber [1919-20] 2003, 190-91). Since coal was viewed as an inorganic or nonrenewable form of energy, modern capitalism was, in Weber's conception, an age dependent on "substituting inorganic" for "organic" materials/energy (Weber 1946, 364, 368).

[1] This synopsis of Weber's views on energy draws on material in Foster and Holleman (2012).

For Weber coal was more important and indispensable than even the revolutionary technologies that it made possible. Rather than seeing coal as the basis of the steam engine, with the latter as the object, he turned this on its head: arguing that the steam engine, used first in mining, "made it possible to produce the amount of coal necessary for modern industry." The ready supply of coal then allowed for the development of bigger steam engines. "The most revolutionary instrumentality known to industry," the railroad, was a product of "the age of iron" and coal (Weber [1919-20] 2003, 297, 304-06).

The burning of fossilized coal in blast furnaces, and its use as a means to steam power, constituted a major transformation in human society, liberating it from its traditional relation to nature. As he wrote in his *General Economic History*,

> In the first place, coal and iron released technology and productive possibilities from the limitations of the qualities inherent in organic materials; from this time forward industry was no longer dependent upon animal power or plant growth. Through a process of exhaustive exploitation, fossil fuel, and by its aid iron ore, were brought up to the light of day, and by means of both men achieved the possibility of extending production to a degree which would have previously been beyond the bounds of the conceivable. Thus iron became the most important factor in the development of capitalism; what would have happened to this system or to Europe in the absence of this development [made practical by the introduction of coked coal in iron smelting] we do not know. (Weber [1919-20] 2003, 305)

Dependence on animal power and plant production decreased with the increased reliance on fossil fuels. "The mechanization of the production process…through the steam engine liberated production from the organic limitations of human labor" (Weber [1919-20) 2003, 305-06). As Weber ([1909] 1984, 39) observed elsewhere, the "relative

energetic significance of human energy" for production in modern industrialized capitalist society decreased due to the substitution of fossilized coal. The decline in the energetic importance of human labor in industry, was mirrored, in an increasingly industrialized agriculture, by the accelerated "liberation of the peasants," and the dissolution of the organic relation to the land (Weber [1919-20] 2003, 92, 96). Coal and iron thus introduced the inorganic, disenchanted age, based on the demise of earlier organic relations. "Iron and coal," in Mumford's (1934, 163) words, "dominated the [new] paleotechnic period." In the highly mechanized world of steam power, as distinct from the earlier era dominated by water power, the modern machine is no longer "the servant of the man," but rather "the inverse relation holds" (Weber [1919-20] 2003, 302).

Weber's emphasis on and understanding of energy in society is also present in his remarkable critique of the Nobel-prize-winning chemist Wilhelm Ostwald in relation to thermodynamics. For Weber, Ostwald's account of the potentially unlimited supply of energy emanating from the sun, which human beings had not yet tapped fully, was questionable if taken to the extreme of denying scarcity—the foundation of economics in the marginalist or neoclassical view. Economics, after all, was "bound up with the application of scarce material means" (Weber 1949, 65). He thus strongly questioned Ostwald's claim that a "'squandering of our inheritance' [with respect to energy and natural resources] seems totally unthinkable" (Weber [1909] 1984, 37). Not only was Weber skeptical about the end of dependence on fossil fuel, but he argued—anticipating in this respect the founder of modern ecological economics Georgescu-Roegen (1971)—that the entropy law could be seen as applying to essential raw materials as well as energy as such, so that the squandering, for example, of iron ore and copper, could prove crucial

in limiting production and enforcing conditions of scarcity (Martinez-Alier 1987, 185). For Weber, Ostwald's views of energetic abundance were naïve in that "the indispensable chemical and form-energy of every substance used for production, transmission, and utilization of the most important energies that are used is equally irretrievably dissipated. This, after all, is the case with all free energy according to the law of entropy" (Weber [1909] 1984, 38).

The historical-sociological significance of Weber's treatment of energy lay in the fact that he was the first major social thinker to argue that industrial capitalism was dependent on a particular environmental or energy regime: the fossil-fuel economy (Foster and Holleman 2012). Every society has its own social-metabolic relation to the rest of the biosphere, defined in large part by its energy regime, a key to understanding a given society's broader ecosocial relations. Social transitions, such as that from precapitalist to capitalist society, entail changes to the entire social metabolic order and can thus be understood as distinct "ecohistorical periods." While human activities have always entailed environmental consequences, it is possible to distinguish "broad 'ecohistorical periods'—periods in which 'human activities have led to (relatively) uniform changes in nature over vast areas'" (Foster 1999, 34; see also Mumford [1934] and Haila and Levins [1992] on energy and technical phases of social development and environmental regimes).

The current 'ecohistorical period' may be defined in terms of its energy and broader environmental regime and distinguished by "two traits specific to capitalism" that shape both of these (Foster 1999, 35):

> First, capitalism has been so successful over the last few centuries in "conquering" the earth that the field of

> operation for its destruction has shifted from a regional to a planetary level. And second, the exploitation of nature has become more and more universalized, because nature's elements, along with the social conditions of human existence, have increasingly been brought within the sphere of the economy and subjected to the same measure, that of profitability. (35)

These features of the system thus shape the energy regime of capital, which is a historically specific development. Weber explained it in this way:

> This [modern economic] order is now bound to the technical and economic conditions of machine production which today determine the lives of all the individuals who are born into this mechanism…with irresistible force. Perhaps it will so determine them until the last ton of fossil fuel is burnt. (Weber [1905/1920] 1930, 181, translation slightly altered; Bell 1998, 150-51).[2]

In other words, Weber saw the social and energy regime of capital as having no self-imposed limits or boundaries and as being driven inexorably toward exploitation at all costs until there is nothing left. Under these conditions, dealing with the impending climate catastrophe, means changing the system, ushering in a new ecohistorical era defined by a new energy regime embedded in a more humane and ecologically responsive social order.

[2] This is quoted in Foster and Holleman (2012). Although employing the Parsons 1930 translation of *The Protestant Ethic* here and throughout this article, we have altered this passage slightly in conformity with Kalberg's 2009 translation (Weber [1905/1920] 2009, 157) to refer, as Weber did, to "fossil fuel" (Kalberg) as opposed to "fossilized coal" (Parsons).

The age of exuberance and the energy lacuna in post-WWII sociology

The classical sociologists thus provide powerful foundations for a sociology of energy. However, post-WWII era sociology failed to develop these classical insights. This period is known as the Age of Exuberance, which infected sociology and led to a significant denial and ignorance of the thermodynamic limits to growth and the interface of social inequalities and ecological degradation, or energy injustices, characterizing the modern energy regime. Assumed energy abundance dominated in this period. "The combination of petroleum supply availability and the vision of a nuclear age engendered a belief in the unlimited availability of energy such as had never before occurred in the history of humanity" (Radkau 1996, 17). The critique of this form of denial, or "human exemptionalism," has been undertaken in environmental sociology since it's founding (e.g. Buttel 1976; Catton and Dunlap 1978a, 1978b; Catton 1980; Schnaiberg 1980). The consequences of the energy regime too often were ignorable (as today) because they were borne by disenfranchised communities, other nations, and ecosystems.

However, there were exceptions to the dominant exemptionalism amongst sociologists even in the 1950s. For example, Cottrell (1955) dealt critically with the topic of energy, and the need for human society to "replace the energy…use[d] up in the process of living [because] a permanent deficit makes life impossible," (4; see also Catton 1980, 44). With the 1970s oil crisis the reality of a limited energy supply, which had been exceedingly unsustainably harvested, caught the attention of more sociologists. As Catton (1980) wrote, "recognition of the social significance of physical energy remained almost nil among politicians and social scientists until depleted resources began failing to meet persistently exuberant demand" (44). Critical social and natural science

developed new alternatives to the significant ecological blinders and lack of cross-discipline understanding that still characterized the dominant view in the 1970s and 80s, and which continues to ignore the relationship between energy, social organization, and environmental degradation (Meadows, et al. 1972; Daly, ed. 1973; Mazur and Rosa 1974; Odum 1974; Georgescu-Roegen 1975; Anderson 1976; Commoner 1977; Daly 1977; Lovins 1977; Kakela 1978; Catton 1980; Schnaiberg 1980).

In the 1970s and early 1980s, three distinct approaches to energy and the broader interaction between society and the rest of the environment began to take shape and may be somewhat illustrated by the following works: (1) Catton's *Overshoot* and the techno-energy/population drivers of ecological degradation (human ecology); (2) Lovins's studies of 'soft energy paths' (foreshadowing ecological modernization); and (3) Schnaiberg's studies the role of energy as a resource, mediator and indicator in the treadmill of production (political economy). A few studies also initiated the examination of gender and race inequalities embedded in the energy regime (e.g., Women's Research Center 1981; Rodney 1982; Bullard 1983). As York, Rosa, and Dietz (2003a) point out, the three main perspectives that became significant in environmental sociology by the 1990s were: human ecology, political economy, and ecological modernization. This triad is distinguishable today in energy studies in sociology, with the technological approach adopted by ecological modernizationists and others sharing their assumptions most common.

Of the sociological work developed in the post-war period through the 1990s, this thesis builds especially on political economy traditions, which link to critical human ecology (York and Mancus 2009) especially in terms of the critique of capitalist

economic growth and the modern energy regime, and the environmental justice literature that developed in the post-war period. Systems ecology, which developed concomitantly, also is integrated as the ecological basis for understanding the ecological rift of capitalism and its inherent environmental inequalities. The following sections discuss the integration of these with the main contemporary developments in environmental sociology that are brought together in this thesis including: the overarching framework of the ecological rift theory building on Marx's theory of "metabolic rift," feminist ecology, and the work of environmental justice scholars. The point is to bring together the insights of several generations of critical natural and social scientists to help us better face our energy challenges today.

The social and natural science basis for a contemporary, critical sociology of energy

Linking our knowledge of social and ecological crises creates a basis for an approach to energy that is sociologically coherent (recognizing systemic injustices and power inequalities) and ecologically grounded. Recent work towards making such links may be found in systems ecology and in broader environmental sociological theory, in particular, the theory of the ecological rift, feminist ecology, and the environmental justice literature. Scholars from each of these latter perspectives have called for more integrated theory in environmental sociology, with greater attention given to the relationship between injustice and ecological degradation (Pellow 2000, 2007; Salleh 2009; Foster, York, and Clark 2010). Coming out of the natural sciences, systems ecologist and energy scholar Howard T. Odum also went to significant lengths to unite social and ecological science, with a focus on the urgent need for society at one and the same time to address environmental inequalities and restore the earth's systems, disrupted

as a result of capitalism's growth (Odum 2007). Odum worked to overcome the nature/society dualism highlighted as a theoretical weakness in sociology by feminist ecologists, among others, by bringing economy and ecology under a unified ecological analysis. My goal is to put these theoretical developments in a context in which they can complement one another and informs the ongoing development of the critical sociology of energy.

The ecological rift: A framework for synthesis

Feminist ecologist Ariel Salleh (2010) highlighted that we remain in need of developing an integrated ecosocial analysis that recognizes the primary importance of "reproductive activities and regenerative provisioning" and includes "inputs by class, race, and sex-gendered others" (213, 215). Salleh sees the basis for an integrated theoretical approach in the ecological rift analysis emerging from Marxist sociology:

> Climate change, biodiversity loss, and social precarity are each results of capitalist overproduction. In responding to this globalizing overshoot, activists need a materialist analysis of social relations, as well as a materialism that engages ecological processes. The dialectical tools of Marxist sociology already offer a basis for such a synthesis, but it remains a big ask for wider publics, because Eurocentric convention splits economics and ecology apart. (205)

The ecological rift framework, which integrates social, economic, and ecological analysis, also puts social justice at its center. Because it adopts an openly emancipatory framework, in ecological and social terms, it is an instance of "strong reflexivity" in theory, characterized by a critical distance from the status quo that makes it possible to question everything (Foster, Clark, and York 2010, 305). This separates it from approaches characterized by what feminist standpoint theorists refer to as examples of

"weak objectivity" that "attempt to separate the positive from the normative" (305). Objectivity, the way it is sometimes understood, is never possible in this society "because science is a socially embedded and often an elitist activity, such exclusion of values is impossible" (305). Not acknowledging this reality results in social science that unreflexively adopts the master perspective, therefore often reflecting the conceptual limits of the dominant ideology.

Absent "strong reflexivity" on the part of social science, it is impossible to see the ways in which "our ontological concepts of nature are often bound to systems of oppression" (305). Strong reflexivity in environmental social science demands adopting the vantage point of those deemed "Others" and a basis in critical ecology (306). Such reflexivity is at the heart of the ecological rift perspective. It thus builds on the best classical work and at the same time is part of the development of critical approaches in environmental sociology, such as critical human ecology, feminist ecology, and environmental justice, that break down disciplinary boundaries and make a contemporary, critical sociology of energy, with energy justice at its core, possible.

The reflexive perspective of the ecological rift theory thus makes it possible, as Salleh suggests, to integrate feminist ecology, and also issues of environmental justice, under this overarching framework. This integration forms the sociological basis for developing a critical sociology of energy connected to broad theoretical developments in sociology and ecology. This makes possible a deep understanding of how the costs of the modern energy regime are borne by women, people of color, and poor people around the world unequally and accumulate as the social and ecological debts of capitalism. K. William Kapp (1950) referred to capitalism as a system of "unpaid costs." Charles

Anderson (1976) published a remarkable book for its time, *The Sociology of Survival*, prefiguring many of today's ecosocial analyses. Drawing on Kapp's analysis and Marx's critique of capital's externalities, Anderson noted that "the growth society operates as if it had tunnel vision and nearsightedness; the accumulation of capital is pursued without regard for the side-effects or for long-range consequences, leaving to nature and the larger community these uncalculated costs" (140). Prefiguring contemporary discussions and movement framing, Anderson referred to these accumulated unpaid costs, or externalities as "the ecological debt," the result of the exploitation of both nature and humans for the sake of economic growth at all costs (142-43), undermining the natural and social conditions of production.

In chapter three of this dissertation, I show how bringing the work of systems ecologist, Howard T. Odum, into the ecological rift framework, provides a basis for the synthesis called for by feminist ecologists such as Salleh, and ecological rift theorists themselves, with attention to environmental inequalities. In the same chapter, I show how Odum's work provides an ecological basis for understanding ecological and social debts, as well as a way to assess socio-ecological practices in terms of what Salleh calls "eco-sufficiency," and critique practices and social organization that "externalizes costs on to others as debt" (Salleh 2010, 214). This also answers the call of environmental justice scholars for theoretical development that is better grounded in ecology (Pellow 2000).

Before this, in chapter two, I illustrate the basis in Marxist theory for understanding the social rift, which includes divisions, exploitation, and oppression based on race, class, and gender, among others, and is the foundation of the ecological rift. Drawing on the environmental justice literature and feminist ecology, the links between

the ecological and social rift are made clear, and these provide the basis for understanding energy injustice and, on the other hand, possibilities for and challenges of realizing energy justice, which I argue is the necessary heart of contemporary energy studies. Energy injustice is defined here as the interface between social inequalities and ecological depredations associated with the modern energy regime. Grounded in this theoretical development, in chapter four I explore developments in Cuba, based on my field research there. In this chapter I show how a broader understanding of the ecological and social rift allows a deeper analysis of the case of ecological change in Cuba than is traditionally presented in the literature. In the chapter on Cuba, the literature review on Cuba is partially drawn from material co-authored with Christina Ergas that we hope to publish later, though the writing and research in the remainder of the chapter are my own.

Unlike those environmental economists and some feminist thinkers who seek to internalize nature and women's work within the capitalist value system (thus "internalizing the exernalities"), the theoretical development outlined in the following chapters is instead an effort to "externalize the internalities," as Odum put it (see Foster [2002], 26-43, on the problem of economic reductionism). On this basis, a radical vision is applied to understand the current relationship between energy, environment, and society, and the true unpaid costs of our current energy practices in social and ecological terms, rather than market terms.

Beyond just developing such an understanding, this approach provides a way of seeing alternatives as well. The hope is to develop the theoretical basis for a critical sociology of energy that will provide a way of envisioning our decision-making and practices around energy as part of a larger process of socio-ecological transformation.

The goal of such a transformation is the realization of a society democratically organized on the basis of provisioning for social and ecological reproduction. Under such circumstances, energy justice is the basis for energy decision-making, and the point is maintaining, ecologically and socially speaking, “the free development of each” as “the condition for the free development of all” (Marx and Engels [1848] 1998, 41).

CHAPTER II

THE HUMAN RIFT: A CALL FOR ENERGY JUSTICE

The promise of an integrated approach: The ecological rift and energy justice

As indicated in the previous chapter, classical sociologists drew on natural and social science and integrated a social and ecological critique within their broader theoretical perspectives. This made possible their powerful analyses of the role of energy in society and the consequences of this for the environment. These early insights were rediscovered in environmental sociology in the past twenty years just as scholars sought again a more integrated approach to theory based on advanced social and ecological science, and drawing on the lessons of social and environmental struggles.

Assessments of environmental sociology since 2000 suggest theoretical development to move the discipline forward, incorporating environmental justice insights, ecology, and more global perspectives. For example, Foster (2002) emphasized the need for "more attention directed to environmental justice—that is, the struggle against environmental racism, environmental sexism, the environmental injuries of class, and the ecological consequences of imperialism" (58). Pellow (2000) called for an approach to environmental justice that is more nuanced, historical, and united with ecology than previous efforts. And Salleh (2010) highlighted the necessity of greater recognition of the gendered nature of the ecological rift and the leadership of the global South and women in environmental change, proposing a focus on unpaid reproductive labor as essential to ecosocial analyses. These scholars are amongst those who have advanced the most "sociologically radical" (Foster 2002, 58) agendas of environmental

sociology, coming primarily out of three traditions: political economy, environmental justice, and feminist ecology.

Although there are diverse strands of each of these perspectives in environmental sociology, much of their work is complementary as a result of shared commitments to uniting materialist social and ecological analyses and connecting theory and praxis, moving back and forth between the academy and experience on the ground. These perspectives have developed parallel to ecological theory, where system's ecologist Howard T. Odum's *emergy* analysis provides a method for evaluating social inequality and ecological degradation on a common footing in ecosystem terms. Put in a context in which they may complement one another, the combined insight of these critical developments provides a powerful basis for insight into issues of energy justice.

In environmental sociology, the theory of the ecological rift provides the context in which the linked insights of these perspectives may inform work on energy. While the implications of Odum's work are developed in the following chapter, the rest of this chapter is devoted to providing the sociological context for linking the ecological and social rift of capitalism and the implications of this for centering energy justice in the broader sociology of energy. In doing so, I will illustrate how the classical foundations of the theory of ecological rift provide insight into the links between this contemporary theoretical development and the environmental justice literature. I will also build on feminist ecologists' understanding of the gendered nature of the ecological rift. This theoretical development is used to introduce the concept of energy justice, taking seriously that "in an era of feminist and postcolonial liberation, gender and race become integral to any such analysis" (Salleh 2009, 4).

In the following analysis environmental injustice is defined as the interface between environmental depredations and inequalities associated with class, race, gender, and international inequalities (imperialism) (Foster 2002, 40). Energy injustice represents that element of environmental injustice directly related to energy flows. An underlying assumption of my argument is that the ecological rift between human beings and nature corresponds to a social rift amongst human beings. Following Liebig, Marx, and Weber, the relation of capitalism to nature can be described as a *Rabbau*, or robbery, system, while in Marx's case this applied to human social relations as well (Foster 2002; Foster and Holleman 2012). In describing the development of industrial agriculture Marx wrote, "all progress in modern agriculture is a progress in the art, not only of robbing the worker, but of robbing the soil (Marx [1867] 1990, 638). In this perspective questions of the ecological rift and the human rift are wrapped up together. The ecological debt to nature overlaps with the ecological debt owed to some human beings by others.

Environmental justice and the ecological rift: Classical integration

A key link between political economy, environmental justice, and feminist ecology perspectives is their common focus on capitalism's unpaid costs and accumulated injustices, both social and ecological, and their commitment to transcending this "omnicidal" system (Pellow 2007, 51). Feminist ecologist Ariel Salleh (2010) thus sees the basis for an integrated theoretical approach in the ecological rift analysis emerging from Marxist sociology, which has at its core the critique of capital in social justice and ecological terms:

> Climate change, biodiversity loss, and social precarity are each results of capitalist overproduction. In responding to this globalizing overshoot, activists need a materialist analysis of social relations, as well as a materialism that

> engages ecological processes. The dialectical tools of Marxist sociology already offer a basis for such a synthesis, but it remains a big ask for wider publics, because Eurocentric convention splits economics and ecology apart. (205)

Marx's work on energy, as noted in the previous chapter, was so insightful because he focused on human oppression and exploitation of the environment as related issues. In fact, his greatest work was dedicated to exposing the oppressive nature of capitalism. Fracchia (2008) observes that:

> The manifest purpose of Marx's critical review of the capitalist mode of production, *Capital*, is to deconstruct the categories of political economy in order to expose capitalism as fundamentally exploitative. But this entire critique of political economy is embedded in, and made possible by, Marx's materialist conception of history, the 'first fact' of which is, as he stated in The German Ideology, 'human corporeal organization.' (38)

The focus on 'human corporeal organization' and its "consequent relation to the rest of nature" (Marx and Engels [1845'6] 1976, 31) makes possible Marx's insights into what we would now call environmental inequalities.

Documenting the differential immiseration related to the exploitation of energy resources is an important part of energy analyses concerned with energy justice. The antecedents for this kind of work, and the importance of it for theoretical development, can be found in *Capital*, where:

> [T]he middle third of the first volume of Capital… literally and analytically the centrepoint of Capital [are the sections dealing with the literal effects on workers' bodies of the Capital relation.] Their disproportionate length results from the wealth of historical detail that they contain, in contrast to the other chapters that are much more theoretically taut. It would, however, be facile to view that historical detail as 'extraneous' and serving only 'unnecessarily' to elongate the theoretical discussion. For it is precisely the rich

> historical detail that completes and complements the theoretical critique, allowing Marx to explain the immediate and inseparable link between exploitation and immiseration. He does this by systematically applying corporeal norms to both the vast social artefact, the capitalist mode of production, and to individual material artefacts, specifically the means of capitalist production. Here, he explains how the meaning of capitalist relations of production is inscribed on the bodies of those whose labour produces unprecedented social wealth. And he reads this corporeal text in order to decipher another kind of hieroglyphics: the corporeal hieroglyphics, barely visible to the observing intellect, inscribed on the wage-labouring body in pain. (Fracchia 2008, 40-41)

This central focus on exploitation and immiseration is inextricably bound to Marx and Engels's analysis of pollution and ecological degradation more broadly speaking. In Marx's work, the rift in the earth's metabolism brought on by capitalism is a product of the social rift engendered by the social relations of capitalism, which are inherently hierarchical and exploitative. However, the ecological degradation that characterizes what we now call capitalism's ecological rift, as it develops, generates its own social dislocations, including new and exacerbated inequalities. Therefore, the relationship between ecological degradation and human exploitation and immiseration is a dialectical one.

In Marx's analysis, for example, the rise of industrial agriculture with the development of capitalism in England was made possible by the expropriation of the majority of the rural population and the exploitation the few who remained. Ecologically, this resulted in a rift between the growing urban centers and rural areas. Food and fiber increasingly were exported from the countryside to the towns, where the wastes associated with this and industrial production accumulated in the form of industrial pollution. The worst effects of this pollution and rural exploitation were of course visited

upon the poor and working classes. In the countryside, the development of capitalist agriculture, geared toward profit rather than meeting human need, entailed such intense and unsustainable practices that the reproduction of the fertility of the soil was compromised while the rural population was both cut off from the means of subsistence and exposed to new environmental dangers. Marx, studying the most advanced soil scientists of his generation, saw the relationship between humans and the rest of nature in terms of social metabolism:

> A metabolic relationship involves regulatory processes that govern the interchange of materials. Natural systems, such as the nutrient cycle, have their own metabolism, which operate independently of and in relation to human society, allowing for their regeneration and/or continuance. Each mode of production generates a particular social metabolic order that influences the society-nature dialectic, regulating the ongoing reproduction of society and the demands placed on ecosystems. (Foster, Clark, and York 2010, 348)

As part of the larger capitalist "social metabolic order," industrial agriculture "disturbs the metabolic interaction between man and earth, i.e., it prevents the return to the soil of its constituent elements consumed by man in the form of food and clothing; hence it hinders the operation of the eternal natural condition for the lasting fertility of the soil" (Marx quoted in Foster, Clark, and York 2010, 350). Indeed, "capitalist agriculture created a metabolic rift in the nutrient cycle," and came to be understood as a *Rabbau* system, or system of robbery (351, 354; Foster 2002, 155-70). This robbery of nature was bound up with the exploitation of human beings domestically and abroad.

The decline in soil fertility in England and other developing capitalist countries, brought on by the metabolic rift between town and country, led to the global search for fertilizers (Foster, Clark, and York 2010, 345-72). Massive guano deposits were

discovered in Peru and once the British understood its significance for increasing agricultural yields, this region's fate was sealed. The imperial entanglements in which Peru became ensnared resulted in a "guano curse" for the people of Peru, with all the trappings of what we now call the "resource curse," associated with ecological imperialism, or ecological unequal exchange. This pattern continues today with the ill effects experienced primarily by the poor in countries that export their ecological riches to the wealthy capitalist centers, often at gunpoint or through undemocratic agreements between first and third world elites. Characteristics of the resource curse, from Marx's era to the present, include the impoverishment of local peoples and lands, and increased indebtedness of the exporting nations. The local population of Peru was exploited, and often outright murdered, all for the enrichment of the local elites and global capitalist class.

While recognizing the localized effects of capitalist development and imperialism, Marx also saw that peoples across continents were brought into contact with the depredations associated with the rise of capitalism and industrial agriculture. African slaves were brought to the new world by the shipload. As part of the guano trade, Chinese and Indian workers also often were deceived or outright kidnapped by British and European human traffickers who brought them to harvest guano in Latin America. Like all forced to work for the enrichment of an elite class, the people brought to the new world with the guano trade as laborers were de facto or literally enslaved, toiling under murderous conditions to provide fertilizer for British and European fields. A similar story was repeated over and over where the search for profits spread. Marx reported on these proceedings, as the ecological and social rift of capitalism went global, accelerating to the

present day. Now entire planetary systems are threatened and too many communities, cultures, and peoples have been sacrificed on the altar of "accumulation without end" (Foster, Clark, and York 2010, 18; Mészáros 2012).

Along with Marx's analysis of the guano trade in association with his study of industrial agriculture, Marx and Engels's combined work on Ireland also serves to illustrate the historical connection between colonial exploitation of humans and the environment (see Foster 2000, 164; Marx and Engels 1972; Marx (1867) 1990, 860). Moreover, Engels studied urban pollution, affecting especially the expropriated rural population now forced to live in urban centers, including the problems associated with the use of coal, in *The Condition of Working the Class in England in 1844* ([1845] 1958; see Foster 1999b and Waitzken 2000 for reviews of Engels' remarkable work in this regard). "For Engels, such features of urban life as crowding, poor housing, inadequate sanitation, and pollution combined with social class position in the etiology of disease" (Waitzken 2000, 57-58). These are just a few examples of Marx and Engels's penetrating analyses of the relationship between capitalism's unpaid social and ecological costs, or "externalities," which are not included in capitalist accounting schemes, though they are internal to the working of the system.

It remains difficult in current political and academic debates to bring or sustain attention to interrelated ecological and social injustices. However, this was a central feature of Marx and Engels's work and it is therefore not surprising that scholars and activists today continue to draw insight and inspiration from this work as the globalization of the accumulation process has left no corner of the land, sea, or air untouched. The cumulative insights of Marx's studies into the social metabolism of

capitalism were presented by Foster (1999a; 2000) as Marx's theory of metabolic rift. Today this perspective, drawing on contemporary and historical interdisciplinary scientific developments, and the lessons of the social and environmental struggles of the past hundred years, has been developed further as the theory of the ecological rift. This approach carries forward the commitment to understanding ecological and social crises in relational terms and to transcending a system in which, in terms of the planet's ecology and its people, the destruction of one is the basis of the destruction for all.

Ecological rift and a critical sociology of energy

In developing the theory of the ecological (or metabolic) rift of capitalism, Foster (1999a; 2000) and Foster, Clark, and York (2010), along with others, have developed the work of Marx and Engels to create a contemporary, interdisciplinary theoretical approach to understanding the ecological and social causes and consequences of capitalist development. Among other major contemporary socio-ecological issues, this approach has been used to explain capitalism's effects on the oceans and fisheries, including the socio-ecological transformation of fishing communities (Clausen and Clark 2005; Longo and Clausen 2011; Longo 2012), the disruption of the carbon cycle (Clark and York 2005) and the nitrogen cycle (Mancus 2007), ecological imperialism (Clark and Foster 2009), the potential of urban agriculture (Clausen 2007; McClintock 2009), and agrarian movements (Wittman 2009).

In Foster, Clark, and York (2010), work completed over the previous decade extending Marx's theory of metabolic rift into an account of the ecological rift, rooted in a historical critique of capitalism, is consolidated. One important advantage of the ecological rift as the foundation for a theoretical integration in the critical sociology of

energy is that it is based on Marx's original analysis of ecological crises as rooted in the exploitation of human by human. Building on previous work illuminating crucial connections, the links between the theory of capitalism's ecological rift, environmental justice perspectives, and broader work on inequalities with relevance to energy studies, is made clear.

Ecological rift theorists have pointed out the primacy of social relations for understanding ecological degradation:

> This ecological rift is, at bottom, the product of a social rift: the domination of human being by human being. The driving force is a society based on class, inequality and acquisition without end. At the global level it is represented by what L.S. Stavrianos in *Global Rift*—a history of the third world—described as the imperialist division between center and periphery, North and South, rich and poor countries. This larger world of unequal exchange is as much a part of capitalism as the search for profits and accumulation. (Foster, Clark, and York 2010, 47)

While these authors have focused on class inequality and inequalities between the global North and South, as yet there is not an explicit framing of the social rift in terms of race and gender. Developing analyses of the relationship between the ecological rift and environmental racism and sexism is central to energy studies concerned with issues of justice. Such work contributes to a more complete understanding of the causes, consequences, and persistence of the ecological rift. For example, studies on racism help explain, among other things, patterns of ecological unequal exchange within and between nations. Racism and imperialism are intertwined, and the comprador relationships between the ruling elites in the global South and the global North, both of which often represent whiteness in their countries and cultural contexts, shape politics and policies within and between countries. Whether robbing indigenous lands for export to rich

countries, or rich areas within nations, extractive activities tend to exacerbate racial inequalities, destroying the land and subsistence basis of entire communities and even cultures. In turn, these activities often are rationalized by various historical versions of the mythological "white man's burden." In this historical justification for domination and exploitation, both white and man are at least equally operative terms.

Along with race, gender also must become a central focal point for understanding the persistence of the ecological rift, and the difficulty of transcending current crises. The way masculinity, for example, is marshaled to win support for resource wars, energy intensive technology, and complicity in the unequal exploitation of women's energy at home and in the society in general—all of which facilitate accumulation at the top, must be acknowledged more widely and further studied (Connell 2005). Also, the top one percent, which dominates and organizes the omnicidal accumulation process worldwide must be understood in gender terms when "women still own just one percent of assets worldwide" and "make up 70 percent of the world's poor and 67 percent of the illiterate" (WILPF quoted in Salleh 2009, 20).[3] There is a reason women are more likely than men to participate in environmental struggles, forge cross-difference alliances, and express ecologically-oriented political views. Women in general of all social classes obviously benefit less than men from their own class from ecological destruction. However, poor

[3] WILPF is the acronym for the Women's International League for Peace and Freedom. Jane Addams, a pioneering sociologist, was the first president when the organization was founded in 1915. WILPF efforts are directed toward:

- the equality of all people in a world free of sexism, racism, classism, and homophobia,
- the guarantee of fundamental human rights including the right to sustainable development,
- an end to all forms of violence: rape, battering, exploitation, intervention and war,
- the transfer of world resources from military to human needs, leading to economic justice within and among nations, and
- world disarmament and peaceful resolution of international conflicts via the United Nations http://www.wilpf.org/.http://www.wilpf.org/.

women and women in the global south, as a result of their role in reproductive provisioning, and their social location, "are hurt most by floods, droughts, resource wars, pestilence, and extreme weather events." In other words, they have more to lose as a result of environmental destruction (Brownhill and Turner 2009, 232).

With energy resources in particular you can see today the lengths to which the capable countries will go to maintain supply—encouraging racism, xenophobia, hyper-masculinity, and preying on class-based fears of unemployment and inflation, to win public support. Wars in the Middle East, attacks on Latin American governments nationalizing oil companies, the "scramble for Africa," and the siting of nuclear waste dumps on indigenous land, show that the incessant growth of energy demand will plague the earth for the foreseeable future. Women, historically oppressed racial and ethnic groups, and poor people will continue to pay the greatest costs. Alternatives are possible, as social movements and left governments seek to reverse these trends. It remains to be seen, however, whether we will transcend the divisions based on nation, race, class, gender, sexual orientation, age, ability, etc… that continue to limit our understanding of current problems, and thus our vision in the solutions we propose, and what these imply about who we expect to bear the burdens of change. If the relationship between the ecological and social rift is not understood, in all its complexity and layers, we miss out on more than just a complex analysis, we miss out on the possibility of forging an alternate future to the dystopic reality in which too many live today. Specifying the links between the ecological and social rift, extending ecological rift theory to integrate the insights of environmental justice literature and feminist ecology, is the goal of the

remainder of this chapter. These links establish the conceptual basis for an energy justice framework as the heart of a critical approach to the sociology of energy.

The ecological rift and environmental racism

The iniquities of ecological and social degradation have led throughout capitalism's history to all kinds of movements for better living and working conditions, including revolutionary and anti-colonial revolts. However, abuses persist, and in relation to energy regimes, the consequences are bloody and globally ecologically destructive. The extension of the analysis of capitalism's oppressive and degradative effects, articulated early on by Marx and Engels, found written in the very bodies of the exploited, has been taken up in the environmental justice literature. This literature, emerging from environmental justice struggles, has shown the long-term effects of environmental racism, a major component of energy injustice, which is defined by the interface of social inequalities, such as those based on race, and the depredations of the current and historical energy regime of capital. As Angela Park (2009) wrote, reporting on the immediate need for the climate movement to become a more inclusive movement for everybody if it is to succeed, "poor people and people of color, who already live in the most polluted communities, are…first in line for the negative effects of climate change" (7). Worldwide, as a result of systemic processes, poor people and people of color experience climate change most dramatically as they "disproportionately suffer from mortality rates from extreme heat waves, dirty air, water scarcity, and the 'heat island' effect of urban areas. They will also be disproportionately impacted by higher costs for food and electricity and by potential job losses and economic shifts" (15).

To understand this interface between energy problems, like climate change, and persistent social inequalities, it is important to review the history of the institutionalization of racism that accompanied the colonial and genocidal patterns of capitalist development. The co-development of the ecological and social rift, in which race is a defining feature and energy imperialism is central to the growth necessary for the survival of capital, are clear if seen in terms of their conjoined history.

Building on previous work in race theory, as well as Marxian analyses of capitalism, scholars today recognize that,

> Contemporary racism by global North nations builds on a rich tradition of conquest, slavery, and colonization. Racism has been an organizing principle of the modern world system since the rise of European states centuries ago. The rise of capitalism and European nation-states was facilitated through intersections between the ideological and structural domination of nature and non-European peoples. (Pellow 2007, 37)

Just as capitalism "depends on the destruction of nature while relying on its wealth to fuel production" it also "depends on the labor of poor people and various ethnic groups, while systematically disempowering and subjugating those populations….In other words, the ideological, cultural, psychological, and physical harm visited on people of color was supported and made possible by a system that did the same to nature" (38).

Pellow (2007) notes the equation in capitalism's, and newly formed European states', domination-justifying ideological apparatus of nature and of non-European peoples. Feminist ecologists have also noted this connection in relation to the exploitation of women (Salleh 2010). In other words, a similar ideology justified the super-exploitation of people occupying certain social locations and the planet, which has consistently accompanied the exploitation, for surplus extraction, of waged labor. As

ideological categories developed in the centrifugal process of differentiation for the sake of exploitation, what became known as "man," "white," "nature," and "civilization," are combined the "artificial product of modern history" (Marx [1867] 1990, 925) as much as, for example, any other of the socially constructed categories based on biological sex, skin pigmentation, ethnicity, human exemptionalism, or nationality. However, while serving as justifications for exploitation, racism and sexism remain "primarily…structural and material relationship[s]", and are therefore literal problems, with real effects on people's lives and the planet, rather than simply problematic literary or discursive developments (Pellow 2007, 42; Salleh, ed. 2009). Modern gender and race relationships were forged in the crucible of capitalist development based in Europe and England, and imposed on the world through capitalist globalization, bound inherently to the worldwide expansion of the ecological rift (Pellow 2007, 42-43; Lugones 2008; Foster, Clark, and York 2010).

As a constantly expanding, hierarchical system of exploitation, capitalism is inherently imperialistic (Foster 2002, 36). Infinite growth, theorized as the promise of capitalism, in finite borders, is a contradiction in terms. Moreover, the competitive nature of capitalism sends capital scouring the globe to secure markets, cheap or free labor, and resources ahead of competitors. While for the majority of the world's population and the environment this means a diminishing basis for life on this planet, for the capitalist, this is survival and the point of all meaningful endeavor: "The mandate to accumulate capital has created the assumption that natural phenomena [and entire communities and peoples] are there for the taking on something of a first come first serve basis. If he were to survive, the capitalist had to move forcefully against nature in order to exploit as rapidly

and cheaply as possible its 'free' supply of raw materials before someone else did" (Anderson 1976, 120-21).

Modern racism and the ecological rift were born of the expansionary nature of the capitalist system, which was both justified by and spread the law of *limpieza de sangre*, or "cleanliness of blood." Traced to the "Christian crusades into Muslim-controlled territories, and to the Calvinist Protestant colonization of Ireland," this law "created the seed ideology and institutions for modern colonialism with its necessary tools—racist ideology and justification for genocide" (Dunbar-Ortiz 2003, 84). From this historical perspective, it is clear that "environmental racism is an extension of the institutional racism which touches every aspect of our society" (Bullard 1992). Indeed, without understanding racism and capitalist development in terms of one another, it is difficult to understand either, or the persistence and difficulty of overcoming environmental injustices in general, including energy injustice:

> A good example of limiting the domain of racism can be seen in conceptions of the market. Instead of viewing the market as both constituted by racism and an active force in (re)producing racism, scholars have treated it as somehow outside the bounds of race…This is troubling given the extent to which discrimination and racism have been proven in the "free market"…Such a limited conception of racism prevents us from either grasping the power and spatiality of racism or identifying its underlying effectivity in perpetuating environmental injustice. (Pulido 2001, 19)

Because racism is such a fundamental aspect of the organization of capitalism, and serves as a powerful legitimizing ideology, (e.g. the "White Man's Burden"), the scouring of the globe to feed capitalism's incessant need for human and ecological inputs, as well as a sink for wastes, has always shoved the consequences of these practices onto, and resulted in the ecological robbery of, the third world and communities of color

(Odum and Arding 1991; Shiva 1997, 2002, 2005; Cole and Foster 2001; Foster 2002; Pellow 2007; Salleh, ed. 2009; Magdoff and Foster 2011). Sometimes this occurs through more subtle (and not so subtle) "development" deals, supposedly intended to bring jobs to communities, or raise the GDP of "under-performing" countries, or through the generally degradative and polluted living conditions of many people of color (Park 2009). But environmental racism also takes the form of outright dumping of toxic wastes, murder, colonization, and warfare (Magdoff 1978, 165-221; 2003; Foster, Clark, and York 2010, 345-72). Thus the social and ecological rifts develop as one and the same process, with oppression and ecological degradation two sides of the same coin. Marx wrote, after discussing the role of colonialism, public debt, regressive taxation, the capitalist press, slavery, child-stealing for factories, and commercial wars, in capitalism's development, that "'if money…comes into the world with a congenital blood-stain on one cheek,' capital comes dripping from head to toe, from every pore, with blood and dirt" (Marx [1867] 1990, 925-26).

The social and ecological dynamics described above "are widely documented in the energy sector, which is at the core of the global economy, making possible its very existence" (Pellow 2007, 40). The histories of the Ogoni in the Niger Delta, and the communities of the Ecuadorean Amazon, who have fought with their lives against the degradation of their lands and the state-supported terrorism of Big Oil, are just two examples (Perkins 2004; Osha 2006). Two more are the longest wars in U.S. history currently being fought in Iraq and Afghanistan—both energy related. In the build up to the war started by the U.S. in Iraq, and throughout the year following the invasion, there was a major resurrection and celebration of a contemporary "White Man's Burden" as a

racialized justification for the U.S. invasion and occupation of both Iraq and Afghanistan. For example, Max Boot's *The Savage Wars of Peace*, the title of which is taken directly from a line in Kipling's poem, received "the Best Book of 2002 Award from the *Washington Post*, *Christian Science Monitor*, and the *Los Angeles Times* and won the 2003 General Wallace M. Greene Jr. Award for the best nonfiction book pertaining to Marine Corps history" (Foster 2006, 129). In his book Boot lauds U.S. involvement in the Philippines and argues in favor of the U.S. deposing the Iraqi leadership and occupying the country even if, as Kipling argued, "colonists everywhere receive scant thanks afterward" (128). Racism also helps explain in part why drilling in national parks can be put on hold by activists in the U.S., whereas the same public can't muster a sustained movement to make it politically unfeasible for the government and profiting businesses to shed the blood of hundreds of thousands of people in the Middle East and wreak the ecological havoc of war all in order to, in the end, conduct basically the same ecologically insane business.

These racialized struggles for energy resources cannot be understood merely as a product of the oil-based economy, the problem is the incessant demand for energy, no matter the form, to fuel capitalist accumulation. You see in the development of so-called "alternative energies" the repetition of every single pattern associated with the oil economy. Take the example of biofuel, the alternative energy receiving some of the highest levels of funding for research and development around the globe. Native lands are stolen and communities destroyed, especially in the global South, to develop this energy sector (Rogers 2010; Holleman 2012). There is an ongoing neo-colonial "scramble for Africa" associated with securing farmlands for this purpose (Allen 2010). Because of the

major role corn plays in food production globally (in animal feed, sweeteners, starch, masa harina, etc.), as with soy, price increases for these staple crops, which serve as the feedstock of biofuels affect the global food chain, decreasing the affordability of basic foods. This especially has affected the third world and poor communities everywhere, which are disproportionately populated by people of color. Increased food prices resulting from biofuel production led in the past five years in particular to food riots and the exacerbation of impoverishment. The United Nations Special Rapporteur on the right of food, one of the world's leading experts on food insecurity, referred to U.S. and E.U. biofuel policy as a "crime against humanity." The U.N.'s Committee on the Elimination of Racism also issued consternation over biofuel developments in southeast Asia (MRG, n.d.). Despite calls for changes to the renewable fuel mandates and agricultural policy in the U.S. and E.U., these policies remain in place and production of corn-based ethanol and soy-based biodiesel will increase as a result, even if advanced biofuels eventually come online (Ferrett 2007; United Nations 2008; Ziegler 2011).

The environmental racism of the current energy regime is one of the starkest features of the social rift of capitalism, accompanying at every turn the deepening ecological rift. Because racism is embedded in the historical and current system of energy extraction and use, it also features in the attitudes of publics to solving problems like climate change and the, and is a factor in the effectiveness of movements, which remain divided along race, gender, and class lines (Taylor 2000, 2002; Foster 2002; Park 2009). This contributes to the difficulties of forging an adequate political opposition to the status quo in order to address environmental threats like climate change.

White voters in the U.S., for example, are the least likely of all to see climate change as a serious threat. As Park (2009) found by reviewing polls and political studies, voters of color often are more likely to support policies addressing climate change and environmental policies generally, and, perhaps most significant, more willing to pay the costs (7-8). Park makes the crucial point that a climate movement, to be successful, must be everybody's movement, overcoming historical divisions. She writes, "while many people of color and low-income communities regard climate change and the environment as priorities, the climate change movement remains highly homogeneous by race and class and significantly by gender in its leadership" (8). This affects the climate movement's internal democracy, priorities, participation by broader publics, and hence overall effectiveness.

Along with overcoming these issues in the movements, energy scholars wishing to center energy justice in their work, must take account of the historical roots of our energy predicament, the connection between the ecological and social rift. For environmental sociologists tasked with studying these connections it is difficult to do so without adopting the environmental justice perspective that sees "climate change and environmental injustice as indicators of a larger systemic problem: a fossil fuel economy that externalizes negative economic and environmental impacts, leading to decisions that don't fully account for the human and natural costs of modern industrial society" (Park 2009, 14).

Our energy practices today are indeed one way to see why "racism remains primarily a structural and material relationship" (Pellow 2007, 42). Pellow notes that with the civil rights and anti-colonial struggles, one of the main things that "may have changed

most in recent years is the nature of the discourse and rhetoric around difference and (in)equality" (42). Unjust practices, however, persist because they are built into the system. Equally destructive is the gendered nature of these developments.

The gendered ecological rift

While the origins of patriarchy are not entirely clear, the origins of capitalism as a patriarchal system, with its own particular gender order, are well-documented. Lorde (1984) put it thus, "institutionalized rejection of difference is an absolute necessity in a profit economy which needs outsiders as surplus people" (115). "Within this society, that group is made is made up of Black and Third World people, working-class people, older people, and women" (114). This institutionalized devaluation of women and other oppressed groups under capitalism means that the worst effects of the system disproportionately are visited upon them. This is clearly the case in the modern energy regime, where energy injustice is gendered, at the same time that it is class and race-based. A report published by Asian Communities for Reproductive Justice, *Looking Both Ways: Women's Lives at the Crossroads* of *Reproductive Justice and Climate Justice*, finds that "women, specifically women of color, are disproportionately impacted by disasters and environmental degradation caused by global warming…low-income women, women of color, and immigrants will be most impacted by the severe weather events, heat waves, and increases in disease rates that will characterize the Earth's changing climate" (quoted in Park 2009).

Explanations for the gendered nature of energy injustice and the broader ecological rift cannot be found in biological differences between the sexes. The globalization of ecological destruction associated with the burning of fossil fuels and the

near global oppression of women today, which interface in the form of energy injustice, are the product of a historically specific growth-oriented economic system.

The expansionary nature of capitalism meant, just as the law of *limpieza de sangre* constituted a portion of the "most important cargo on the 1492 voyage of Christopher Columbus" (Dunbar-Ortiz 2003) so too was the European conception of gender globalized starting in the colonial era (Leacock 1981; Lugones 2008). Lugones (2008) writes that "it is important to consider the changes that colonization brought to understand the scope of the organization of sex and gender under colonialism and in eurocentered global capitalism" (195). Indeed, it is difficult to understand the relationship between the exploitation of women and the environment that has been discussed by feminist ecologists without studying gender as a historically specific construct, bound up with the racism and class divisions at the heart of capitalism as a particular social metabolic order (Waring 1999; Salleh 2009, ed.).

The "myths of male dominance" used to justify capitalism's gender order invoke the European imposition of European style gender oppression back onto the whole of history, across cultures. In this way, male dominance is justified as a biological and historical inevitability. However, the historical evidence shows that while patriarchy predates capitalism, and is linked to the rise of class society itself, "one of the most consistent and widely documented changes brought about during the [capitalist] colonial period was a decline in the status of women relative to men" (Leacock 1981, 18). With the rise of manufacturing in Europe, privatizing men's domestic work that was once part of the household labor shared with women, "the ideology of womanhood began to raise the wife and mother as ideals. As workers, women had at least enjoyed economic

equality, but as wives, they were destined to become appendages to their men, servants to their husbands. As mothers, they would be become passive vehicles for the replenishment of human life" (Davis 1983, 32). Thus "white women came to be seen as inhabitants of a sphere totally severed from the realm of productive work," as the ideology of femininity marked them as "inferior," along with their reproductive work as mothers and housewives (Davis 1983, 12).

The gendered division of labor was institutionalized in the political sphere where property laws, and laws regulating political participation, excluded the possibility of women's self-determination, even for women working outside the home (Deere and Doss 2008). The diminution of the work now deemed "women's work" made it possible for capitalist employers to justify paying less, or not paying at all, for reproductive and regenerative labor. It has also made the second and third shifts invisible—which women who cannot afford to hire out domestic work and/or who must work extra jobs, or work more than others in the same job, experience in their daily lives (Waring 1999; King et al. 2002; Ehrenreich and Hochschild 2003). The great irony, as feminist ecologists and many other scholars and activists have pointed out, is that the very work that makes life possible on earth, and the ecological processes on which life depends, became the least valued in the capitalist value system (Davis 1983; Odum and Arding 1991; Waring 1999; Anzuldúa and Keating 2002; Foster 2002; Shiva 2005; Salleh 2009). Thus the devaluing of women's work accompanied the devaluing of the rest of nature, as both were treated as "free gifts" to capital. The irony is greatest perhaps in the global South where subsistence production carried out primarily by women is deemed without value along with nature (the natural conditions).

Early capitalist imperialism began the spread of these divisions of society and nature around the globe: "Under colonial conditions, the 'public' and 'private' sphere became divided, as had not been the case when the 'household' *was* the 'community,' and the 'public' sphere became invested with male power it represents in state-organized society" (Leacock 1981, 23). At the same time, the globalized colonial division of labor meant that along with the expropriation of women's work in the global North, capitalism relied on the forced labor of the global South, including the incorporation of men of color, and other subordinated men, into the households, or otherwise under the legal foot, of white, mostly upper class men. Racist and sexist ideology mingled in the exportation of the European gender order abroad, and in the treatment of slaves and the working classes not yet considered "white" in Europe, England, and North America (Roediger 1991; Lugones 2008). Whiteness and European masculinity were offered to white working class men as "psychological wages" to buy their complicity in the oppression of women and men of color, and their own, and to divide movements that would threaten the capitalist order (Leacock 1981, 308; Roediger 1991, 12).

The hegemony of sexism and racism helps recruit alienated functionaries (of all races, classes, and sexes, but especially white men) to ensure the social hierarchy necessary for capital accumulation persists. In this context, the ideologies developed to justify exploitation take on a life of their own. Race, class, and gender, are thus incomprehensible taken apart from one another, though they also have strong independent effects, as in many cases of environmental racism and the near universal exploitation and underrepresentation, today, of women. Racism and sexism under capitalism facilitate environmental exploitation on a global scale. These ideologies were

necessary to justify the spread of capital globally, to keep white men in the factories and armies, alienated from subsistence work, from the land and the rest of humanity, and to pass the buck of the ecological rift generated by capitalism.

In the insidious way those in power divide and conquer, and justify oppression, men of color were feminized and patronized to justify their subordination, and the devaluing of their work, in an otherwise male supremacist culture and economic system (Hymer 2011). And women expected to do hard labor outside the home could not be idealized through the same lens of femininity as white European women whose work generally was now confined to the home and differentiated from white men's industrial labor. Characteristic of capital's opportunism, gender differentiation, whether religiously based or explained in terms of imagined biological differences arising from sex, changes in various contexts. Thus European women of the upper class in particular, during the colonial period, were to be protected from labor, mental or manual, though they were subject to their husbands, fathers, sons, and brothers. However, just as today, working class and enslaved women, especially women of color and Third world women, were considered plenty fit for work, punishment, and sexual exploitation and assault. Davis (1983) describes this selective differentiation arising during the slavery/colonial era:

> Where work was concerned, strength and productivity under the threat of the whip outweighed considerations of sex. In this sense, the oppression of women was identical to men…But women suffered in different ways as well, for they were victims of sexual abuse and other barbarous mistreatment that could only be inflicted on women. Expediency governed the slaveholders' posture toward female slaves: when it was profitable to exploit them as if they were men, they were regarded, in effect, as genderless, but when they could be exploited, punished and repressed in ways suited only for women, they were locked into their exclusively female roles…Since slave women were

> classified as "breeders" as opposed to "mothers," their infant children could be sold away from them like calves from a cow….As females, slave women were inherently vulnerable to all forms of sexual coercion. If the most violent punishment of men consisted in floggings and mutilation, women were flogged and mutilated, as well as raped. Rape, in fact, was an uncamouflaged expression of the slaveholder's economic mastery and the overseer's control over Black women workers….If Black women were hardly "women" in the accepted sense, the slave system also discouraged male supremacy in Black men. Because husbands and wives, fathers and daughters were equally subjected to the slavemasters' absolute authority, the promotion of male supremacy among the slaves might have prompted a dangerous rupture in the chain of command. (Davis 1983, 6-8)

This selective imposition of gender differentiation throughout capitalism's history exposes the roots and aims of the modern gender order: profit and domination.

The unpaid and under-paid work of white women, of people of color, and of nature, thus became a subsidy to capitalist development that included the reproductive and regenerative services necessary for life, which the system disregards as an aim in and of itself. This work, and the violent oppression which makes its exploitation possible, is part of the unpaid costs associated with maintaining the labor and resource supply of capital. Viewed in this way, it is clear that surplus extraction involves the expropriation of the labor of the majority of the earth's population, officially employed and unemployed, as well as the appropriation of nature, to serve a minority, the modern day robber barons—the 1%. This continues today:

> The global majority of women–being mothers and care givers–are culturally positioned as labour right at the point where humanity and nature interact. Likewise, men 'outside of' capital, such as small farmers and forest dwellers, undertake regenerative, or meta-industrial labor…It is certainly no exaggeration to say that the entire machinery of global capital rests on the material

> transactions of this reproductive labour force. (Salleh 2009, 7)

Understanding capital's consistent appropriation of the unpaid labor of women and men from historically oppressed groups contributes to the recognition that energy injustice is a result of the unequal extraction of energy from the earth and the majority of human beings, for the sake of accumulation at the top. It is in this reality, as well as the unequally borne costs of waste, wars, and other depredations of the energy regime, that energy injustice is most clear.

In studying the current energy regime, one of the first facts is that insatiable energy demand is growth-driven and impossible to transcend in a growth-oriented economy (EIA 2008; York 2010; York, Ergas, Rosa and Dietz 2011). This is why the key conflict arising in climate negotiations is that between ecological, social, and economic priorities (Clark and York 2005; Bazilian 2009; York 2010). Despite evidence to the contrary, one of the main justifications for continued energy extraction and use, no matter how ecologically destructive or socially disruptive, is that it fuels economic growth, which is necessary to raise all boats and improve general social well-being (Waring 1999).

Clearly, when you look at this predicament through the lens of the social rift, as the basis of the ecological rift, this position on energy development and economic growth is revealed for the ideological shield that it is. The growth myth hides the reality that "the profits of environmental neglect accrue primarily to one class whereas the costs are borne primarily by another" (Anderson 1976, 139). And this process is gendered as well as racist, classist, and imperialistic. One need look no further than the statistics on global

wealth to reveal who indeed are the primary beneficiaries of growth-driven energy consumption.

Deere and Ross (2008) point out that "it has only recently garnered attention that women may not share in the wealth of men, even within the same household or family" (353). This means that "if women systematically have less access to wealth, then the equity issues are similar for the distribution of wealth by gender as by race and ethnicity" (353). As part of a landmark study in which many researchers took part and prepared chapters for the World Institute of Development Economics Research of the United Nations University, Deere and Ross find that "women and men not only have significantly different access to wealth but also may use their assets and asset income differently, which may have consequences for household well-being as well as for the larger society" (353). As noted above, "women still own just one percent of assets worldwide" and "make up 70 percent of the world's poor" (WILPF quoted in Salleh 2009, 20). This is highly consequential since,

> it is well-recognized that the ownership of assets improves the lives of the women and men who own and control them. The relationships between asset ownership and reduced poverty and enhanced security have been extensively researched, as has the relationship between asset accumulation and economic and political power. (Deere and Doss 2008, 353)

For example, women's land ownership, which in Africa and Latin America maxes out at 25%, while for most countries it is much lower, "leads to improvements in women's welfare, productivity, equality, and empowerment" (354). Moreover, this is environmentally significant both because the gendered wealth gap indicates that women benefit less than men from growth-driven energy extraction and use, especially poor

women throughout the world, and also because women's empowerment is linked to better environmental outcomes (Ergas and York 2012).

While women globally benefit less from wealth production and the energy throughput this requires, wealth concentration at the very top of the income ladder has created a deeper divide between rich and poor women, especially between the women of the global North and South. Global inequalities have been perpetuated and exacerbated by the trends of the last thirty years as a result of the relationship between race, class, gender, and position in the world system. As the global economy has grown, the major beneficiaries are at the very top of the income brackets and are mostly the elites from wealthy countries (Milanovic 2009). The inequalities are stark:

> In 2007, the top 1 percent of wealth holders in the United States controlled 33.8 percent of the wealth of the country while the bottom 50 percent of the population owned a mere 2.5 percent. Indeed, the richest *400 individuals* had a combined net worth of $1.54 trillion in 2007—approaching that of the bottom *150 million people* (with an aggregate net worth of $1.6 trillion). On a global scale, the wealth of the world's 793 billionaires was, in 2008, more than $3 trillion—equivalent to about 5 percent of total world income ($60.3 trillion in 2008). A mere 2 percent of the world's adult individuals have more than half of the global household wealth, with the richest 1 percent accounting for 40 percent of total global assets; while the bottom half of the world's population has barely 1 percent. (Magdoff and Foster 2011, 84)

At this level of inequality, it is impossible to see the responsibility for climate change in universal terms.

Along with major divisions between the beneficiaries of energy use globally, the burdens of the modern energy regime, which is notorious for its "externalities," fall unequally. Energy injustices embedded in our current regime of extraction, use, and

pollution, mean "that women and the poor, especially in the global South, are at the bottom of the social order and hurt most by floods, droughts, resource wars, pestilence, and extreme weather events" (Brownhill and Turner 2009, 232). The United Nations Women Watch has stated, "The Threats of Climate Change are Not Gender-Neutral." They provide a concise summary of the relationships between class, race, world system position, and gender, which determine who bears the brunt of this planetary crisis:

> The effects of climate change will vary among regions, and between different generations, income groups and occupations as well as between women and men. Due, in part, to their lower adaptive capacities, developing countries and people living in poverty are likely to experience significant impacts…Women form a disproportionately large share of the poor in countries all over the world. Women in rural areas in developing countries are highly dependent on local natural resources for their livelihood, because of their responsibility to secure water, food and energy for cooking and heating. The effects of climate change, including drought, uncertain rainfall and deforestation, make it harder to secure these resources. By comparison with men in poor countries, women face historical disadvantages, which include limited access to decision-making and economic assets that compound the challenges of climate change. (UN Women Watch 2009)

Moreover, gender analyses show climate change leads to "the increase in physical and sexual attacks on women [that occur] during natural disasters and afterwards as mass displacement causes chaos and instability" (Park 2009, 16). As a result of the recognition that climate change is gendered and conditioned by other inequalities, scholars and activists are increasingly calling for more analyses on energy, climate change, and inequality. In other words, there is increasing concern for energy justice.

An energy justice perspective is crucial not only to understand energy crises but to work toward solutions that do not exacerbate inequalities. This means working toward

displacing current proposals that are expected to do just this. Today, the lack of representative decision-making under capitalism means "a range of currently debated and applied economic policy tools to mitigate climate change are likely to have regressive effects…[wherein] households in lower income brackets bear a (considerably) higher burden of the cost as a percentage of their income than those in higher brackets" (Büchs, Bardsley and Duwe 2011: 286). As stated above, because women and children make up the majority of the poor, this lack of representation has a greater affect on them.

The benefits of the most popular, market-based, solutions to climate change amongst governments and business worldwide, unsurprisingly, will accrue to the top of the already bloated upper income bracket. If nothing is done to make real significant changes, these "solutions" will divert attention from the serious ecological and social threats of the crisis. Market-based strategies are geared more toward economic growth than environmental protection, and do not at all change the unequal power relations at the heart of capitalism's externalization of social and ecological costs (Waring [1999] 2004; Foster 2002). So-called solutions to climate change that fall into this category, and are cited by some as evidence of ecological modernization, have as their explicit goal the further facilitation of accumulation, and the revival of high growth rates in stagnant economies.

For example, carbon markets, advertised to the public by PR firms and government agencies as a solution to climate change, as a way to internalize externalities, are described by one corporate chairman as the next market "nirvana." "Indeed, the anticipation of a larger, federally regulated carbon market is the biggest driver behind the growing popularity of green finance, and experts say emissions trading and climate

change-related investments stand the best chance of reviving Wall Street's fortunes" (Gronewold 2009). It is no wonder that, especially the upper class and male economists and business leaders in wealthy countries see market solutions to energy problems as the best way forward. As the primary beneficiaries of growth (which requires that we not truly cap energy consumption), as long as the economy expands they are like Midas, everything they touch turns to gold, even if it is the life-suffocating waste generated by a globally destructive energy regime (Foster, Clark, and York 2009).

As a result of the power relations of capitalism, the struggle for real environmental change, including energy justice, involves the struggle for more democratic decision-making based on a new system of value that does not leave out women and nature, as well as other vulnerable groups of people. As Ergas and York (2012) point out "despite their recognized vulnerability, women are practically excluded from climate policy decision-making bodies" (10). Moreover, "women's contributions to resource management and indigenous knowledge from their respective regions in the world continue to be largely ignored by scholars and policy makers (10).

Ergas and York echo Salleh (2009), Spitzner (2009), and Waring (1999; 2009), amongst others who have pointed out that work dealing with the environment and gender, among other inequalities, is scant, in spite of increasing calls for just such analyses. It obviously is difficult to include these issues in decision-making at the movement or policy level if they are kept invisible in major research and data collection. Waring ([1999] 2004) has reviewed all of the excuses given for why data is not gender disaggregated more often, and women's voices are not included in research and decision-

making on which they rely. She came to the conclusion that within patriarchal contexts like capitalism women just don't count.

The work of Ergas and York shows that all of this is crucial in dealing with climate change because women's empowerment actually mitigates the destructive process of andro-centric energy decision-making, with positive affects for the environment and people:

> We hypothesize that in societies with greater gender equality there will be relatively lower impacts on the environment, controlling for other factors. We test this hypothesis using quantitative analysis of cross-national data, focusing on the connection between women's political status and CO2 emissions per capita. We find that CO2 emissions per capita are lower in nations where women have higher political status, controlling for GDP per capita, urbanization, industrialization, militarization, world-system position, foreign direct investment, the age dependency ratio, and level of democracy. (Ergas and York 2012)

This research confirms hypotheses of feminist ecologists who have long pointed out that women, as a result of their social roles in the reproduction of society and nature, have specialized knowledge and make different environmental decisions. That women's environmental concerns and activities differ from men's has been well-documented:

> A significant body of research on environmental attitudes, risk perception, environmental justice organization membership, and activism, examining a variety of nations and cultures, shows that women tend to express different concerns about the environment than men. Women are more active in environmental reform projects and tend to perceive environmental risks as more threatening (Buckingham, 2010; Flynn et al., 1994; Bord and O'Connor, 1997; Davidson and Freudenburg, 1996; Dietz et al., 2002; Kalof et al., 2002; Eisler et al., 2003; McCright, 2010; Seager, 1996). McCright (2010) recently found that women in the United States demonstrate greater scientific knowledge of climate change, approach the issue of climate change differently, and express different

> concerns and potential solutions to problems. In addition, although they are not as active as men in mainstream environmental organizations, women are estimated to make up 60% to 80% of grassroots environmental organization membership (Bell and Braun, 2010; Seager, 1996; Stoddart and Tindall, 2010). Further, research shows that women often cite their roles as caregivers as the primary reason they are active in grassroots environmental movements (Bell and Braun, 2010). (Ergas and York 2012)

Combined, this research highlights why "integrating women into climate change policy and decision-making may be vital for creating the necessary changes for reducing anthropogenic greenhouse gas emissions" (10).

Along with the ecological improvements that result from women's empowerment, the empowerment of women is, of course, also key to any democratic movement that seeks to break down inequalities based on gender, race, class, and nation. It is therefore an inherent part of the struggle for energy justice.

Energy and the ecological debt

This chapter so far has highlighted environmental injustice, and more specifically energy injustice, as the product of the alienation and domination of human being by human that is inextricably bound with the alienation of capitalist society from the earth. In other words, energy injustice is the interface between social inequality and environmental depredation associated with the modern energy regime, and is therefore an essential sociological reality of the ecological rift. The entire infrastructure and development patterns of capitalism are energy intensive and thus require concentrated energy resources that can only be extracted at great ecological and social cost (Odum 2007). Whether we dig deeper into the bowels of the earth for fossil fuels, displace food crops and plant every inch of vulnerable land with feedstock for biofuels, or endure

another wave of atomic enthusiasm, the insatiable appetite for energy to power the growth economy means there inevitably will be environmental dislocation on grander and grander scales barring revolutionary change. There is, as we know, no free lunch with energy, which always involves entropy and often the using up of low entropy fuels, along with climate change and other sink-related problems. There is no technological change that will alter the social relations at the heart of capitalism as an exploitative system (Foster 2002, 22-24; York 2010).

The externalities of energy production, or unpaid costs, have accumulated today in the form of unpaid debts to nature and the oppressed in society (Kapp 1950, 13; Anderson 1976, 140-47; Foster 2002, 101; Foster 2009, 242-47). The concept "ecological debt" appears to have first been introduced by the Marxist sociologist Charles Anderson (1976, 143). He wrote of the ecological crises,

> The unpaid costs to the environment underlie the ecological challenge to survival…In truth, however, these costs are already being borne by the earth and its entire population…Aside from the day to day economic, social, and physical costs borne by the natural and human victims of growth for quick gain, an unpaid debt is being recorded with the environment which will soon come due. The magnitude of the debt is unknown, although we know it is already of extensive proportions….A rationally ordered economic system could put science and technology to use in a constructive manner and reduce the ecological debt while simultaneously raising life quality. (Anderson 1976, 141)

Anderson thus recognized the links between the social and ecological crises, drawing on Marx and Kapp.

Today, the ecological debt is a central concept in the global environmental justice movement. Martinez-Alier traces the "ecological debt" in the movement to the early

1990s, when the "Debt Treaty" of the 1992 Rio Earth Summit called for the cancellation of third world external debt on the grounds that it was already paid many times over. This payment was made in the form of colonial and neocolonial ecological extraction and the cost of pollution imposed on the global South by the global North through ecological imperialism, or ecologically unequal exchange (Martinez-Alier 2002, 213). With climate change and energy imperialism, two of the largest ecological and social threats in history, you can see the extent of the energy regime's historical imposition of unpaid costs throughout the world. It is difficult to imagine the scale of the truly astronomical and unquantifiable costs of energy resource wars for targeted populations and global ecosystems, but the carbon debt, the contribution of wealthy nations to one of the largest crises facing humanity, has been calculated. On this basis, an argument centering energy justice would require the acknowledgement that what little amount of carbon we may still afford to burn, in ecological terms, is rightfully owed the poorest in the world. The rich have already done their share of soiling the biosphere.

Feminist ecologists have extended the notion of debt to include the interrelated environmental inequalities described earlier in this chapter as the basis of the ecological rift. Salleh (2009) writes, building on cumulative work of feminist ecologists and other environmental justice activists and scholars, that we need models for understanding and change that integrate three kinds of subsumptions:

> the *social debt* owed by capitalist employers for surplus value extracted from the labouring bodies and minds of industrial, service, and enslaved workers, (the focus of socialism);
>
> the *ecological debt* owed by the global North to the South for direct extraction of the natural means of production or

> livelihood of non-industrial peoples (the focus of postcolonial and of ecological politics);
>
> the *embodied debt* owed North and South to unpaid reproductive workers who provide use values and regenerate the conditions of production, including the future labor force of capitalism (the focus on feminism). (Salleh 2009, 4-5)

The struggle to redress the grievances of capitalism's history with regard to energy exploitation, and alleviate the burden of contemporary inequalities resulting from energy imperialism, require a confrontation with elites over the issue of debt. Naomi Klein calls the concept of ecological debt the most important "social justice issue of our time" because it marries climate, or broader environmental, and economic justice. It is the only way, really, to conceptualize environmental inequality in historical terms and environmental justice in restorative and restitutive terms. Therefore, the ecological debt is the actionable framework for conceptualizing energy justice in terms of the historical relationship between the ecological and social rift described above in race, class, and gender terms.

Energy justice: Externalizing the internalities

The insights of global environmental justice scholars and activist, feminist ecologists, and ecological rift theorists in environmental sociology complement one another and provide a basis for a broader understanding and conceptualization of energy injustice, rooted in the history of capitalism and imperialism. Energy injustice within this framework connects the denial of self-determination and the unequal oppression of people with the ecological destruction inherent in the modern energy regime. The struggle for energy justice thus is part of a larger struggle for the democratic control of natural resources, the end of oppression in all its layers, and the ecologically necessary

end to energy intensive development, regardless of the discovery of alternative energy sources.

One of the essential calls of feminist ecologists has been the recognition of the leadership of women and men whose labor has been off the accounting sheets of capital, even while necessary to the its functioning. As a result of their experiences with reproductive and regenerative efforts, these women and men carry knowledge that has been suppressed by capital, because it undermines the ideology claiming the market as the best source for all your needs and desires. This is the knowledge of social and ecological provisioning, which are one and the same thing, and are independent of the market. The market must use all of its might to promote the idea that "there is no alternative" to hide the fact that capital is dependent on the reproductive and regenerative sphere of activity that is not accounted for in its accounting schemes, but the reverse is not true (Shiva 2005; Salleh 2010). Humanity can provision for itself, and in much less destructive ways, autonomously from capital.

A movement toward energy justice is a movement toward social and ecological autonomy from capital, toward a system of decision-making that is democratic and ecologically sound, rather than based on the "ability to pay" of the pricing system. Therefore, unlike those environmental economists and some feminist thinkers who seek to internalize nature and women's work within the capitalist value system (internalizing the externalities), a movement toward energy justice is part of a larger process of socio-ecological change intended to "externalize the internalities" (Odum and Odum 2000, 21; Foster 2002). The goal of such a transformation is the realization of a society democratically organized on the basis of provisioning for social and ecological

reproduction. Under such circumstances, energy justice is the basis for energy decision-making.

A global perspective

Bullard (2002) writes that environmental justice "is not meant to shift risks among populations" (43). This shifting around of externalities is a tactic of capital to avoid systemic change. Under this system, when the social struggle or complete ecological degradation places limits on exploitation and degradation in one place, capital simply moves on, globalizing destruction (Clark and York 2008). Anderson (1976) noted, "there is good reason to fear that, given the growth society's need for social inequality, it might attempt to divert attention toward isolated environmental clean-up programs"(139). Indeed this has been the case. While ecological modernizationists in Europe celebrated supposed ecological change in the North, their own data forced them to admit that "production is supermaterializing in the South, even if arguably dematerializing in the North" (Mol, Sonnenfield, and Spaargaren 2009, 387). Therefore, a movement toward energy justice aimed toward truly healing the ecological and social rift is necessarily a global environmental justice movement.

A new system of value

Scholars from nearly every critical ecological perspective have pointed out the need for a decision-making framework that transcends the focus in capitalism on market prices and represents a new system of value (Waring 1999; Spitzner 2009; Salleh 2010). Ariel Salleh (2010) highlighted that we remain in need of developing an integrated ecosocial analysis that recognizes the primary importance of "reproductive activities and regenerative provisioning" and includes "inputs by class, race, and sex-gendered others"

(213, 215). She proposes the concept of metabolic value, which refers to the regenerative labor done off capitalism's accounting books especially by women, peasants, etc. "in supporting ecological integrity and the social metabolism" (212), as a tool of analysis to this end. She distinguishes metabolic value from the anthropocentric notion of "use-values" which does not necessarily incorporate ecological provisioning. She writes, "metabolic value is not the same as humanly produced use value, though it is certainly involved when humans make use values…Both forms of labor and value will be central to any mode of production; whereas capitalist exchange value is a historically relative form" (213).

Such a form of valuation would provide a method of assessing social energy choices in terms of social and environmental justice. This way of seeing energy choices, making visible regenerative and reproductive efforts, as well as degenerative and destructive processes, can facilitate a movement toward energy justice, and the larger societal transformation of which this must be part. The following chapter proposes systems ecologist Howard T. Odum's emergy analysis framework as a method of accounting that puts social and environmental valuation on just such a footing as Salleh proposes. This method transcends the focus on prices, and the definition of efficiency in terms of profit maximization. Transcending the capitalist valuation system is necessary because it is clear that "the old definitions have not served us, nor the earth that supports us. The old patterns, no matter how cleverly rearranged to imitate progress, still condemn us to cosmetically altered repetitions of the same old exchanges…The master's tools will never dismantle the master's house" (Lorde 1984, 123).

CHAPTER III

ECOLOGICAL UNEQUAL EXCHANGE

The resource curse, an ahistorical analysis

Rick van der Ploeg (2011), Oxford economist and co-director of OxCarre, the Oxford Centre for the Analysis of Resource Rich Economies, recently published a review of the leading debates in contemporary economics about causes of the "resource curse" plaguing what Stephen Bunker termed "extractive export economies" (1984, 1018). Social scientists have long recognized the "'resource curse,' whereby countries rich in natural resources are often unable to dig or drill their way to broad-based prosperity" (Kraft 2009). Orthodox economists have attempted to explain this phenomena, under some circumstances called the "Dutch disease." The various interpretations they offer include:

> that a resource bonanza induces appreciation of the real exchange rate, deindustrialization, and bad growth prospects, and that these adverse effects are more severe in volatile countries with bad institutions and lack of rule of law, corruption, presidential democracies, and underdeveloped financial systems. Another hypothesis is that a resource boom reinforces rent grabbing and civil conflict especially if institutions are bad, induces corruption especially in nondemocratic countries, and keeps in place bad policies. Finally, resource rich developing economies seem unable to successfully convert their depleting exhaustible resources into other productive assets. (Van der Ploeg 2011, 366)

However, there is ongoing difficulty in the economics literature establishing why some countries (Norway and the United States are cited) do seem to benefit from their natural resource wealth whereas other countries (like those in Latin America dependent on oil

exports) experience increased conflict and corruption, negative economic development, and decreased social welfare once they are economically dependent on natural resource exports. Most analysts don't look at the root of these problems in historical terms. The solutions proposed by many economists to this problem tend to involve, or put at the center, building better institutions, fostering further economic openness, and learning from "U.S. history and adopt[ing] an optimist, forward-looking approach to technological innovation in resource exploration and the search for new reserves" (Van der Ploeg 2011, 407).

Missing from the dominant "resource curse" discussion are the wider insights of sociologists and political economists who study the historical relationship between economic development in the first world and so-called underdevelopment in the third world. Orthodox economists typically fail to explore the implications of the historical transfer of natural wealth from poor to already wealthy countries, or ecological imperialism.

In this chapter I use the case study of Ecuador, considered the "poster child for the paradox known as the 'resource curse,'" (Kraft 2009), to illustrate the explanatory power of a synthesis of systems ecology (in particular Howard T. Odum's work), and historical materialism for understanding ecological unequal exchange and the relationships governing today's global energy system. "Ecuador is a typical example of the resource curse" because its "overreliance on oil since the early 1970s has seriously eroded the country's social and cultural foundations and weakened government accountability. Previous governments' access to a wealth of natural resources has fostered political and social pathologies" (Van de Ven 2010). Within environmental sociology, the historical

materialism of ecological rift theory provides a link between natural and social history, and ecology and social science, which allows us to develop a more robust understanding of the causes and effects of ecological unequal exchange, a central feature of ecological imperialism afflicting countries like Ecuador. Via the ecological rift framework for understanding ecological unequal exchange, Odum's emergy analysis of the economic and ecological impact of trade is brought into social science. This work answers Bunker's call for measuring the transfer of natural wealth in ecological terms, rather than focusing primarily on labor and economic exchange values, and in doing so develops a richer understanding of current circumstances than is commonly found in the resource curse literature of mainstream economics.

The approach outlined here contributes insights relevant to the critical sociology of energy that puts questions of historical and contemporary inequalities, and hence energy justice, at the heart of energy analyses. This focus also makes possible a contribution to current debates over ecological debt, which figure prominently in global climate change negotiations and protests of third world external debt. The findings of systems ecologists combined with historical analyses of unequal exchange help paint a picture of the cumulative impact of ecological unequal exchange and hence the potential scale of ecological debt owed by the global North to the South. In relation to energy analyses and the "resource curse," this analysis illustrates why the assertion of environmental sovereignty by countries heretofore serving as supply depots for the North, and the redress of historical inequalities, are both necessary components of a movement toward energy justice.

Ecological unequal exchange: An historical analysis

In the *American Journal of Sociology* in 1984, Stephen Bunker illustrated the need for detailed historical analysis of events conditioning the economic malaise and inequality then affecting the Brazilian Amazon (see also Torras 2003). Bunker showed that "the relative underdevelopment of regions from which matter and energy are extracted is best explained as a consequence of the internal dynamics and external trade relations of their economies" (Bunker 1984, 1018). Unequal trade dynamics leading to the extraction and transfer of natural wealth from one ecosystem and region, to be consumed in another, constitute "the socioeconomic and ecological linkages to the extracted commodity [that] tend to a loss of value in the region of origin and accretion of value in the region of consumption or transformation" (1019). This reinforces inequality while setting the stage for its intensification at greater and greater scales. "Focusing on the necessary relations between extractive and productive economies permits a solution to [the] ultimately fruitless debate," over whether the sources of underdevelopment are found externally in the world economy or are determined internally by specific regions (1019).

Analyses such as Bunker's, along with earlier work on uneven development and unequal exchange, opened the door for contemporary studies:

> Recent scholarship on 'ecologically unequal exchange' has drawn on Bunker's seminal work, as well as the theory of unequal ecological exchange, to demonstrate the disproportionate (and undercompensated) transfer of matter and energy from the periphery to the core, and the exploitation of environmental space within the periphery for intensive production and waste disposal. The environmental footprint of economically advanced nations involves appropriation of land, resources, and labor in lesser-developed countries, increasing the environmental

> degradation in the latter for the benefit of the former.
> (Foster, Clark, and York 2010, 347)

Rice succinctly defines ecological unequal exchange as "the environmentally damaging withdrawal of energy and other natural resources and the addition or externalization of environmentally damaging production and disposal activities within the periphery of the world-system as a consequence of exchange relations with more industrialized countries" (2009, 215).

The over-use and draw down of the world's energy supplies, and the competition between food and fuel caused by the number of hectares of crop-lands devoted to agrifuel feedstock production, would not be possible without a global network of ecological unequal exchange. This network is the product of five hundred years of colonial domination and ongoing imperialistic relationships between the world's rich and poor countries. The persistent exploitation of the world's poor, by the wealthy both within and between countries, to maintain energy supplies is enforced by the largest and most lethal militaries in history, bringing death and destruction to countless humans, continuously threatening entire communities and cultures, and the environment (Bagchi 2005, 292-303; Rogers 2010, 97-115; Clark, Jorgenson, and Kentor 2010). Building upon extant research on energy flows within the world systems approach, Lawrence (2009) explains, "In world-systems, energy flow has been, and continues to be, a basis for intersocietal conflict and competition, including unequal exchange that generates inequality in levels of development and ecological degradation across societies" (335). Not only does unequal exchange condition the extraction of resources, but also the final use and pollution associated with energy consumption. The results of Lawrence's statistical and historical analyses show that "the core countries are using more energy, emitting more

CO2, and attaining more GDP per capita relative to the semiperiphery, with the periphery lagging well behind both" (335).

Without looking at the relationship between wealth accumulation in core countries and the wealth depletion in extractive economies, mainstream economics suffers a major setback in understanding the resource curse plaguing countries like Ecuador. Without specifying the connection between under- and over-development, and the relationship between subjective and objective forces affecting exploited countries, economists use examples, such as the rapid economic growth of the United States, as evidence that all countries could make similar use of their resource wealth. In this view, under the right circumstances, which are primarily internal and self-determined, "the curse, where it exists, is self-fulfilling" (Wright and Czelusta 2004, 36; see also David and Wright 1997).

Ecological rift approach to ecological unequal exchange

Ecological rift theorists' treatment of ecological unequal exchange is rooted in analysis of the historical development of capitalism. The depth of this analysis is due to cumulative Marxist theory of economic expansion, imperialism and ecological degradation. Indeed, theories of unequal exchange first emerged from within the Marxist tradition (Preobrazhensky [1926] 1965, 227; Emmanuel 1972; on unequal development and exchange, see Amin 1976). While most studies of imperialism, and earlier studies of unequal exchange, focused on flows of the economic surplus, ecological unequal exchange illustrates how, through primitive accumulation, and ongoing exploitation "[d]istant lands and ecosystems became mere appendages to the growth requirements of

the advanced capitalist center" (Clark and Foster 2009, 314; Foster, Clark, and York 2010, 345-72).

Within environmental sociology, the historical materialism of ecological theory provides a link between natural and social history, which allows us to develop a more robust understanding of the causes and effects of ecological unequal exchange on societies, the economy, and ecological systems. Unlike previous theories of the economy/environment nexus, in which "nature is often in the background," ecological rift theory considers how the social system "confronts natural systems and affects their ability to sustain life" (Clark and York 2005, 395-96). Important for analyses of the current era, this approach allows for the conceptualization of the relationship between the accumulation of environmental degradation and the accumulation of capital, which is the driving force organizing productive relations across the globe. In a critical sociology of energy, which does not abstract away our ability to observe the relationships between oppression, exploitation and the political economy of energy, as well as the ecological impact of energy choices, this theoretical space is crucial. The analysis of the global carbon cycle within this framework is an essential starting point for understanding our contemporary energy regime and the impact of this regime on particular countries.

Carbon metabolism: Global capitalism, climate change, and the biospheric rift

Clark and York (2005) cite research showing that "over the past 400,000 years, the carbon cycle and climate system have operated in a relatively stable manner, sustaining the temperature of the earth and maintaining the balance of gases in the atmosphere" (402). However, the advent of capitalism, an inherently expansionary system, brought about a rift in the global carbon cycle resulting from the historic

accumulation of CO_2 in the atmosphere, a waste product of industrial activities. "The drive to accumulate capital fueled the development of industrial productive forces, which at the same time, created a growing need for raw materials mined from the earth to power the machines…Thus, capital, as Foster explains, was pushed to 'structure the energy economy around fossil fuels (a reality that is now deeply entrenched)'" (405-06). Increased technological development and efficiency gains make possible the exploitation of fossil fuels on an ever-greater scale, and the drive toward ceaseless economic growth means that the quest for fuel to feed production only expands in absolute terms. "As the economic system grows under capitalism, the throughputs of materials and energy increase and capital incorporates ever-larger amounts of natural resources into its operations" (407):

> Capitalism, organizing social relations of commodity production, effectively plunders the historic stock of concentrated energy that has been removed from the biosphere only to transform and transfer this stored energy (coal, oil, and natural gas) from the recesses of the earth to the atmosphere in the form of CO_2. In this, capitalism is disrupting the carbon cycle by adding CO_2 to the atmosphere at an accelerating rate. At the same time, capital's constant demand for energy necessitates the continual plundering of the earth for new reserves of fossil fuel. With over 23 billion metric tons of CO_2 released into the atmosphere per year, capitalist production is creating 'waste emissions faster than natural systems can absorb them.' As a result, CO_2 is accumulating—as atmospheric waste—at alarming rates, warming the earth, and potentially causing dramatic climate change. (Clark and York 2005, 409)

To propel the growing market, energy companies backed by national governments scour the globe for new fossil fuel resources, while also introducing and promoting alternative fuels with their own destructive logic and consequences, such as biofuel. It bears

reiterating that efficiency gains and technological development facilitate this expansionary process, rather than slowing down or reversing these trends.

The ecological rift, global inequality, and the sociology of energy

The costs and benefits of the energy-fueled economic expansion of the capitalist system have not been born equally by communities around the world. In fact, inequality is worsening between poor and rich countries. World Bank economist Branko Milanovic published a 2009 paper comparing global inequality within and between countries in the 1800s with global inequality today. The combined results of his current study "with the earlier finding that the composition of global inequality has shifted from being 'caused' by internal factors, like domestic income distribution, to 'external' factors like differences in mean country incomes," make clear there is growing inequality between poor and rich states (with of course some exceptions) (Milanovic 2009, 19; 2011).[4] Rather than an economic miracle, many countries in the world, like Ecuador, which followed all traditional economic prescriptions, playing up its comparative advantage (e.g. oil), implementing austerity measures in times of crisis, and fostering economic openness, have experienced a social and ecological nightmare. With the exception of a few elite families—as in other countries plagued by the so-called resource curse and other manifestations of neocolonialism—Ecuadorans have benefitted relatively little from their trade with the U.S. and other wealthy nations. They have been unable to develop an autocentric economy, or to control their own economic surplus. Rather, upon entry into the global market as exporters to wealthy countries, Ecuador followed the well-worn path

[4] Milanovic writes, "we can conclude that the main 'inequality extractors' today are not (within)-national elites, but an elite which is basically composed of the citizens of rich countries" (2009, 19).

of resource-export dependent nations leading to increased depravation and ecological degradation. In a recent cross-national analysis, Jorgenson found that it is common that

> less developed countries with relatively higher levels of exports sent to more developed countries exhibit suppressed domestic levels of consumption, well below globally sustainable levels for many nations. More importantly, further results indicate that structural relationships between more developed countries and less developed countries have become more ecologically unequal through recent decades. In other words, the vertical flow of exports has contributed to a widening gap between the resource consumption levels of 'the haves' in the global North and the 'have nots' in the global South. Overall, this growing body of research helps to explain the disparities between consumption-based environmental demand (i.e. per capita footprints) and actual forms of environmental degradation (i.e. deforestation)…These disparities are partly a function of ecologically unequal exchange relationships via the vertical flow of exports, which help more developed countries treat less developed countries as supply depots. (Jorgenson 2010, 459)

In the resource curse literature, the curse is identified primarily as the crisis of negative economic growth. Ecological rift theorists, like other critical scholars, see the exploitation of humans and the environment as part of our current energy regime as the real, underlying material contradiction, and the source of ecological *crises*, which exist independently of (those sometimes overlapping with) economic *crises*. These divergent diagnoses lead to opposite prescriptions for change.

The critical sociology of energy, taking into account historical realities, must find its way through myriad arguments that recognize many consequences of the "curse of resources" while at the same time promoting the system which gives rise to such a paradox. A central aspect of energy-fueled economic expansion is the inherently unequal exchange involved in a world economy structured hierarchically with those at the top

able to appropriate world resources for their own development, even when the cost to majority is very high. Recognizing our current "energy predicament" as an ecological, economic and social justice crisis, rather than a technical economic or engineering problem (Rosa, Machlis, and Keating 1988), allows a more meaningful exploration of the future of energy in human society, and a true assessment of global ecological debts and the inequalities that must be redressed if we are to move toward a system founded on energy justice as a component of environmental justice and equality in general.

Ecological rift theory focuses on global inequality and ecological destruction and the relationship between "capitalism and the accumulation of catastrophe." This framework helps us better understand the history of ecological imperialism, which made possible "the environmental overdraft that contributed to European prosperity while hiding the extent of ecological degradation of industrial capitalism" (Foster 2011; Foster, Clark, and York 2010, 352). Ecological rift theorists' have employed "the Lauderdale Paradox" as a way of referring to the recognition in classical political economy to the amassing of private riches through decreases in both the common good and public wealth (Foster, Clark, and York 2010, 54-72). Classical political economists like the Earl of Lauderdale questioned distribution of the benefits of economic growth—before the completion of the bourgeois revolution "sounded the knell of scientific" economics, and prize-fighters for capital replaced disinterested inquirers (Marx [1867] 1990, 97).

The paradox of a decline in public wealth accompanying an increase in private riches helps explain why the majority can be worse off, as in the case of Ecuador, even as private wealth grows as a result of the overexploitation of Ecuador's natural resources. With the ecological rift theory providing the historical context and connection to broader

sociological theory, systems ecology (which also distinguishes between the accumulation of exchange value as private wealth and the public wealth found in countries' natural endowments) may be brought into studies of ecological unequal exchange to provide a further empirical basis for this area of research. This answers Bunker's call for analysis of exchange in ecological terms.

Systems ecologist Howard T. Odum developed a method for measuring the total work of ecosystems embodied in commodities resulting from economic and ecosystem processes, and hence a way to measure the extent of natural wealth exchanged between countries, or the loss of a country's natural endowment through commodity trade. He called this embodied ecosystem work—which may be measured in terms of the embodied energy required to produce or sustain a commodity, natural resource, or an entire national economic system or ecosystem—*emergy*. Like the Earl of Lauderdale, Marx, and today's ecological rift theorists, Odum argues for a distinction between measures of economic wealth or value, on the one hand, and real public wealth viewed in ecological terms, on the other. Economic valuations or prices, he argued, are not good indicators of the natural wealth embedded in commodities. Often the cheapest commodities are the result of the most environmentally destructive, or unsustainable practices. He also developed a basis on which to analyze the compensation received by countries per loss of ecological value, creating a means to compare the relative benefit of terms of trade for different countries. Given exchange inequalities, according to Odum, it is impossible for countries to foster long-term development that is both ecologically sustainable and benefits export regions so long as unequal trade relationships persist.

It is my intention to illustrate the utility of Odum's emergy analysis for studies of ecological unequal exchange, where its importance has not yet been recognized.

Odum and ecological unequal exchange

Systems ecologist Howard T. Odum's introduction and refinement of emergy analysis for measuring the embodied ecological work in economic processes, including the human labor component, informed the development of multiple disciplines. His work influenced fields ranging from ecological economics, ecology, and biology to engineering, biogeochemistry and environmental policy. As one of the twentieth centuries greatest ecological theorists, who dealt with the economy/society/environment nexus, his work offers one of the most important links to ecology for social scientists. Indeed, one is not likely to find a more sophisticated and ecologically grounded guide to understanding ecological unequal exchange than that offered by Odum. Most ecological theorists have failed to "understand the linkages among various components of the world—for example, among economies, environments and energy. Although there certainly have been a number of attempts previously to integrate these ideas, one great thinker stands head and shoulders above the rest: Howard Thomas Odum…Clearly H.T. Odum is one of the most innovative and important thinkers of our times" (Hall 1995, ix).

Although Odum's work is occasionally referred to, his emergy analysis, which brings economy, society and ecology under common study, and highlights issues of trade inequality, has yet to be successfully integrated within the methodological toolbox of ecological unequal exchange theory within social science.[5] Incorporating Odum's

[5] Hornborg (2009) writes that "by combining the world-system perspective of Frank and Wallerstein with Emmanuel's notion of unequal exchange and Odum's notion of energy value, Stephen Bunker (1985) assembled the first formulation of a concept of ecologically unequal exchange" (249). However, there is no

ecologically grounded calculations into an analysis of Ecuador's current position vis-à-vis wealthier countries in the global North will highlight useful aspects of emergy indicators for studies of ecological unequal exchange. In what follows I will introduce Odum and the significance of his work, explain the concepts and use of emergy analysis, and address criticisms of Odum's framework, before turning to the specific case of Ecuador.

Odum and the emergy concepts

Briefly defined, emergy analysis is "a method for calculating the value of a resource or product by summing the [ecological] investment made in each step of its production process" (Olsen in preface to Odum and Arding [1991]). Expressed in solar "emjoules," as the common unit, emergy analyses provide quantitative measures of the natural forces of production. This allows assessment of the emergy (embodied energy) required to replenish resources, or a measure of sustainability in terms of actual ecosystems processes.

The main emergy theorist, Howard T. Odum, is one of the founders of contemporary ecosystem ecology, ecological economics, and ecological engineering. Odum's contributions, (along with those of his elder brother, Eugene P. Odum), to moving ecosystem studies forward and developing a measure of wealth in ecological, rather than economic, terms (emergy) are recognized around the world. In 1987 the Odum brothers were awarded the Crafoord Prize, akin to a Nobel Prize for ecology and one of the largest international science prizes, "for their pioneering contributions within the field of ecosystem ecology. Their fundamental findings have strongly promoted our

---

direct reference to Odum in Bunker (1985).

understanding of the dynamics of natural systems and formed a scientific base for the long-term exploitation of the natural resources including pollution abatement" (RSAS 1987). This is only one of the many instances in which the Odums were recognized for their path-breaking work. H.T. Odum, "alone or with his brother, Eugene, has received essentially all of the most prestigious awards available to an ecologist" (Hall 1995, x).

Earlier scientists (e.g. Lindeman, Hutchinson, Deevey, Juday, and Lotka) developed energy flow approaches and applied thermodynamic principles in ecosystem studies, thus anticipating and influencing the Odum brothers' work. However, the Odums were the first to use "the principles and concepts" of energy analyses of ecosystems as the basis of a theory of ecology (Golley 1993, 80-81). As a result of the Odums' early work,

> the energy flow approach that entered ecology as a way for comparing diverse biological processes was transformed into a theoretical foundation for ecosystem function. Although most ecologists were inadequately prepared in the physical sciences to take advantage of the energy concepts and language—except in a general way—adoption of the energy approach provided two useful tools to ecological analysis. First, by following the first law of thermodynamics, ecologists studying energy flows in a defined system could expect that all energy entering the system would equal all energy leaving the system, plus that stored within it…Second, according to the second law, at each transfer of energy in the food cycle, energy is lost to a heat sink and is no longer available to do further work. Therefore, efficiencies of energy transfer must be less than 100 percent. (Golley 1993, 81)

It was through Howard T. Odum's work in particular that "Lotka's ideas on energy flow…had a pervasive influence upon the way later ecologists thought about ecosystems" (Hagen 1992, 125). Odum was uniquely positioned to make such advances. "Given his background in the physical sciences, particularly his training in meteorology

and physical chemistry, it is perhaps not surprising Odum should have been so attracted to Lotka's book…More than any almost any other ecologist, he has approached the study of ecosystems as a physical scientist might" (126). He was thus able to propose a unified approach to ecosystem science, which represented a new synthesis of lasting significance. As a result, "more than any other ecologist, Howard Odum has shaped the way biologists think about energy" (142).

Along with his other advances, Howard T. Odum also pioneered "a method of studying system dynamics by measuring the chemistry of the input and output of water. The difference between input and output, under steady state conditions, was a measure of the metabolism of the whole system. [Howard] Tom Odum (1957, 56) was motivated to study the whole system as a unit" (Golley 1993, 70). The Odum brothers were the first ecologists in history to investigate "a complete ecosystem with the intent to measure its overall metabolism" (Hagen 1992, 103). The energy and systems approach to ecology, and other areas in which the Odums were innovators, helped set the stage for H.T. Odum's development of emergy analysis, which represents a culmination of his vast and lasting contributions. "One reflection of the importance of [H.T.] Odum's earlier work is that there are now at least six scientific journals, generally representing their own scientific societies, in areas in which Odum published either the first, the first significant, or the first systems-oriented paper (Hall 1995, x).

The Odums were not only responsible for major advances in ecological science, they also brought the ecosystem concept out of ecological science and into wider use: "The ecosystem concept became known outside of the limited literature of ecological science and its specialists when Eugene Odum…made it a central concept in his textbook

Fundamentals of Ecology in 1953" (Golley 1993, 62). Howard T. (Tom) Odum, Eugene's younger brother,

> played an important role in the development of the book. Tom Odum was a doctoral student studying under Hutchinson at the time. Eugene Odum credits Hutchinson's ideas, transmitted as copies of class notes by Tom Odum, as being a key inspiration in his using the ecosystem as a central organizing theme for *Fundamentals of Ecology*…Not only did Tom Odum contribute his own interpretations of these modern ecological concepts to Eugene Odum, he also read and commented on the manuscript of *Fundamentals* and wrote the chapter on energy in ecological systems. (Golley 1993, 67)

The text that resulted from the Odum brothers' early collaboration "created a generation of ecosystem ecologists—as distinct from plant ecologists and animal ecologists—who were prepared mentally and technically to contribute to the environmental decades." The "book was reprinted several times, revised twice, and translated into numerous foreign languages" (Golley 1993, 69). Hayden (1992) notes that "what might have remained a rather narrow, technical literature was brought into the mainstream of biological thought" with the publication of *Fundamentals* and "one can trace much of the evolution of the ecosystem concept through subsequent editions of the textbook" (126).

Both Odums understood the social implications of their theoretical developments and saw systemic change as necessary regarding human society's relationship to the larger ecosystem of which we are part (Craige 2001, xiii). "Because in an ecosystem the constituent parts are interdependent and subordinate to the whole, ecosystem ecology offers a philosophical challenge to individualism and a political challenge to capitalism and free enterprise" (xvii). Their study of ecology and environmental problems led

Howard T. Odum, and his brother, to realize the confrontation between capitalist production geared toward endless economic growth and the well-being of the larger biospheric system and human communities, which are a part of it. H.T. Odum also used emergy analyses to trace the transfer of natural wealth from the periphery to core and found that poor countries and regions were under-compensated for their natural resource exports and wealthy countries' economies and living standards benefitted most from environmentally damaging international trade.

Because orthodox economic theory could not account for environmental degradation, or issues of trade inequality, especially in ecological terms, Howard Odum saw the need for alternative methods of measurement for decision-making, outside of traditional economic calculus. Developing an alternative to economics for making policy-decisions was urgent for Odum because "after two centuries of [capitalist economic] expansion, the economic development of the diminishing resources of the earth has reached a new stage. Enterprises for private profit are consuming the environmental systems that are the basis of public welfare. The conflict between those intent on protecting the environment and those intent on further economic development are becoming increasingly important in public policy discussions and political elections" (1996, 1). He saw his ecological science-based system of placing environmental and economic accounting on a common basis, through emergy analysis, as a solution to the adversarial nature of environmental debates. (He underestimated the power differential that renders science no match for capital, in the absence of external pressure, in policy-making at the national level). By implementing policies promoting the maximization of emergy production, real wealth grows and the public benefits. Rather than internalizing

externalities, Odum saw the task as to "externalize the internalities," valuing the market in ecological terms rather than bringing nature into the economic calculus (Odum and Odum 2000, 21).

Emergy analysis is Odum's method for measuring the ecosystem work, in energy terms, embodied in productive processes (found in human or non-human environmental systems). The term "emergy" is meant to connote "energy memory." Odum and others utilized his embodied energy concept "since 1967…. [For example, it] was used in *Environment, Power and Society* [1971 version]." However, "emergy units were defined in 1983 [the term was suggested by David Scienceman, Odum's collaborator] to clarify the confusion that arose from the use of the same units for both embodied energy and energy…Emergy records the available energy previously used up, expressed in units of one kind but carried as a property of the available energy of continuing outputs" (Odum 2007, 100).

Odum traces the methodological prerequisites for the development of emergy analysis to his earlier work and to other studies of energy in ecosystems in the 1950s. To Odum, by the 1960s, "it became apparent that environmental and economic systems could be evaluated on a common basis" (1996, vii). What he refers to as "preliminary efforts" toward developing a methodology for such an evaluation were published in *Environment, Power and Society* (1971) and *Energy Basis for Man and Nature* (1976). *Environmental Accounting: EMERGY and Environmental Decision Making* (1996) is an important methodological text, a sort of emergy accounting handbook, written after Odum clarified the emergy and transformity concepts through rigorous definition in 1983, which are the essential concepts in his methodology for measuring real wealth

(Odum 1996, 278). *Environmental Accounting* "introduces the EMERGY accounting for evaluation of environmental and economic use" and succinctly defines "EMERGY, a measure of real wealth, [a]s the work previously required to generate a product or service" (vii).

Transformity, one of the "two main rigorous measures" developed by Odum along with emergy, is defined as "the EMERGY of one type required to make a unit of energy of another type" (Odum and Arding 1991, 110, 114). "Because EMERGY evaluation traces what was required for a product back to a common form of energy, it is a way of showing how the requirements for different products compare" (100). It is in the emergy and transformity concepts that Odum sets his method of environmental accounting apart from previous efforts.

Emergy accounting as a distinct method

Emergy is a donor value, a measure opposite to the receiver-oriented "human willingness to pay" expressed in prices (Odum and Arding 1991, 108).[6] Like Marx, whose labor theory of value included assessment of dated inputs of labor time, Odum's emergy analysis looks at past energy inputs required for production (in human society or nature's processes). Indeed Odum suggests that emergy analysis could be seen as putting Marx's labor theory of value on a more scientific footing (Odum and Arding 1991, 109; Odum 1996, 260-61). As Odum himself states, "Many economists were taught that early efforts to find an absolute basis for value failed, often citing Marx's labor theory. As several authors have pointed out, Marx's labor value concept was also a donor-value

[6] Donor value: "A value of a product determined by the production process and not by what a person is willing to pay (examples, mass & energy of wood)" (Odum and Arding 1991, 113).

concept, using hours of labor as the measure of labor power. But what labor can accomplish depends on the EMERGY inputs of the education, the machinery used, and other aspects of labor. EMERGY measures put labor value on a more scientific basis" (Odum and Arding 1991, 109).[7] Odum here is raising issues that have less to do with economic value in the narrow sense, and that relate to the wider material foundations of Marx's value theory, encompassing use value as well as exchange value. Indeed Marx himself recognized the limitations of the labor theory of value (the value form under capitalism) since it didn't incorporate nature's role in the creation of wealth.[8]

Odum's emergy concept especially is indebted to Lotka's proposal of the maximizing power principle as a fourth law of thermodynamics. However, because Lotka did not specify systems principles based on qualities of energy, Odum modified Lotka's statement of this principle by placing "energy of each level on a common basis using the concept 'empower'" to say: "Prevailing systems are those whose designs maximize empower by reinforcing resource intake at the optimum efficiency" (Odum 1996, 26). Systems must operate according to principles dictated by "the universal energy hierarchy" which "provides transformities for quantitatively relating energy on one scale to that of another" (34). In this way, energy quality is expressed in quantitative terms, with energies at different levels in the hierarchy put on equal footing for analysis. Solar emjoules were chosen as the common unit for emergy analysis as a matter of convention (coal emjoules could also have been used, for example). This means that inputs to

---

[7] It is important here to reiterate that Odum does not see emergy analysis as a study of pricing nor does he propose emergy as an alternative method of determining prices.

[8] On Marx's value theory and nature see Paul Burkett's *Marx and Nature* (1999) and *Marxism and Ecological Economics* (2006); John Bellamy Foster's "Marx's Ecological Value Analysis" in *Monthly Review* (2000) and *Marx's Ecology* (2000, 9); and Paul Sweezy's "Marxian Value Theory and Crises" in *The Faltering Economy* (Foster and Szlajfer [1984] 2009, 236-50).

productive systems of quantities of energy of various qualities are converted to the amount of solar energy required to make the type of energy under consideration, with the final quantity expressed in solar emjoules. This allows all the energy inputs in a process, now expressed in a common unit, to be summed. Solar emergy, expressed in solar emjoules, is thus defined as "the available solar energy used up directly or indirectly to make a service or product" (8). "Solar transformity measures position in the energy hierarchy and indicates the appropriate range of effective action" (36).

The formal relationship between emergy and transformity may be expressed as follows:

Emergy (solar emjoules, sej) =Available Energy (J) x Transformity (sej/J)

Odum writes that "the failure to convert each kind of energy into each other kind before adding or comparing energy flows may be the main reason that energy theories of value have been initiated and dropped so many times. We can improve the previous attempts to use energy by multiplying energy-flow data by transformities, thus converting them into EMERGY flows" (Odum 1996, 34). Transformities provide the quantities necessary to express various qualities of energy in common units and sum the total emergy. They also provide the relationship between *energy* and *emergy*, which have different algebras (271).

The process for calculating emergy begins with drawing an energy system diagram for the system under study. Odum suggests that experts on a process gather round a table and list all the elements contributing to the system. For example, if you wanted to calculate the emergy of corn, you would draw an energy system diagram illustrating the inputs required to grow corn under the particular conditions. Their relation

to one another via energy pathways is also indicated via energy systems diagramming notation.

Once the system diagram is completed, each input becomes a line item in an emergy evaluation table. In this table the raw energy data for each line item (found in already existing literature) is multiplied by its previously published or currently calculated transformity (according to method laid out in Odum [1996]), to arrive at the solar emergy of each item. In this way the items may be summed and other indices may be calculated to look at the quantities in relation to one another and to compare systems. Calculations are included in the table according to the needs of the particular study. Emergy per dollar calculations, which are explained with some detail below, are common to relate economic and ecological indicators. The Center for Environmental Policy published emergy calculations for the natural resource base of 134 national economies. This database illustrates a range of useful emergy calculations.[9]

In emergy analysis the issue of the dispersion and degradation of energy are taken into account in both the diagrams used to map energy systems, and via the integration of the notion of energy hierarchy to recognize the qualitative differences between items under analysis. Odum and Arding write that, "the definition often used in elementary physics and engineering courses that energy is the ability to do work is incorrect. Degraded energy can't do any work. The work that potential energy can do depends on its position in the energy hierarchy" (Odum and Arding 1991, 97). Available energy (exergy) is "the potential energy capable of doing work and being degraded in the

[9] http://www.cep.ees.ufl.edu/nead.asp

process" (Odum 1996, 16). Emergy sums all the previous potential energy inputs to the series of energy transformations required to produce any given output of currently available (potential) energy. Exergy, or availability, analyses, which measure available energy (methodology often called process analysis), are thus not as comprehensive as emergy. However, data measuring exergy can be converted to emergy data by multiplying by the correct transformities (268). Higher transformities represent higher levels of previous work required to concentrate the resultant available energy in the system under analysis. The higher the transformity, the lower the efficiency of the system in ecological terms because increasing amounts of nature's work goes into the final product. Emergy is seen as an important improvement on resource accounting currently in use, including ecological footprint and exergy analyses:

> System boundaries in a cradle-to-gate LCA [life-cycle assessment] typically begin with an initial unit process in which a raw material is acquired (e.g., extraction) and include raw materials entering into that process but do not include any information on the environmental processes creating those raw materials. Emergy traces energy inputs back further into the life cycle than any other thermodynamic method, summing life cycle energy inputs using the common denominator of the solar energy that directly and indirectly drives all biosphere processes…This energy could also be conceived as the energy requirements underlying at least some of the ecosystems services used in a process (Zhang et al)…Other thermodynamic models, including exergy, do not include energy requirements underlying environmental processes (Ukidwe and Bakshi). (Ingwersen 2011, 551)

In a festschrift dedicated to Odum's work, Hall (1995) identifies the difference between Odum's analysis and that found in ecological economics (in spite of Odum's initial influence). Ecological economics asks "How can we measure the contributions of nature to the human economy in terms relevant to humans?" while emergy analysis asks

the more comprehensive question, "How can we fit the activities of humans into the grand energy schemes of the world around us, which sooner or later will determine what we do anyway?" (205). In other words, as stated above, emergy analysis seeks to "externalize the internalities"—a task opposite that of much ecological economics. Indeed, the difference between Odum's work, grounded in ecology, and ecological economics as it has developed since Odum's original contributions, which as a whole distanced itself from ecology in favor of economistic approaches, can be seen the treatment of efficiency in the journal, *Ecological Economics*, since its founding issue published in 1989.

A 2006 article published in *Ecological Economics*, analyzed the application of the core concept of "efficiency" in the entire body of work by ecological economists published in the same journal, from volumes 1 to 42. The author of the study found this literature was dominated by economic efficiency concepts and much was "essentially indistinguishable from neoclassical economic analyses" (Jollands 2006, 363). Only 10% of all articles in *Ecological Economics* drew on an ecological theory of efficiency. Moreover:

> Thermodynamic-related efficiency concepts (energy efficiency and recycling efficiency categories in above) were applied in approximately 20% of the articles. However, most of these articles addressed issues of energy efficiency from a thermal- efficiency perspective. Only three articles actually attempted to draw energy quality considerations into the ecological economic literature…Few articles (10%) drew on the ecological theory of efficiency. This is surprising given ecological economics' putative attempt to integrate ecological and economic theory. (Jollands 2006, 363)

The utility of "EMERGY evaluations and designs based on unchanging physical measures" is that they "may provide an efficient and predictable means for achieving public wealth and sustainable economic patterns" (Odum and Arding 1991, 89). Emergy allows us to assess sustainability and measure efficiency in truly ecological terms. In relating economic and ecological processes, it does not subsume the environment in the economy:

> Emergy approximates the work of the environment to replace what is used…The emergy of a resource is the energy required to make it, including work of the environment, and assuming equivalent conditions; this is the energy that it takes to replenish the resource. Sustainability ultimately requires that inputs and outputs to the biosphere or its subsystems balance out…As the only measure that related products to energy inputs into the biosphere required to create them, emergy relates consumption to ultimate limits in the biosphere by quantifying the additional work it would require from nature to replace the consumed resources. (Ingwersen 2011, 551)

Emergy, money and sustainability

Because prices do not capture the environmental impact of production, or reflect the ecosystem processes that form raw materials, another indicator is necessary to measure the natural wealth consumed in various economic processes. Cleveland saw "the counter-current flow of energy and money" as "one of Odum's two most important contributions to biophysical economics, the other being energy quality":

> He [Odum] pointed out that wherever a dollar flow existed in the economy, there was a requirement for an energy flow in the opposite direction. Money is used to buy goods and services, of necessity derived from energy. Each purchase operates through the economy as a feedback, stimulating more energy to [be] drawn from the ground and into the economy to produce additional goods and services. Money circulates in a closed loop, whereas low-entropy energy

> moves in from the outside, is used for economic tasks, and then leaves the economic system as degraded heat. Odum also observed that the large natural energy flows of solar radiation, water, wind, etc. that are essential for life, have no associated dollar flows. The cost of using these energy flows do not, therefore, enter into economic transactions directly, often leading to their misuse or the mismanagement of life-sustaining environmental services. (Cleveland quoted in Brolin [2006], 254)

Odum highlighted the tension between the market valuation of goods and the valuation of goods in ecological terms in his definition of sustainability:

> Sustainability of a development is possible when its EMERGY yield is higher than alternatives AND when EMERGY feedback from the economy goes to the environmental work processes (not to humans) so as to reinforce their ability to compete with alternative ecosystems that tend to displace the ones under environmental loading. When ecosystems, like fisheries, get no feedback or reinforcement, they crash. Environmental use systems are displaced when demand for one species in that system is sustained through a critical juncture, ignoring the entire ecosystem and the environmental system is overloaded. Policy should focus on incentives and regulations for feedback EMERGY reinforcement. Policy should consider EMERGY ratios. (Odum and Arding 1991, 22)

While not proposing emergy as a price/exchange value determinant, Odum did relate emergy to money via several indicators that are used to assess the long-term viability, equity and sustainability of economic processes (like production, extraction and trade). Having a working knowledge of these concepts is essential to understand Odum's analysis of ecological unequal exchange and his study of Ecuador:

- The emergy/Money($) ratio, or total emergy a nation exports per the money received, illustrates how much purchasing power a country has relative to others. A high relative emergy/money ratio means that countries are exporting high levels

of their natural wealth, or emergy, for the money received, and have lower relative purchasing power. "Rural countries have a higher Emergy/dollar ratio because more of their economy involves direct environmental resource inputs not paid for" (Odum and Arding 1991, 18).

- The emergy exchange ratio is the ratio of emergy received for emergy delivered in a trade or sales transaction (Odum provides the of example of a trade of grain for oil). "The area receiving the larger EMERGY receives the larger value and has its economy stimulated more. Raw products such as minerals, rural products, from agriculture, fisheries, and forestry, all tend to have high EMERGY exchange ratios when sold at market price. This is a result of money being paid for human services and not for the extensive work of nature that went into these products" (Odum and Arding 1991, 18). To assess trade between countries or local sales, "the relative benefit is determined from the exchange ratio…A local economy is hurt when the new development takes more EMERGY than it returns in buying power. Keeping the product for home use raises the standard of living of those living at home" (Odum and Arding 1991, 22).
- The emergy/investment ratio is the "ratio of the EMERGY fed back from the economy to the EMERGY inputs from the free environment…This ratio indicates if the process is economical as a utilizer of the economy's investments." To be economical, a process should have a similar ratio to competitors, and the regional investment ratio. "The ratio for an area is set by the state of development of the economy using non-renewable resources" (Odum and Arding 1991, 16). This ratio is used to evaluate foreign direct investment, as well as more localized

investment, and the ratio for projects should not exceed the local ratio if it is to be a net benefit to the local economy:

> Often in the development of environmental resources, early success is followed by over-development, which puts too much purchased EMERGY for the matching environmental input. This wastes economic potential and overloads the environmental resource. The EMERGY investment ratio…is the index for determining the development intensity and the environmental loading. The ratio should not exceed the regional investment ratio if the development is to be part of that economy. (Odum and Arding 1991, 22)

Emergy and ecological unequal exchange

Brolin (2006) writes that "the most advanced modern ecological descendent of Petty's or Cantillon's attempted unidimensional measure of value—in the 'real' as distinct from the 'price' sense—is certainly the 'emergy' concept of Howard T. Odum…which arguably is also the most comprehensive and inclusive estimation tool of ecological unequal exchange" (243). Odum utilized the ratios and indicators described above to assess the benefit of exchange between wealthy and poorer countries. He looked at the net benefit to poor countries of their natural wealth exports and why inequalities persist in international trade. In focusing on the relationship between the U.S. and Ecuador, Odum illustrated that U.S. currency has much higher buying power in Ecuador than in the U.S. This is shown by comparing the emergy/$ ratios of these countries. If the emergy/$ ratios differ greatly between countries, unequal exchange is inevitable because the countries are not equally compensated for the amount of natural wealth they export. The financial relations wherein poor countries borrow money from the wealthy to finance their imports further exacerbate inequalities. For example, because of the difference in the purchasing power of their currencies, expressed in terms of emergy, if Ecuador

borrows money from the U.S. to buy U.S. goods, "3.6 times more buying power is paid back. This is equivalent to an interest rate of 360%. Little wonder," Odum says, "that investments by developed countries in underdeveloped countries have caused financial depression in underdeveloped countries" (Odum and Arding 1991, 37).

Trade also is considered apart from the financial elements. Given the ecological loss involved, and that labor is much cheaper in poor countries, the price paid by the rich countries for what they get in terms of embodied natural wealth and labor is too low to be a benefit to poor countries. Poor countries would be better off using their own resources to benefit the local population rather than selling them off at prices that leave nothing for re-investment at home. Along with the loss to the local population, poor countries are not compensated enough under the current terms of trade to do restorative work ensuring long-term ecosystem survival in areas degraded to supply the export market (Odum and Arding 1991, 37).

While Odum's work is not cast in terms of contemporary sociological analyses of unequal exchange, he does express concern with imperialism and shows the impact of the transfer of wealth, in ecological terms, from poor to wealthy countries. He shows why countries are further impoverished as long as they remain supply depots for the wealthy, and argues that countries should focus on internal development independent of external markets for resources. In doing this, he succeeds in providing evidence for Bunker's point that to better understand how earlier modes of extraction condition current inequalities, and social and economic problems, one must look at the transfer of natural wealth in its own terms, and focus on the relationship between extractive and productive economies. Bunker writes,

> I believe that the unbalanced flows of energy and matter from extractive peripheries to the productive core provide better measures of unequal exchange in a world economic system than do flows of commodities measured in labor or prices. I also believe that the partiality and distortion which an excessive concern with labor creates in development theories underlie the increasingly sterile debate about whether the causes of underdevelopment occur in a world system external to any particular regional economy…or within regionally specific modes of production…. Focusing on the necessary relations between extractive and productive economies permits a solution to this ultimately fruitless debate. (Bunker 1984, 1019)

The method Odum developed makes clear the environment's role in wealth creation, the inequalities and changes over time in trade relationships, as well as the consequences of modern production and trade for the environment. Odum's work has been and can be used to look at issues of urbanization, inequalities between regions, and ecological imperialism. Looking at emergy exports over time, and the inadequate compensation received for this wealth transfer, Devincenzo King (2006), analyzed the ecological debt owed Sub Saharan Africa as a result of cumulative emergy exports that have enriched wealthier countries. According to this analysis, Sub Saharan countries paid off all international debt in emergy terms by the 1970s and should now be allowed to use their resources to develop internally. In emergy terms, the countries are shown to be net creditors, rather than debtors.

Bringing Odum in, answering criticism

Disciplinary boundaries may help explain the lack of application of Odum's work to questions of ecological unequal exchange. It also is possible that criticism and misinterpretation of Odum by scholars have discouraged the adoption of his work in this line of study. Hornborg, a scholar who has explored the question of ecological unequal

exchange, erroneously criticized Odum's work on thermodynamic grounds. (Hornborg expressed preference for exergy analysis over emergy, while claiming Odum didn't deal with the dissipation of energy.) Odum's work, he claimed, was potentially and problematically "normative" whereas neoclassical economics and exergy anayses are "descriptive" (Hornborg 2001, 40-43).

Hornborg declares that the emergy concept "is obviously a metaphysical one" and that "it remains unclear…whether an emergy theory of value proposes to be (1) descriptive, or (2) normative, or (3) both? In other words, does it propose to explain how people actually do evaluate things (as reflected in prices) or how they *ought* to evaluate things?" (Hornborg 2001, 41). Hornborg mistakenly and repeatedly suggests, even in more recent work, that Odum attempted an energetic theory of value to explain market valuation/pricing. He does this while at the same time citing Odum's papers where Odum explains in detail, for those who don't understand his conceptual framework, or its thermodynamic basis, that he is not attempting to analyze market valuation, or replace it with emergy. Odum writes, "some confuse EMERGY concepts with the technocrat movement of the 1930's, which used energy as the basis of value and proposed to pay people with energy certificates in place of money…Technocrats wanted to substitute energy value for money, whereas EMERGY value is not meant to be used for market value, but for larger scale evaluation of the economy" (Odum and Arding 1991, 109).

Even so, Hornborg charges:

> Odum (1971) was influenced by the so-called Technocrat movement led by the above- mentioned M. King Hubbert. He offered an energy theory of value similar to that of the Technocrats, suggesting that *emergy* ('energy memory') – that is, the amount of solar energy spent to produce a given commodity or organism – is an adequate measure of

> economic utility (Odum, 1988). In a paper co-authored with J.E. Arding, Odum used this notion of 'emergy' to argue that trade between nations at different levels of technological development tended to be unequal in terms of net flows of energy (Odum and Arding, 1991). Odum's concepts of 'emergy' and 'embodied energy' are clearly similar to Marx's concept of embodied labor, and both shared the problematic conviction that such past investments (of energy or labor) should be a measure of value.
>
> Odum's attempts to ground economic increases in (exchange) value in thermodynamics can be criticized from the perspective of both economics and thermodynamics (Hornborg, 1998). In physical terms, as Georgescu-Roegen showed, increases in value in a production process correspond to a *decrease* in total energy quality (negentropy, or 'negative entropy', closely related to *exergy).* Accumulation of 'emergy' or 'energy memory' thus represents a dissipation of exergy. The concepts of emergy and exergy, in other words, suggest inverse ways of describing processes of energy transformation. Although a common pitfall, ever since the days of Podolinsky, has been to seek a thermodynamic foundation for an objective measure of value, more 'real' than price (see Hornborg, 1992), such arguments should be abandoned. The driving forces of consumption are cultural, both in general terms and in specifics (Sahlins, 1976). 'Value' must pertain to what human beings perceive, rather than to physics. In fact, it is only by keeping human valuation and physical properties analytically separate that we can reveal the destructive logic of capitalist processes: the more people are willing to pay for a particular product, the faster will be the dissipation of resources required to produce it. (Hornborg 2009, 248)

It is difficult to sort out what is correct from incorrect in this passage. Neither Marx nor Odum believed that labor or energy should be measures of value (or determine prices)--Marx saw labor value as a restricted calculus of economic value under capitalism (which ignored the role of nature); Odum was not concerned with economic value but rather *emergy* (or embodied energy), analyzing processes in ecological terms. The

implication of the above passage that Odum (or Marx for that matter) failed to appreciate the second law of thermodynamics is preposterous. (For a discussion of Marx's treatment of thermodynamics see Burkett and Foster [2006]). The notion that exergy and emergy are "inverse ways" of describing energy effects reflects a gross misunderstanding of these concepts, each of which exist within the same systematic theory.

Hornborg's goal is to "try to show that the relation between energy and value, although of great significance, is better stated in terms diametrically opposite to those of Odum"— although what precisely he means by this is left obscure (Hornborg 2003, 6). This again reveals Hornborg's incorrect assumption that Odum proposes an energetic theory of market value (prices). Because of this faulty conclusion Hornborg sees Odum attempting value analysis that is both descriptive and normative, which means for Hornborg emergy analysis "would seem to amount to nothing less than a way to legitimate, by and large, world market prices as they are" (Hornborg 2001, 40-42). Odum, however, has made it amply clear, even in early work, that "EMERGY value is not meant to be used for market value" (Odum and Arding 1991, 109). This particular issue (whether Odum's work is descriptive or normative), and the solution Hornborg suggests (using exergy analysis rather than emergy), is repeated by Joan Martínez-Alier (2002), who accepts Hornborg's definition of 'the problem' with Odum's work (217-18).

Hornborg's criticism follows a complete misinterpretation of Odum's work and a lack of understanding of the thermodynamic basis of Odum's ecological framework. In fact, Odum's work is not even analyzed in its own words, on its own terms, in these analyses. As indicated in the description of emergy analysis in the previous sections, Odum was not proposing an energy theory of exchange (market) value/prices. Neither

was this great ecologist ignorant of thermodynamic principles. Rather, his entire methodology represents the most comprehensive method of environmental accounting based in ecological principles, including, obviously, the laws of thermodynamics. Odum was one of the leading figures to apply thermodynamics to ecosystem analysis (see Hagen 1992; Golley 1993; Hall 1995; Craige 2001). To point to a failure to recognize the second law of thermodynamics as a shortcoming of his analysis indicates serious lack of knowledge of his thought and method.

This is not a minor issue. While most approaches to ecological unequal exchange have so far come up short in a concrete sense, the argument here is that Odum offers a clear path.

Emergy and Ecuador

Ecuador was chosen as a case-study for analysis given its status as a paradox of a country rich in natural resources with a history of lagging social gains. The following section will interpret EMERGY calculations in terms of an historical analysis of ecological unequal exchange involving Ecuador. Whereas "most ecological 'theories' of unequal exchange have been concerned with environmental accounting rather than theoretical or historical explanation" (Brolin 2006, 6) this work hopes to bring environmental accounting into the ecological rift theoretical framework to offer an alternative and historically specific explanation of Ecuador's "resource curse."

While Odum's report commissioned by the Coastal Resources Center of the University of Rhode Island focused on shrimp mariculture and export from Ecuador to wealthy countries like the U.S., Odum's study also contained emergy analysis of petroleum exports. For Ecuador, he calculated that 74% of Ecuador's annual emergy

exports were oil, and that Ecuador exported fives times as much emergy as it received via imports or payments for exports (Odum and Arding 1991, 24, 32, Table 4, line 9). Without petroleum exports, the total emergy trade deficit would be reduced 92 percent (compare emergy exports in oil on page 24—(+)231.0e20sej/yr— to emergy trade deficit on page 32, Table 4, line 8—(-)252.0e20sej/yr). Major geographical regions supporting Ecuador's economy are the "tropical rain forests of the Amazon Basin, the high Andes with their populations and agriculture and the coastal systems and fisheries. Oil from the Amazon is pumped over the mountains and down to a shipping terminal on the Pacific Ocean for export" (Odum and Arding 1991, 23). This means the Amazon region suffers most as a result of the export of oil.

The enormous emergy trade deficit has to do with the ecological work embodied in petroleum products, the concentration of carbon over millions of years, and the poor compensation received for the export of oil. "The EMERGY/$ ratio of Ecuador in 1986 was 3.6 times that of the U.S. in that year," meaning that one U.S. dollar could purchase several times more oil in Ecuador than in the U.S. Moreover, foreign loans in U.S. dollars create a constant siphon of wealth from the Ecuadorean economy (Odum and Arding 1991, 37). Odum argues that the natural wealth of Ecuador is drained through the mechanisms of international trade and debt to benefit the importing countries: "Energy, minerals, and information are the real wealth. It takes energy to concentrate the minerals needed by an economy. It takes energy to maintain and process information. When resources are abundant and cheap, there can be abundant wealth and a high standard of living. If resources and basic products are imported cheaply, abundant wealth is imported….Countries that sell their energy give away their EMERGY 6 for 1 or worse.

The benefits to countries that buy their fuels depend on the EMERGY ratio of their trade transaction" (89-90, 104). As seen above, the emergy ratio between Ecuador and the U.S. represents a high level of inequality.

As a result of this analysis, Odum concluded "the export of oil and shrimp is very bad for the economy of Ecuador compared to the development that would occur if these products were used internally. Consider the inequality in real wealth of the exchange…and the reasons" (Odum and Arding 1991, 37):

> Because of the export sale of raw fuels, shrimp, and other environmental products, much more EMERGY goes abroad than is received in payment…Five times more EMERGY was sent abroad than received. Ecuador was contributing to the largesse of developed countries, stripping its wealth from its own people, 75% form its non-renewable soils and oil, i.e., its future. Equity might be arranged by balancing the higher EMERGY in the exported shrimp with feedbacks to the shrimp-producing economy in some other products, services, or information. (Odum and Arding 1991, 39)

Ecuador and unequal exchange: A historical problem

Odum's work provides a quantitative and empirical basis for measuring the impact on the Ecuadorean economy of the export of its energy resources and other natural resources, goods and services. He also provides suggestions on how to remedy these imbalances. He advocated emergy analysis be used, rather than traditional economic indicators such as exchange rates and prices, to set economic policy. The tone of the work suggests that politicians, like economists, suffer from an ignorance of the true cost of current policy, and if they just knew, they could adjust the terms of trade to be more beneficial to poor countries. While providing a materialist analysis of trade relations, Odum winds up with an idealist interpretation of how we can reverse these inequities.

The ecological rift theory provides a framework and approach to ecological unequal exchange that puts the situation faced by Ecuador, which Odum studies, into historical context and thus offers a more realist interpretation of why these inequities persist and the real obstacles to overcoming them. Foster, Clark and York (2010) write that "transfers of economic value are shadowed in complex ways by real material-ecological flows that transform ecological relations between town and country, and between nations, especially the core and periphery. Control of such economic and material flows is central to the forces of competition and accumulation of capital, and generates social and environmental inequalities throughout the global economy" (346). They refer to Bunker's earlier work that showed unequal trade relations "negatively affected and undermined the socio-ecological conditions in extractive countries" (347). They also discuss how this influenced contemporary analyses of ecological unequal exchange, which empirically demonstrate that "the environmental footprint of economically advanced nations involves appropriation of land, resources, and labor in lesser-developed countries, increasing environmental degradation in the latter for the benefit of the former" (347). Ecological rift theorists see these trade relations as part of a history of ecological imperialism, "which entails control over natural resources [and] creates asymmetries in the exploitation of the environment and unequal exchange" (347).

Understood in these terms, ecological rift theorists provide a framework connected to broader social theoretical developments looking at the historically specific context of capitalism. This hierarchical and ever-expanding system, which requires natural resource throughput to create products and services for market, recognizes no natural barriers to accumulation. If resources are exhausted in one country, then sights are

set on others. Through early colonial exploits to facilitate capitalist development in Europe and England, "a new division of labor and nature took shape with the development of capitalism as a world system…The process of primitive accumulation established divisions between core and periphery nations, as wealth of distant lands was appropriate through various mechanisms." Today, with a more thorough globalization of the system, "distant lands and ecosystems" more than ever serve as "mere appendages to the growth requirements of the advanced capitalist center" (from the perspective of capital) (Foster, Clark, and York 2010, 349). Ecuador's current economic, ecological and social problems are explained best in the context of this historical division of the world system and current neocolonial relations which make the inequalities analyzed by Odum possible and persistent.

Ancient culture in Ecuador dates back as far back as 10,000 B.C. In the modern era, the Inca ruled over much of Ecuador (since the late 15th century) until the arrival of Francisco Pizarro, Diego de Almargo and their conquistador entourage in 1532. The trickery, hypocrisy, slaughter and disease characterizing European civilization was brought to bear on the indigenous population, and despite consistent resistance, the Spanish declared what is now Ecuador and beyond the property of the Spanish crown. They were searching for gold and other resources, but finding less mineral wealth in Ecuador, land became the crucial commodity, and the encomienda system was introduced. Spanish elites controlled large tracts of land and initiated the long history of unidirectional net wealth export, from Ecuador to Europe and England, as well as their white settler colonies. The impact of the racialized class system imposed by the Spanish, and related patterns of land ownership, persist today in spite of land reform starting in the

1960s and subsequent reforms, including those of the current president, Rafael Correa. Ecuador has experienced several revolutionary periods, replacing one elite with another, while retaining essential features of the race, class and gender system of the colonial period.

Without this hierarchical social development, the discovery of oil in the 1960s in Ecuador, and the intensified neocolonialism that ensued, could not have occurred because western companies would not have had the same access as that which resulted from their deals with Ecuadorean elites, the local comprador class. The U.S., more than any other country in the 20th century, benefitted from the colonial legacy of domination that made the oil-fueled expansion of capitalism possible (Klare 2011): "America's rise to economic and military supremacy was fueled in no small measure by its control over the world's supply of oil." Rather than rest on the laurels of previous colonial powers, "as they became ever more dependent on the extraction of oil in distant lands, American foreign policy began to be reorganized around acquiring and protecting U.S. oil concessions in major producing areas" (Klare 2011).

The role of oil as the main concentrated energy source in the era of capitalist expansion overseen by the U.S. means the discovery of oil in any country almost guarantees U.S. intervention in the form of corrupted local politics, odious debt, and when necessary for the U.S. to have its desired outcome, war and other forms of military intervention or assassination. Ecuador is no exception to this pattern and the discovery of oil sounded the death knell for many indigenous peoples and aspects of Ecuador's diverse ecosystems. As Galeano observed, "The more a product is desired by the world market, the greater the misery it brings to the…peoples whose sacrifice creates it" (quoted in

Foster, Clark, and York 2010, 354). Since oil companies first entered Ecuador, "Vast areas of rainforest have fallen, macaws and jaguars have all but vanished, three Ecuadorian indigenous cultures have been driven to the verge of collapse, and pristine rivers have been transformed into flaming cesspools" (Perkins 2004, xviii). This devastation continues to plague Ecuador, whose area encompasses several regions with some of the greatest biodiversity and cultural diversity in the world. While "Ecuador is only the size of Nevada, it has more than thirty active volcanoes, over 15 percent of the world's birds species, and thousands of as-yet-unclassified plants, and…it is a land of diverse cultures where nearly as many people speak ancient indigenous languages as speak Spanish" (Perkins 2004, xvii).

Branko Milanovic (2005) has shown that Ecuador, which seemed to have economic prospects in the 1960s from the perspective of this world bank economist, has been in economic decline ever since. Oil revenues did not bring wealth to the country, and the people of Ecuador are worse off today, as is their environment. As Perkins writes, "Ecuador is in far worse shape today than she was before we introduced her to the miracle of modern economics, banking, and engineering" (Perkins 2004, xviii, 203). Since the Oil Boom in the 1970s, poverty and public debt have increased exponentially, while the share of resources going to the poor has decline by more than half.

Illustrating the transfer of economic wealth that accompanies the transfer of ecological wealth measured by Odum, Perkins explains in monetary terms what happens to oil profits:

> For every $100 of crude taken out of the Ecuadorian rain forests, the oil companies receive $75. Of the remaining $25, three-quarters must go to paying off the foreign debt. Most of the remainder covers military and other

> government expenses—which leaves about $2.50 for health, education, and programs aimed at helping the poor. Thus, out of every $100 worth of oil torn from the Amazon, less than $3 goes to the people who need the money the most, those whose lives have been so adversely impacted by the dams, the drilling, and the pipelines, and who are dying from lack of edible food and potable water. (2004, xx)

Perhaps most insidious has been the role of finance capital in the baiting and hooking of local elites to play comprador roles in the energy extraction and export game. Favors are provided to local elites so they buy into the plans of U.S. oil companies operating in Ecuador by taking out loans from U.S. banks to hire other U.S. companies to conduct massive works projects in Ecuador, which facilitate oil extraction by building infrastructure free of charge for oil companies. At the same time, these projects represent massive sources of income for U.S. contractors and the banks loaning the money. "In essence, most of the money never leaves the United States; it is simply transferred from banking offices in Washington to engineering offices in New York, Houston, or San Francisco" (Perkins 2004, xvii). Moreover, if successful, "the loans are so large that the debtor is forced to default on its payment after a few years…When this happens, then like the Mafia we demand our pound of flesh" (Perkins 2004, xvii). The countries, like Ecuador, defaulting on these types of odious debts, are pressured to avoid greater economic repercussions by conceding to U.S. demands, for example, for military bases on their land, U.N. votes, or further access to resources.

To enforce control and maintain the ecological and monetary wealth transfer from Ecuador, what Samir Amin ([1978] 2010, 110-11) refers to as the system of imperial rent extraction, the U.S. has intervened in local politics on a regular basis. As a result, Ecuador "suffered under a long line of dictators and right-wing oligarchies manipulated

by U.S. political and commercial interests. In a way, the country was the quintessential banana republic" (Perkins 2004, 141). Shortly after Jamie Roldós–the first democratically elected leader after a long line of dictators—proposed in his inaugral address on August 10, 1979 to assert sovereignty over decision-making regarding natural resource exploitation, he was killed, following his vilification via red-baiting by the media and U.S. officials. The U.S. also has used missionaries and stoked conflict between indigenous groups in Ecuador to make it easier to gain access to lands with oil beneath the surface. No option is off the table when it comes to terrorizing local peoples, destroying communities and the land for the profit of western oil companies.

La encrucijada

The presumed assassination of Roldós remains etched in the minds of social scientists in Latin America analyzing the predicaments and contradictions of the current Ecuadorean presidency of Rafael Correa. Protests in Ecuador, many related to the persistent demands of the population that domestic resources be used to benefit local communities who suffer as a result of Ecuador's extractive political economy, ousted several presidents before the left-leaning economist, Correa, was elected in 2006. Recent articles in Íconos (Ortiz T. 2010; Ortiz 2010), a social science journal based in Ecuador, have focused on the *encrucijada*, or crossroads, confronting the Correa presidency and the anti-neoliberal movement which brought him into power.

Correa has not broken with the hydrocarbon economy and this has put him at odds with the largest indigenous confederation in the region, CONAIE (Confederación de Nacionalidades Indígenas del Ecuador). He also has not broken with neoliberal policies—inspiring protests several times as he attempted to institute austerity measures during

times of crisis. All of these issues highlight the challenges faced by countries like Ecuador, who have local populations demanding sovereignty while the economy remains a captive of the colonial model based on ecological degradation, resource export, and "apartheid on a world scale" (Amin [1978] 2010, 110).

Odum's work provides further evidence in support of indigenous demands for environmental sovereignty and suggests that Correa gambles Ecuador's ecological, economic and social future by continuing to base plans for social development on oil revenues. However, Correa, like the social scientists in the region, remembers Jamie Roldós, and understands the economic embargo against Cuba and other punishments meted out to those seeking to break away from this exploitative system. He also looks to Venezuela, which has used oil revenues to support social programs. Nevertheless, social movements in Ecuador suggest that breaking away from the old model can be done, and they raise the issue of ecological debt as one way forward and away from the false choices of continued exploitation of indigenous lands for oil export or dire poverty.

In focusing on the ecological debt, movements raise the issues of global ecological imperialism, the reconfiguration of global power relations, environmental sovereignty, and redistribution of the blood money represented by oil profits, among others. For the people of Ecuador, this is an existential struggle. For capital, it is the same. Oil companies backed by governments will work against any barriers to access to energy resources, no matter the cost to local people, because economic growth requires ever-greater quantities of fuel. The question is, what power is strong enough to overcome capital?—a necessary step toward healing the ecological rift and redressing the burdens of the long history of oppression. And which side will we all be on? The movements are

waiting to see which direction Correa will turn. Like other social struggles, the outcome of Ecuador's internal and external conflicts will be determined by the "relative power of the combatants." Will oil companies and U.S. diplomats threaten Correa into submission? Will Correa buy into the Venezuelan model, which remains subject to international energy markets? Or will the internal political pressure of peoples who see no net benefit from oil exploitation bring a political shift in the Correa administration? Will the presidency throw its weight behind the struggle for an economy that meets local needs, as determined by local peoples, without mortgaging Ecuador's ecological heritage for short-term gains?

Energy justice: Redressing ecological debt, repairing the rift

Restoring the ecological and social rift requires transcending the system that requires fundamental power imbalances to serve the capital accumulation process. These imbalances manifest themselves in similar, but specific ways around the world because countries have particular histories, geographies and positions in the world system (Amin 1976). The struggle to redress the grievances of this history, and alleviate the burden of contemporary inequalities resulting from energy imperialism, require a confrontation with elites over the issue of debt, especially ecological debt, which Naomi Klein calls the most important "social justice issue of our time" because it marries climate, or broader environmental, and economic justice.

It is no surprise that the debate over ecological debt started in oil-exporting Ecuador. The peoples of Ecuador's Amazon region, which is the subject of the biggest environmental lawsuit in history, are demanding that they be paid to keep oil in the ground in the Yasuní national park and the Amazon region in general. While Correa's

plans seek to retain more oil profits for Ecuadorean development, assuming the anti-imperialist posture Amin proposes as necessary for internal development (Amin [1978] 2010, 110), the ecological debt movement puts forth a much more radical program—challenging the oil-export and exploitation model—forcing attention to ecological and internal indigenous issues, including the persistent racialized class divisions. They also assert that they owe no external debts, and hence do not need oil revenue to service international loans.

As Odum argued, measured in terms of the extraction and export of natural wealth, Ecuador is a net creditor, rather than debtor. Ecuador should be paid to keep oil in the ground for environmental reasons, but also because they are due. Moreover, poor countries in the global South are bearing the brunt of climate change. They are doubly assaulted by the energy regimes of the wealthy, first through the dislocations resulting from extraction, and second through the effects of climate change, which disproportionately affect the poor. The wealthy countries continue to develop at the expense of third world economies, environments and peoples, and a reversal of this trend is necessary to achieve any kind of social or environmental justice. The repayment of ecological debts is one mechanism in the movement toward energy justice, and justice in general.

Escaping the resource curse (as an analysis and as the paradox of development)

A critical sociology of energy must address the issue of energy justice. Systems ecologists' analyses of the inequalities in exchange in terms of natural wealth, brought into the ecological rift framework for understanding the political economic drivers and historical context in which these inequalities developed, provide powerful tools for

understanding current problems and thinking through solutions. The issue of ecological debt may be understood in this context as a mechanism for repairing the global ecological and social rifts. When taking account of the history and context in which energy extraction takes place in Ecuador, the confusion in the mainstream economics literature over the "resource curse" can only be explained by the fact that orthodox economists' training requires they wear blinders to inequalities, history and the relationship between first world growth and third world struggles. They become apologists rather than critics, and hence cannot explain crucial aspects of reality. A critical sociology of energy developed to service the struggle for energy justice may help the movement toward transcending the "resource curse," both as an a-historical mode of analysis, and as a real affliction of regions bearing the brunt of the consequences of the ecological and social rift of capitalism.

CHAPTER IV

THE POLITICAL ECONOMY OF ENERGY JUSTICE IN CUBA

The literature review on Cuba in the following chapter is partially co-authored with Christina Ergas as part of a manuscript we hope to publish later. I am responsible for all of the writing and the research in the rest of the chapter.

The preceding two chapters have attempted to illustrate how a focus on energy justice in sociological and ecological terms provides insight into energy issues. Energy justice necessarily requires that social energy choices reflect a commitment to social equality and inter-generational ecological provisioning. A sociology of energy concerned with energy justice requires attention to the role of energy in social processes that generate inequalities and ecological depredations accumulating as social and ecological debts. Attention also is required to the ways in which ecological change disproportionately burdens the historically oppressed. The research summarized in chapters two and three of this thesis, building on previous critical scholarship, makes clear that both the consequences of business as usual, as well as so-called solutions to energy problems like climate change presented under the current system, are borne unequally. Moreover, rather than work toward truly healing the ecological rift, the system tends to shift the burdens of crises from one ecosystem to another, from region to region, and from one community or nation to the next (Clark and York 2008). The same social groups and regions historically burdened under capitalism are expected to go on paying

the costs of fossil fuel extraction and use as well as those of emerging "alternatives" such as biofuel.

The failure to recognize these social and ecological costs is related to the value system of capital, which conveniently treats the reproductive work of humans and nature as value-less, though it is in the end dependent upon these labors. Moreover, social scientists, especially orthodox economists, retain the assumption of *quid pro quo* in their models of economic exchange with the result that the coercion and plunder of humans and nature remain invisible (Baran and Sweezy 1966, 336). Therefore, social scientists working within this value system have little to offer in the way of explaining our current energy problems, or finding ways out that do not reproduce current energy injustices.

The preceding chapter illustrated the advantages of an energy justice perspective integrating the study of ecological unequal exchange, over more common models for understanding the "resource curse" plaguing Ecuador. Neoclassical economists have treated the case of Ecuador and other resource rich countries that struggle economically and socially as a conundrum given their natural wealth and adherence to the dominant economic model (Collier and Goderis 2007). Adopting such assumptions as "all is for the best in the best of all possible worlds" and "there is no alternative" to the current system, it is difficult for many social scientists today to transcend the dominant model even when empirical reality presents counterfactual data (Baran and Sweezy 1966, 1; Fukuyama 2006). This affects the way countries like Ecuador, whose social welfare has decreased even as it increased its adherence to the dominant model, are understood. But it also leads to the complete inability to explain the opposite phenomena, which is the fact that countries breaking away from the dominant model may have improved social welfare and

equality, even if resource poor. Cuba represents this phenomena in the world today and is explored here as a case study providing rich theoretical insight.

The following chapter explores the way in which the energy justice framework developed previously in this thesis provides insight into the Cuban experience. Lessons are also identified in the history and future of Cuba's energy regime, which allow further theoretical refinement. I first explain Cuba's ongoing significance as an exception to the dominant capitalist model, in social and ecological terms, and as a common referent in the environmental literature. Then I present historical analysis based on my own research and materials gathered in Cuba, the existing scholarship, as well as information drawn from Cubaenergía and the Oficina Nacional de Estadísticas, Cuba's main national energy information and statistics sources. Through this analysis I explain the importance of, and conditions that made possible, Cuba's response to the almost immediate 70% reduction in energy resources forced on the country in the 1990s at the onset of the larger economic depression of the special period. Then I explore the implications of the energy debates and challenges facing Cuba today for understanding the global limitations placed on efforts toward achieving energy justice within the current system.

Cuba's efforts and challenges are significant today for social scientists from wealthy countries mired in orthodox models. Sociologists in this context are confronted primarily with proposals to deal with the dislocations of the current energy regime that reflect the limited experience and imagination of capitalist countries. An alternative vision is necessary and urgent because, as scientists have warned us, business cannot continue as usual. The research is clear that we must reduce energy consumption globally and immediately to avoid irreversible and radical alterations in natural conditions (see

Clark and York 2008 and Magdoff and Foster 2011). But how do we accomplish this at all, or without incurring the ecological and social disaster that a contraction in energy availability (whether externally or internally imposed) implies within this system? These questions require sociologists to engage in the confrontation of "reality with reason to draw the necessary conclusions for conscious action designed to bring about desirable change. And this confrontation inevitably involve[s] comparisons of what [is] with what would be reasonable" (Baran and Sweezy 1966, 134). This is the task of the following pages and provides further grounding for the continuous development of the sociology of energy with energy justice at its core.

Cuba: An exception in the era of austerity and growing inequality worldwide

Scholars and activists interested in the links between ecological and social change study the unprecedented social gains Cuba made since the 1959 revolution as well as Cuba's environmental achievements of the past twenty years. In 2006 Cuba was designated in the World Wildlife Fund's *Living Planet Report* the only sustainable country in the entire world (WWF 2006). In the year 2000 the United Nations set eight Millennium Development Goals aimed at achieving high levels of human development in areas ranging from health and education to gender equality and environmental sustainability. As a result of attention given to these U.N. targets, and the earlier achievements of the Cuban revolution, Cuba has repeatedly been recognized for its long-running high levels of human development, rivaling wealthy countries in many areas, though achieved with a much lower GDP per capita (see, for example, discussions in Cooper, Kennelly, and Orduñez-Garcia 2006; U.N. 2005; UNESCO 2005). Starting in the earliest years of the revolution, the commitment to an egalitarian society made Cuba's

achievements possible and inequalities based on race, gender, and class were greatly reduced (Fleites-Lear 2000; Fuente 2008; Pagés 2008; Argüelles 2010; Prieto and Ruiz 2010). From an energy justice perspective, these social gains indicate greater commitment of resources, including energy, to meet social needs. It also means energy demand for the society as a whole has not been driven by the same factors as found in wealthier countries. Development in general in Cuba has been geared toward other ends.

Many social gains and substantial reductions in inequality were accomplished in the period from the start of the revolution in 1959 up until the economic collapse of the early 1990s associated with the fall of the Soviet Union. While the *special period* resulting from the Soviet disintegration had catastrophic social implications, Cuba's commitment to social spending even in times of crisis (going against what is prescribed in capitalist countries experiencing crises) meant that all was not lost.

In the most recent regional U.N. Human Development report, Cuba ranks in the top five of countries in Latin America and the Caribbean—the only five considered to have achieved a high level of human development (UNDP 2010). Cuba has the lowest GDP per capita in this category, but rivals much wealthier countries in terms of the welfare of its population and ecological protections. Cuba also ranks 7th globally in the Happy Planet report, which indicates that Cubans report a high life satisfaction and life expectancy per ecological footprint relative to other nations (NEF 2009). This is in contrast to the United States, which ranks 114th and Ecuador, which ranks 25th.

This doesn't mean there haven't also been new problems in Cuba the past twenty years, including increasing inequalities associated with reforms intended to spur the economy and provide access to foreign exchange. However, the path Cuba took during

the crisis is unthinkable in almost every other country in the world, where economic crises result in further cuts to social spending, skyrocketing inequality, increased suffering, and an abandonment of ecological change and previous social gains for the poor and disenfranchised. In other words, Cuba put efforts toward protecting people and the environment first, spending its reduced national income on ensuring the welfare of the population through more ecological means. This is unimaginable from the vantage point of the U.S. or Europe today.

As detailed in previous chapters, the dominant economic model is understood as the main driver of ecological depredations associated with energy extraction and use, such as climate change, and the structural determinant of the way the costs and benefits of energy exploitation are distributed. Cuba offers the possibility of exploring the energy regime of a society freed from the sole dominance of capitalist logic internally, though it remains subject to global pressures. Cuba's environmental and social achievements have taken place even while the country has been subject to the longest running economic blockade in world history and repeated military attacks on Cuban soil, both inflicted by the United States (U.S. Department of State 1961-63; Lamrani 2005; U.N. General Assembly 2011). The U.S. imposed the economic embargo beginning in the early 1960s, which is now in effect a multi-lateral blockade. The blockade was a response to Cuba's anti-imperialist policies, including the nationalization of U.S. properties, aimed at ending U.S. domination of Cuba, which was ongoing since the Spanish-American war of 1898. As a result of the embargo, Cuba's relationship with its heretofore largest trading partner ended and new political and trade agreements were negotiated between the Soviet Union

and Cuba to replace the loss of the U.S. market and forestall U.S. attacks on the island nation.

The collapse of the Soviet Union in 1991 led to a Cuban economic catastrophe in the early 1990s as a result of the almost immediate cutoff from food, fuel, and health care supplies, among other necessities. At the height of the crisis, the situation was made worse by a simultaneous tightening of U.S. restrictions on aid and supplies to Cuba under the 1992 Cuban Democracy Act and the Helms-Burton Act signed by president Clinton in 1996. This led to Cuba declaring the 1990s the *special period in time of peace*, because shortages and hardships were similar to the special conditions experienced by populations during times of war, and indeed, the actions of the U.S. are seen by many as war by other means.

As a result of these events, Cuba has experienced a prolonged economic crisis, which is the intent of U.S. policy. The U.S. blockade against Cuba is seen by nearly every country in the world as illegal (Israel is in fact the only country that sides with the U.S. over the Cuba "embargo"). For twenty years the United Nations General Assembly has called for its end. In October of 2011, the Assembly voted 186 to 2 to pass a resolution calling for an end to the U.S. blockade against Cuba (only the U.S. and Israel were pro-embargo and only three countries abstained: Palau, Federated States of Micronesia, and Marshall Island). The blockade is estimated to have cost Cuba over $975 billion dollars and, because humanitarian aid was restricted, caused unnecessary suffering to the Cuban people (U.N. General Assembly 2011).

Under these conditions, Cuba's work toward social and environmental goals is even more remarkable, though the society also has experienced significant losses and

social problems as a result of externally imposed conditions and lingering internal problems. With little national income, and under constant threat, this small country has managed feats that defy the trickle down neoliberal ideology promoted by elites, avoiding the fate of many other poor countries that followed all the traditional economic rules and came out worse for it the past fifty years (Milanovic 2005, 2009, 2011). Economic excuses are always made by wealthy countries to explain why we can't address major humanitarian and ecological issues like climate change and global poverty (see, for example, the behavior of the wealthy countries at the 2011 UN climate conference in Durban). While not claiming it as an energy justice utopia, Cuba, by virtue of its survival alone and moreover as a result of its accomplishments, is an exception to the rules. Therefore, energy developments in Cuba are worth studying in terms of what they tell us about energy developments in a dramatically different socioeconomic context.

Energy justice lessons of the Cuban experience

Seen from the perspective of the ecological rift framework presented earlier in this thesis, the healing of which requires the realization of energy justice, the experiences of Cuba offer several key lessons. The first two are more developed in the existing literature than the last, which I see as my contribution, building on the work of others, toward exploring the lessons of the Cuban experience for efforts to realize energy justice. Energy choices are a limiting factor in social development and also in efforts toward ecological change. Viewing societies through the commitments represented in their energy regime provides keys to understanding the distinct social metabolic order of the society and the extent to which it has transcended the current ecohistorical period characterized by the globalized ecological and social rift.

There is a lesson in energy justice represented in the social and ecological developments Cuba made possible by the re-orientation of its entire economic, broader environmental, and energy regime starting in 1959 to meet human needs more evenly throughout society. This reorientation led to more efficient use of energy resources, and a reduction in energy demand relative to other developing countries in Latin America. It also led to the achievements described above under difficult conditions.

There is also a lesson in how this re-orientation allowed Cuba socially to survive its own version of peak oil and introduce so quickly reforms and educational programs to transform Cuba's food system by applying agro-ecological principles (Altieri 2002; McKibben 2005; Morgan, Murphy, Quinn, and Corner 2006; Wright 2009). This approach allowed Cuba to close energy flows in the agricultural system, reducing the necessity for external, energy-intensive inputs. It also made Cuba more self-sufficient and food secure, which reduced the high-energy demands of long-distance shipping for food and supplies and contributed to the social safety net.

Finally, there are energy justice lessons in the lingering external and internal challenges facing Cuba today. Cuba's energy developments and increased imports from Venezuela are part of the reason Cuba is no longer considered sustainable by the WWF. It lingers around the edges of the 'sustainability sweet spot,' but appears headed further afield. In fact, it is now about even with Ecuador in terms of ecological footprint, even with Ecuador's ongoing petroleum development and export, though of course for the same footprint Cuba still has better social outcomes. Internally, Cuba's energy scientists and environmental activists struggle to assert ecological concerns amid the focus by policy-makers on market reforms and conventional energy developments.

In agriculture, though agroecological principles still dominate, as energy resources are more available and cheaper, there are farmers that look forward to a more energy-intensive model. This is not to say that it is heading in the direction of a country like the U.S., but that the environmental movement there will not necessarily dictate policy in an energy-rich environment. Debates were occurring when I was in Cuba over the introduction of genetically modified crops as well.

Also, inequalities exacerbated by the Soviet collapse, as well as several reforms implemented by the Cuban government in response, have led to the increasingly unequal distribution of wealth and privilege. Cuba made great strides toward equality up until the 1990s, however, lingering inequalities meant the energy crisis burdened some in society much more than others. While the decline in energy resources in itself led to Cuba having a lower ecological footprint, and Cuba's response in the form especially of agroecological transformation meant greater environmental outcomes, this period also revealed energy injustices in the form of these unequally distributed burdens. This is relevant for societies around the world contemplating the need for great reductions in energy use to curb global warming, among other ecological crises associated with the modern energy regime. Also, without a great reduction in energy demand worldwide, resource wars are expected to continue that might impose reduced energy availability in specific countries at different times and further destroy regions afflicted by the energy resource curse. Who will bear the costs of growing energy demand, or the either internally or externally imposed reductions in energy use in our society, which does not even have the social safety net, previous gains in social equality, or relatively strong social solidarity found in Cuba?

As a result of growing inequalities and increased energy availability in Cuba today, some Cubans enjoy more recent energy-intensive developments, such as resorts and the increased import of automobiles and gasoline consumption, while others do not. One person I interviewed was very worried by the fact that there is now smog in Havana and large new cars for wealthier Cubans and tourists bringing with them the diversion of resources to more roads and road maintenance. Health-related illnesses caused by smog are expected to go up, which will further burden the social safety net. These are just a couple of examples of the problems some Cubans identify with the current development plan, which is more energy intensive than before.

In sum, these lessons may be seen in relation to three distinct periods in Cuba's revolutionary energy regime, coinciding with what one scientist called Cuba's three energy revolutions: 1) The revolutionary break with U.S.-dominated oil interests, and the introduction of Soviet energy resources that were part of the complete transformation of Cuba's political economy and society. This period also is characterized by the introduction of the U.S. embargo against Cuba. 2) The introduction of energy, food, and supply shortages with the collapse of the Soviet block in 1991, and the further tightening of what by now was truly a U.S. blockade against the Cuban people. The policies and developments of this period are far and away the most studied in the environmental literature because of the remarkable agroecological achievements during the crisis. 3) The period from the late 1990s and early 2000s to today is characterized by the re-introduction of greater availability of non-renewable energy resources, but also new alternative energy technologies. This is also the period comprising major internal transformations, which will be described below, of which the outcomes are yet unclear.

There are ongoing debates over the future of what I call here, energy justice in Cuba. We can learn from current policy and debates about the possible directions of the Cuban revolution.

The energy regimes of each of the three periods are the result of rapid changes in the availability and sources of energy, and correspond to social changes. The rest of this paper will address these periods and the lessons for sociologists today concerned with better understanding the role of energy justice in broader socio-economic and ecological change. In doing so, following Lewontin and Levins (2007, 344), I don't attempt to simply list achievements and failures, but to answer the question about how Cuba has accomplished what it has, but also, how is it changing?

I went to Cuba because I have lingering and innumberable questions about the relationship between ecological and social transformation, and the role of energy in each of these. It also is difficult to sustain an exchange between Cuba and the U.S. as a result of the U.S. embargo and the politics between the countries, which has seriously hindered academic exchange and made communications very difficult by e-mail, mail, and other means. My original questions were regarding what the (at the time) only sustainable country in the world did about energy. In other words, how does energy fit into the ecological changes in Cuba beyond the impetus for change in the energy supply crisis of the 1990s?

Other questions for which I sought insight in Cuba were: How can energy be used to address issues of inequality and the historical burdens of oppression without destroying the environment? What do recent changes in Cuba's economy and political framework mean for the energy sector and social equality in the country? What can we learn from

the case of Cuba about the complexities of promoting energy justice in an international context? All of these concerns are motivated by the strong conviction that people, and the rest of the biosphere on which we depend, suffer enormously and unnecessarily as things stand. Understanding what it takes to effect conscious change is the goal of the sociology of energy as presented here. My work on Cuba represents the desire for this knowledge and my respect of the Cubans and others throughout the world who have tried to find a better way and have in any way lit the long, winding, and arduous path out of this omnicidal world system.

Data and methods

I worked toward answering the questions listed above by visiting Cuba twice, in the summers of 2009 and 2010, and through further study conducted while home in the U.S. using available scholarship and materials brought from Cuba. My second trip, which was a four-week visit in the summer of 2010, was made possible by the significant assistance of contacts made during my first visit in the summer of 2009. In sum I spent 5.5 weeks in the country. My trips consisted of gathering as much information as possible in my limited time there and seeing as many projects and developments as possible (rather than ethnographic research). These were invaluable as it is notoriously difficult to obtain information about Cuba from the U.S. in particular, as academic and press ties, as well as communications, are mostly severed.

My analysis is based on information gathered through a variety of means. I engaged in participant observation in a major environmental conference in Havana in July of 2011, where delegates from all over Cuba who work on environmental issues presented papers and engaged in discussion and debate. Along with Cubans, there were

many representatives from Latin American and Caribbean countries, as well as countries around the world. My second trip was scheduled so that I could attend this conference, the eighth Convención Internacional sobre Medioambiente y Desarollo (International Convention on the Environment and Development) with this year's theme being: Por el Respeto y los Derechos de Nuestra Tierra (For the Respect and Rights of Our Earth). The conference, organized primarily by Cuba's Ministry of Science, Technology, and Environment was also supported by other internal Cuban organizations and international organizations like the United Nations and the World Wildlife Fund. The meetings were the sight of the UN's initiation of the decade on biodiversity in the Caribbean with a speech delivered by the UN secretary of the convention on biodiversity (which the U.S. has not signed).

At the conference I went to meetings primarily focused on climate change, Cuba's energy and general environmental policies and projects, and international cooperation and environmental justice. It was an opportunity to hear from Cubans who live and work all over the country about the environmental projects in which they are engaged. I also learned how environmental concerns are woven into other activities, such as into the educational curriculum, rural medical programs, in housing projects, etc. This was a chance to hear about energy developments in Bolívia, Mexico, Haiti, Brazil, Peru, Ecuador, and other countries. I learned so much in such a short amount of time as a result of listening to the dialogue and the debates between representatives within and between countries, as well as information about their cooperative environmental projects across national borders. Many meetings were also real planning meetings and it was interesting

to hear the priorities and interests people had in working out goals and practical steps for environmental work in the future.

My participation in this context was primarily in asking follow-up questions after the most relevant of the twelve meetings I attended in the five days of the conference and near constant informal conversations with other participants between meetings. Some of these conversations led to new contacts for ongoing exchange of information, ideas, friendship and perhaps future visits between countries. I also obtained materials provided by presenters and environmental organizations in Cuba that had booths at the conference. These materials are a wealth of information on their own.

Outside of this conference, during the remainder of my trip, I attended the presentations of workers, ministers, scholars, and activists involved in efforts focused on energy, agriculture, conservation, and the economy and trade at locations around the city of Havana and in smaller towns and environmental projects in the rural Pinar del Río Province. These events were organized separately from the main conference. I was invited to attend thanks to the help of contacts in Cuba and the U.S. During the remainder of my trip I attended the primary televised forum for intellectual debate organized by *Temas*, a Cuban scholarly journal. I also visited for the second time the Fundación Antonio Núñez Jiménez de la Naturaleza y el Hombre (the Antonio Núñez Jiménez Foundation for Nature and Humanity) and Cubaenergía (an important governmental organization employing energy scientists, involved in public education regarding energy and advising the government on energy policy).

Through these presentations and visits, and through contacts made on my previous trip in 2009, I was able to interview with special depth five people who basically

gave me all the time I could possibly need. I focused on securing longer interviews with these people in particular because they had years of experience working within the energy sector in Cuba, or were otherwise environmental activists or working in relevant sectors. With these key interviews I was able to ask all of the questions that I had left after over two dozen less formal conversations with Cubans attending and presenting at the large environmental conference and working in various projects in the city and in the rural Pinar del Río Province. These interviewees and the less formal conversations that I had shed further light on recent and upcoming changes that will affect the energy sector and socioeconomic developments in Cuba. They also taught me a lot about the environmental movement in Cuba. The findings of these interviews are presented primarily in the section below on Cuba's third energy revolution. They also informed my understanding of Cuba's first and second energy revolutions, though my sections below covering these periods are based on other data, academic work, and other sources on Cuba.

In preparation for my work in Cuba, I studied Spanish formally for five quarters in classes at the University of Oregon. While this is obviously an insufficient amount of time to master the language, the skills I acquired allow me to read materials in Spanish at a fair level and get by in conversation in Cuba. When this was insufficient, I utilized the services of translators. I also applied for and won funds through my home department and the University of Oregon College of Arts and Sciences, which allowed me to complete my research in Cuba, in particular the second trip. Global Exchange also supported my trips financially and logistically. Finally, I applied for and received permission from the

Research Compliance Services office, which includes oversight of the protection of human subjects, to conduct my research in Cuba.

What I learned about Cuba's energy and social developments are, in my view, best told through historical narrative, drawing from all my studies and research trips. Told in this way, the co-evolution of Cuban social, energy, and environmental practices within the evolving revolutionary process, and the energy justice lessons, are most clear.

Cuba's first energy revolution, social equality, and the environment

One of Cuba's foremost energy scientists and environmental activists explained to me that Cuba has had three energy revolutions since the 1959 ousting of Batista. This periodization of socioeconomic and energy development reflects pivotal events in Cuba's history. In all societies, entire patterns of social development are shaped by the availability and final uses of energy (Rosa, Machlis, and Keating 1988). In Cuba, transformations in energy use are connected to dramatic social changes. The following pages will explain these three energy revolutions in social, economic, and ecological terms, putting current changes and debates in Cuba in historical context.

The pre-revolutionary Cuban economy was dominated by the United States starting in 1898, when the Treaty of Paris ceded Cuba, formerly a Spanish possession, to the U.S. From this time on, the island nation suffered under a model neocolonial relationship with the U.S., with major sectors of the economy and the political machinery controlled by foreign direct investment and management. Cuba, from the first landing of Columbus to the invasion of U.S. entrepreneurs and multi-national conglomerates, was the sight of extraordinary excesses and offshore corruption. As one Cuban writer put it, whose letter was published in C. Wright Mills's *Listen, Yankee* (1960), "if we Cubans

have ‘gone to extremes,’ know this: so have you Yankees…Our country, our Cuba, it *was* simply an economic colony of the U.S. monopolies until our revolution” (25). U.S. developments on the island led to a colonial-style Las Vegas, where everything went, as long as you were white. Money could buy anything in Cuba during this period and hotels and casinos were built alongside brothels and abortion mills primarily for the benefit of wealthy U.S. and European tourists, along with Cuban elites. The country was so racially segregated that even the U.S.-backed dictator, Batista, because he was not white enough (though he was light-skinned), was not allowed to join Havana’s yacht club.

U.S. banks, oil and mining companies, and sugar and fruit companies made millions during the pre-revolutionary period. Economic development was highly successful (from the perspective of elites). It was so successful, in fact, that Cuba became one of the very richest countries in Latin America. Havana was the fourth most expensive city in the entire world by the 1950s. Needless to say, this wealth was highly concentrated at the top, and the kind of development promoted by U.S. interests was export-oriented, dependent, and led to the suppression of wages of local workers, high unemployment, and high inflation. The spending habits of the rich, and the trade agreements made with U.S. companies to supply basic commodities at prices too high for the local market, contributed to these developments. By the 1950s Cuban per capita income for workers was one third of that found in Mississippi, the poorest state in the U.S. at the time, but Cubans were expected to pay U.S. prices to meet basic needs (Wolfe 2010).

During this period, oil was imported primarily from Venezuela and also the U.S. to meet development demands. Refineries on the island controlled by U.S. oil companies,

such as Esso, Standard Oil, and Texaco, and the Dutch Shell, were major sources of revenue. After the revolution, all of this changed. Revolutionary reforms in the country starting immediately in 1959, including nationalization of key industries, were geared toward re-orienting the Cuban economy to end U.S. control and benefit all Cubans. An important early reform of the Cuban government was the agrarian reform law, aspects of which the U.S. agreed upon initially, that redistributed all holdings over one thousand acres to peasants and workers and prohibited foreign ownership of Cuban land (which previously covered seventy-five percent of Cuba's most fertile soil). Cuba came to purchase agreements of foreign owned lands with other countries but not the United States. Cuba also nationalized the main telephone company, and immediately lowered rates as they also did for rents. The response, especially to land reform, in the U.S. was the reduction in the sugar quotas setting the amount of sugar imported from Cuba. Covert operations against Cuba and to assassinate Castro commence during this period (summer of 1959).

In January 1960 Cuba expropriated lands held by United Fruit Company, which refused to sell to the Cuban government. U.S. attacks began on sugarcane fields and the oil refineries owned by the Cuban government, among other key sites. Cuba establishes relations with the Soviet Union in the spring of that year as U.S. covert military and more open economic attacks from the U.S. begin in force. Embargoes are placed by the United States on oil, guns, and sugar and the U.S. begins issuing propaganda against the new government. The Cuban government then entered a trade agreement with the Soviet led Council for Mutual Economic Assistance (CMEA), receiving crude oil in exchange for sugar, among other barter and preferential trade arrangements. The importation of oil

from the Soviet Union, in particular, meant "'the position of strength' from which the oil companies have traditionally operated… completely crumbled" (Huberman and Sweezy 1961, 168). A private oil embargo imposed by U.S. oil companies could no longer cripple the Cuban economy as it had in other countries in the past. Their last foothold was their refineries.

"Early in June 1960, the three big oil companies which had long dominated the Cuban oil market (Jersey Standard, Texaco, and Shell) flatly refused to refine the Soviet oil which was about to be imported by the government with the terms of the Soviet-Cuban trade agreement of the preceding February" (Huberman and Sweezy 1961, 179). This "was a direct challenge to the authority of the [Cuban] government: failure to meet it head on would have meant the end of the Cuban revolution then and there" (179). Within a month Cuba responded by nationalizing the refineries and the properties of U.S. monopolies and other "big businesses" in rubber, cigars and cigarettes, banks, etc. (Núñez Jiménez 1961, 419; Huberman and Sweezy 1961, 181). The U.S. eliminated all remaining sugar quotas and initiated a broader embargo against Cuba (and covertly began plans for invasion). "The Cubans had enough ammunition left for one more big counter blow: on the 25th of October, 166 American-owned companies were nationalized" (Huberman and Sweezy 1961, 181). "This act, said the *New York Times* the next day, 'virtually eliminated major investments of Unites States citizens in Cuba" (181). And Cuba now had external support to counter U.S. attacks. "A round of sharp blows and counter blows thus ended with Cuba the clear winner" (179).

During this period Cuba's revolution was radicalized and went from assuming that private enterprise "would remain quantitatively dominant" to the realization that to

actually have the economy work for the Cuban people it had to be controlled by the Cuban people (Huberman and Sweezy 1961, 184). Covert and overt attacks on the Cuban economy, cities, and land, also indicated that the U.S. was determined to maintain neo-colonial relations with Cuba. It was during the Bay of Pigs in 1961, a failed but bloody attempt of the Eisenhower and Kennedy administrations to reinstate the exiled Cuban elites, known in Cuba as the Playa Girón invasion, that the Cuban revolution declared itself officially socialist.

These events are referred to as constituting the first Cuban energy revolution. It was a revolution in the terms under which Cuba was supplied oil, and a revolution in the ends toward which energy exploitation were directed. Soviet support was crucial as Cuba asserted sovereignty in the face of U.S. attack, but also resulted in a modified form of dependency. However, this did not result in Cuba's loss of sovereignty to the USSR, as had the former relationship with the U.S. where economic dependency and political domination were intertwined. The relationship with the Soviet Union allowed the continuation of energy-intensive and environmentally unfriendly development, but the new drivers of energy demand mitigated the level of energy consumption. Because social programs and reforms took center-stage over flashy development and conspicuous consumption, energy demand grew at a slower rate in Cuba than almost any other Latin American country.

Post-WWII economic exuberance led to the intensified growth of electricity and fuel consumption in wealthy and developing countries. This followed the usual pattern wherein economic growth leads to increased energy consumption (Pérez-López 1981, 122-23). However, studies conducted on planned economies in the 1950s and 60s showed

no statistical relationship between economic output and growth in energy consumption (123). In contrast to most of the hemisphere, in Cuba the rate of growth of energy demand immediately slowed after the revolution. Per capita growth in energy consumption during the first two decades of the revolution were the second lowest in all of Latin America next to Chile (120-22). This is even with lowered utility rates, rural electrification programs, and the growth in public housing projects (128). Early initiatives took place to curb household energy consumption and change the mix of energy resources used in the home (127). The government sent out educators to teach residents how to curb wasteful energy use in homes. Energy efficiency and conservation efforts in industry were also started in the early 1970s (130).

These efforts were intertwined with a growing ecological consciousness in Cuba amongst a minority of scientists, educators, students, farmers, and community activists. The unity of ecological and social concerns are reflected in some of the energy policies described above, but also in a series of environmental reforms and practices that occurred starting in the 1960s. The experiments in agroecology and significant overhaul of the environmental regulatory system, which paved the way for Cuba's famous agroecologcial reforms in the 1990s, actually began in the early years of the revolution. Cuban scientists in the 1970s started advocating shifts away from input-intensive farming. In the 1980s the Cuban Academy of Sciences was commissioned to make a plan for "the organization, structure, and operation of a new environmental regulatory system," which was implemented in 1990 (Whittle and Rey Santos 2006, 78). An overview of this history is provided in Lewontin and Levins (2007, 355-56).

This style of development did not make Cubans rich, but all the dynamics of inequality were transformed during this period, though there were environmental costs even if they were less than in other development cases. From the earliest period of the revolution, Cuba made great strides towards getting rid of most forms of institutional inequality, equalizing access to resources, and increasing political participation by traditionally oppressed sectors of Cuban society. This was an all out attack on the social rift and relations of capitalism. The revolutionary government established rights to health care, education, food, housing, etc. Thus, the first energy revolution was tied to a focus on efficiency in the energy regime as part of overall efforts to direct resources toward social development, and avoid the wanton resource wastefulness of the previous neocolonial period. In this way, the energy regime of the new revolution was marshaled in efforts break down societal divisions, especially improving the lives of the poor, women, and people of color in Cuba. Two significant areas of social change are described below.

The Federación de Mujeres Cubanas, or Federation of Cuban Women (FMC), was founded in 1960 to implement changes necessary to meet women's needs and work toward gender equality. In 1961, the FMC began literacy campaigns that led to an almost 100% literacy rate. New laws in Cuba included the 1975 Family Code that mandates that men share equally in household responsibilities and guarantees women and men rights to their respective properties before and after marriage. The 1976 Constitution intended to ensure that "women enjoy the same rights as men." Practical needs that were emphasized included women's access to safe health care, contraception, and free abortion, free and subsidized childcare, education, jobs, maternity leave, divorce, literacy campaigns,

reeducation programs for sex-workers and domestic servants, and help from men in household chores. The Federation of Cuban Women has worked to ensure advances in women's employment, inclusion in leadership positions, and the extension of women's legal and political rights.

For Afro-Cubans the gains were similar. By 1981, life expectancy was virtually the same amongst white, black, and multiracial populations. There was only a year difference between the white and black populations compared to the over six years gap found at the same time between whites and blacks in the U.S. and Brazil, for example (De la Fuente 2008, 316). Illiteracy was eliminated on the island right away following the revolution and by the 1980s "inequality in education had disappeared all the way up to the university level (316). The proportion of black and multiracial students graduating from highschool was even higher than whites. These educational gains were reflected in the occupational structure. While there were some areas of the economy where Cubans of color were underrepresented, "the index of dissimilarity (a summary measure of inequality) in the Cuban labor market was in the early 1980s three to four times lower than in the United States or Brazil" (317). The main areas where black and multiracial Cubans remained underrepresented were in managerial positions and in political leadership, which is "an area in which the Cuban government is frequently criticized," though these inequalities declined in the first three decades of the revolution as well (317).

Given the real material gains, unimaginable in the divided-and-conquered capitalist world, and the ideology of the revolution, which deemed racism and sexism as problems solved or divisive topics, inequality disappeared in public debate (Prieto and

Ruiz 2010, 164). However, in 1985, the Third Congress of the Communist Party of Cuba discussed the fact that women and Afro-Cubans remained underrepresented in leadership positions. The Congress established affirmative action like policies to remedy this problem (164). Upon further review, the state acknowledged that even further measures were needed to achieve equality. However, soon after this public re-orientation toward race and gender specific policies, the Soviet Union and CMEA collapsed, putting the Cuban economy in jeopardy almost overnight, initiating a shocking energy crisis. Projects to increase equality in Cuba, like building homes for people in dilapidated housing and daycare centers so women could work more easily, came to a halt.

While the *special period* resulted in the initiation of a process of ecological restoration in response to the collapse of the energy supply and other imports, it also revealed the lingering social divisions described above. These conditioned the distribution of burdens during the energy crisis. The exacerbation of inequality during the *special period* represents ongoing challenges for Cuban activists and others around the world seeking to heal the metabolic and social rift of modern society.

The *special period* and the greening of the revolution

As noted previously, the fall of the Soviet Union and the Council for Mutual Economic Assistance (CMEA), resulted in a sharp and immediate loss of crucial supplies and Cuba's export market. Eighty percent of Cuba's trade was conducted within this trading bloc and therefore its dissolution initiated a profound depression for the entire Cuban economy (Pérez, López, and Berdellans 2005, 298). One of the most significant changes for the economy, society, and environment, was the loss of energy imports amounting to nearly three-fourths of Cuba's energy supply for fuel and electricity. This

initiated the second energy revolution in Cuba, characterized primarily by major shifts resulting from the decline in oil imports, including Cuba's return to animal traction and human labor as primary sources of energy, and other forms of adaptation.

Along with everything else, Cuba was cut off from access to many of the essential ingredients of input-intensive industrial agriculture and its export market. These events led to the collapse of Cuba's sugar industry, which was one of Cuba's economic mainstays since the introduction of monocrop agriculture for export with the colonial *latifundia* system. Because agriculture remained geared toward export after the revolution and Cuba was dependent on the CMEA for food imports and agricultural inputs, the crisis exposed Cuba's persistent dependence. Coupled with the effects of the U.S. embargo, which cruelly was tightened during the special period in 1992 and again in 1996 (McKibben 2005), the consequences for the Cuban people were by all accounts traumatizing: "Daily per-capita intake fell from 2,908 in 1989 to 1,863 calories in 1995…and protein intake dropped by 40 percent. Some estimated that the average Cuban lost 20 pounds by 1994" (Sinclair and Thompson 2008, 156). Nearly everyone I spoke with in Cuba that is old enough remembers a repetitive menu of sugar water for breakfast, if not other meals as well, and black bean soup made only with beans, water, and some salt.

This crisis provided environmentally oriented scientists and activists in Cuba a new opening in the early 1990s, allowing "ecologists by conviction to recruit ecologists by necessity" (Lewontin and Levins 2007, 367). This is the period when agrarian reforms and urban agriculture really took off. These reforms helped prevent complete destitution in Cuban society, building a more sustainable safety net based on increased food security

and providing jobs working the land. They were possible, in part, because of the previous level of development of Cuban's environmental knowledge and environmental reforms, and the general level of education, oriented toward social goals, throughout Cuba's population. Because of this orientation, the entire educational and scientific apparatus could be reorganized under the circumstances to train Cubans in new farming methods, non-conventional energy development, and ecology. Energy scientists were already concerned with efficiency and self-sufficiency to divert more resources to social programs and reduce dependency. Many also were wary of nuclear developments, which started with the U.S. and continued with the Soviet Union, but were halted during the crisis. The crisis thus helped what we might now call Cuba's environmental movement make the case that ecological, economic, and social priorities could and should be considered as one and the same thing. It also produced an immediate incentive for change because the survival of the revolution was at stake.

One of Cuba's most remarkable responses to the energy crisis was their move toward the transformation and decentralization of the food and agricultural system according to less energy intensive agroecological principles. This allowed the development of a sustainable relation to the soil on which Cuba was now much more dependent for survival. As a result of these changes, which enhanced food security and self-sufficiency, Cuba is now considered a world leader in organic agriculture and permaculture. Accordingly, social scientists and activists have focused more papers on the virtues of Cuban agriculture than almost any other aspect of the "greening of the revolution" (Rosset and Benjamin, 1994; Rosset and Cunningham 1994; Rosset 1999, 2000; Altieri 2002; Funes and Pasture Forage Institute 2002; Morgan et al. 2006; Clausen

2007; Raby 2009; Stricker 2010; Koont 2009, 2011; Bell 2012; Altieri and Funes-Monzote 2012). Rather than give in to U.S. demands for the liberalization of the Cuban economy, and the restoration to power of Cuba's former plutocrats, Cuba survived it's own version of peak oil by focusing on the social safety net and ecological change. The major agroecological changes that were implemented allowed Cuba to close energy flows in the agricultural system, reducing the necessity for external, energy-intensive inputs. (Altieri 2002; McKibben 2005; Morgan et al. 2006; Wright 2009). Because the energy regime and agricultural system of any society are inevitably linked, understanding changes in Cuban agriculture is an important starting place for a discussion of the role of energy in Cuba's social metabolic order. Their development of de-centralized, more self-sufficient, and less energy intensive farming methods are important to consider in an era where climate change and unaffordable food are linked in the nexus between the global energy and agricultural markets (Ho 2008; Holleman 2012).

Cuba's efforts toward developing organic urban agriculture are especially well documented. These efforts are bound with social changes of the era, some of which decentralized control of land and made possible new patterns of ownership and incentives for people to engage in agricultural labor. Urban agriculture in the form of urban gardens, reforestation projects, and animal husbandry utilizes about 87,000 acres within and around Havana (Koont 2009; Raby 2009). Today these urban gardens, or *organopónicos*, "supply 70 percent or more of all the fresh vegetables consumed in cities such as Havana and Villa Clara" (Altieri and Funes-Monzote 2012). Many scholars have noted the significance of this achievement for the human health and environmental well being of Cuban city dwellers, as well as the major reduction in energy use and wastes associated

with the total dependence on long-distance transportation of food typically required for cities (Companioni et al 2002; Levins 2005; Premat 2005; Clausen 2007).

The urban farms are the product of the state's formalization of the right of urban residents to claim abandoned lots and sell produce. "All urban residents can claim up to one-third of an acre of vacant land, as long as they abide by the rules of all organic farming methods" (Clausen 2007, 49).

Rural reforms beginning in the 1990s complemented the development of urban agriculture and initiated a new social relation, a reconnection of labor, to the land as more people who had worked in cities or other jobs now saw agriculture as a more attractive option (Clausen 2007, 48). In 1993 the Cuban government passed reform allowing *campesinos* to own and manage cooperatives that replaced large-scale, state-owned industrial farms. Three times as many of these former plantations were devoted to sugarcane than food crops prior to these special period reforms (47). "The new programs transformed 41.2 percent of state farm land into 2,007 new cooperatives, with members totaling 122,000 people" (48). Additionally, "the Cuban government has turned over approximately 170,000 hectares of land to private farmers. The government retains title to the land [which is worked under principles of usufruct], however the private farmers receive free rent indefinitely, as well as subsidized equipment" (48). Today "the new farmers tend to be adults with young families (many with college education), early retirees, or workers with a farming background" (48).

Farmers are aided by teams of agronomists who are stationed around the country to answer questions and help solve problems as they arise, using ecological principles geared toward long-term sustainability of the soil. Rural farms in Cuba employ a

combination of organic, permaculture, and conventional farming methods, which mainly are represented in the selective use of pesticides and fertilizers. Animal traction is frequently relied upon for plowing and new plows were invented to prevent topsoil erosion. As a result of the education of farmers and the replacement of heavy machinery with oxen, soil compaction in Cuba has given way to fertile, loamy soil (McKibben 2005). All of this is made possible because the agricultural revolution was backed by a complete reorientation of science and education. In Cuba, where production is geared toward meeting needs as efficiently as possible, education, science, and technology have developed with the same goals. Unlike the U.S., where chemistry dominates over ecology in agricultural studies, during the *special period* Cuba's agronomists focused on how to transition away from the fossil-fuel and chemical intensive mono-cropping of its past.

Along with the environmental and social benefits of Cuba's response to the crisis through agricultural reform, these changes led to Cuba outpacing all other Latin American countries in increases in agricultural productivity. Cubans now have the highest average daily supply of calories in all of Latin America. "No other country in the world has achieved this level of success with a form of agriculture that uses the ecological services of biodiversity and reduces food miles, energy use, and effectively closes local production and consumption cycles" (Altieri and Funes-Monzote 2012). Urban agriculture, combined with the transformation of Cuba's countryside, has demonstrated possibilities in modern society for restoring "the spatial relations of physical processes regulating nutrient cycling" (43) and closing the energy cycle of the food system. This is a key component of transcending the ecological rift, which disrupted the soil nutrient and carbon cycle by separating "humans, livestock, and crops,"

generating the enormous wastes of fossil-fuel dependence in agricultural systems, through the now globalized spatial divide between town and country (43). With Cuba's efforts in the countryside and cities Cuba has made great strides towards food security, food sovereignty, and a more sustainable social metabolism (Clausen 2007; Haranandani 2010; Koont 2011).[10] While today Cuba is still more dependent on food imports than it would like, it "may be the world's largest working model of a semi-sustainable agriculture, one that doesn't rely nearly as heavily as the rest of the world does on oil, on chemicals, on shipping vast quantities of food back and forth" (McKibben 2005).

Scholars trace Cuba's ability to undergo such transformations in a time of crisis to "roots in a complex history of colonial science, anti-imperialism, the emergence of a self-conscious community of ecologists, and the transformations of Cuban society since 1959" (Lewontin and Levins 2007, 343). Moreover, social scientists (e.g. Rosset 2000; Koont 2011) recognize that this makes the Cuban response to crisis unfortunately unique in the world today:

> In policy debates worldwide, economic development and environmental protection are often pitted against each other and miscast as incompatible goals; it is particularly rare for governments anywhere to propose, adopt, or enforce

---

[10] According to the Food and Agriculture Organization (FAO) of the United Nations (1996), "food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." Food sovereignty means:

> The right of each people to define their own policies concerning agriculture, to protect and regulate their national agricultural production and markets with the aim of sustainable development, to decide to what extent they want to be self-sufficient in food, and to prevent their domestic markets from being inundated with subsidized products from other countries. The emphasis is on local, ecologically sustainable production of culturally appropriate, wholesome, and nutritive foods. Thus conceived, food sovereignty incorporates the concept of food security (adequate food supplies to meet the population's needs) and even overlaps with national security. (Koont 2011, 187)

> stricter environmental requirements during a time of economic crisis. (Whittle and Rey Santos 2006, 77)

This is not to say Cuba's response to the twin crises of the blockade and collapse of trade has been perfect, or there are no contradictions or challenges. While in Cuba, I never met one Cuban that made this claim, or who saw the current state of affairs as satisfactory. But Cuba is unique and provides lessons for the entire world that now is experiencing global economic and ecological crises and being told that we cannot afford to deal with either in humane or ecological terms.

Along with ecologically oriented reforms that occurred in Cuba during the *special period*, economic reforms were passed to spur the economy. These did not bring equally distributed benefits. Like crises everywhere, the *special period* really put Cuba to the test and the country survived, though not unscathed. While there were enormous environmental benefits to imposed energy scarcity and agrarian reform, contradictions remaining in the revolution were brought to the surface, especially remaining social inequalities, external dependence, and an unsustainable development model.

The previous gains of the revolution were the necessary groundwork for survival and solidarity during Cuba's experience with peak oil. This is an important lesson, but it is also an important lesson that a consequence peak oil in Cuba was growing inequality, which in some instances has been exacerbated by reforms. Moreover, two acts by the U.S. congress, in 1992 and 1996, stiffened the embargo, making it nearly impossible for Cuba to receive food aid, medicine, and other necessities. This further challenged Cuba's survival of peak oil, especially in social terms.

In the 1990s social inequalities based on gender, race, and class, widened. In 1953, Cuba's Gini coefficient, a measure of inequality, was .56.[11] By 1986 it had decreased to .22 (with 0 indicating a completely egalitarian society). But between 1996-1998, the coefficient increased to .38, though Cuba was still ranked lowest in Latin America (Argüelles 2010, 114). Before the 1990s, poverty was believed eradicated. But commencing with the Soviet collapse in 1991 "the issue of poverty has reemerged" (IAEA 2008, 53). While poverty is different in Cuba than that found in other countries in Latin America and the Caribbean, 20% of the Cuban population was considered "at risk," without sufficient access to food and necessities still in 1999. "A major share of this population also had no access to electricity and used non-commercial energy to meet their minimum energy requirements" (53). This is in spite of the economic recovery that began in the late 1990s and the increase in available energy resources.

Just as there are persistent debates over energy policy in Cuba, socioeconomic reforms are also contested. For policy-makers, liberalization of the economy has been the key to overcoming the crisis that started in the 1990s. During the *special period* Cuba opened up the economy to foreign tourism, allowed circulation of the dollar, and instituted a dual currency system. Additional market mechanisms, such as legalizing small private businesses, were also established. Many of the reforms that began in the *special period*, and the crisis itself, which is dramatically shaped by the U.S. blockade, have led to a stratified Cuba.

---

[11] "The Gini coefficient is an indicator employed traditionally to measure income inequality for a group of people. It ranges from zero (reflecting perfect equality in which everyone has the same income) and one (a value that describes the extreme hypothetical case in which just one person possesses all the income). In other words, the higher the Gini value, the greater the prevailing income inequality…The Gini index is the same Gini coefficient but expressed as a percentage" (UNDP 2010).

Increased inequalities in Cuba fall along lines of race and gender, as well as class. For example, Afro-Cubans are most likely to occupy dilapidated housing. The Ethnology Department at the Anthropology Center in the Cuban Ministry of Science, Technology, and the Environment found that present day racial inequalities in Cuba manifest themselves through remnants of historical structures and interpersonal discrimination. In urban areas, blacks and multiracial Cubans inhabit the more depressed neighborhoods while white Cubans inhabit the more desirable residential neighborhoods (Prieto and Ruiz 2010). In one case, the Carraguao neighborhood of Havana, 50% of tenement residents are black or multiracial and live in poor quality dwellings. This suggests that people of color disproportionately experience class-based economic difficulty and worse living conditions (165).

The legalization of small businesses during the *special period* operated out of houses, like paladares (restaurants) and casas particulares (bed and breakfasts), was one reform that spurred the economy, but exacerbated inequality as a result of the differential access to housing. The possibility of earning income through opening a small business is restricted by the kind of housing you have and what that makes possible. Other changes have had a similar effect, such as allowing remittances from Cubans' U.S. relatives. Because it was mostly white, upper and middle class Cubans that went to the U.S. after the revolution, it is mostly white Cubans that receive remittances from U.S. relatives. Eighty-five percent of Cuban-Americans identify as white (United States Census 2011). These remittances made a big difference in how well families survived the economic crisis and today generate major inequalities in lifestyles, including energy use.

In addition, persistent discrimination means a smaller proportion of black and multiracial Cubans work in the emerging tourist sector, one of the biggest reasons for increased energy demand in Cuba today, and other sectors associated with foreign investment. These are two of the only ways, aside from remittances, for Cubans to earn convertible pesos, or more significant wages (Argüelles 2010; Bell 2011). Cuban pesos, or moneda nacional, which is the main wage currency, are worth much less than the convertible pesos that tourists receive in exchange for their national currency. Tourist sector employees can receive tips of up to $3 a day, which is significant when factoring in that the average Cuban wage is under $20 a month. Thus, people of color have more limited access to some of the most lucrative employment on the island, in one of the most energy-intensive sectors.

While Cuba still is not racially segregated in the ways with which we are familiar in most countries in the world, it is difficult to see how the racial divide in Cuba will not deepen unless major strategies are adopted that mitigate the effects of reforms initiated during the crisis of the 1990s. The tourist sector is so segregated, that even tourists with darker skin have been stopped when they were mistaken for Afro-Cubans. No Cubans are allowed on the beautiful grounds and beaches of resorts and hotels unless they can afford to pay a fee at the hotels that offer admission to Cubans, or they are the pre-approved guest of a tourist or a prostitute. One person with whom I spoke said the way to understand the difference between racism in Cuba and the United States is that in Cuba darker skin means you get asked more often for your papers, but it doesn't get you shot.

The *special period* also affected women's post-revolutionary gains. "A number of experts from the FMC's Women's Studies Center indicate that women are the ones who

have been hardest hit by the difficulties of daily life in the Special Period" (Pagés 2008, 313). For working women, the double-shift persisting after the revolution became a deeper burden during this time. While more women went to work in the 1990s out of necessity, many women gave up jobs they preferred or retired early. This was because of increased domestic demands and the loss of jobs associated with the economic depression. Women were more likely than men to take on the responsibilities of standing in line for hours to buy available household necessities, deal with shortages, improvise meals, and care for children, the elderly, and the disabled (Vigil 2008, 310). Energy shortages exacerbated structural problems after the economic collapse and led to the loss of adequate transportation. Many women had to move to jobs closer to home to avoid spending time away from domestic duties by riding a bike to work long distances, etc. Services that alleviate women's domestic burdens, like daycare, also were cutback during the *special period* (Pagés 2008). With the rise of tourism and general economic depression, Cuba saw the return of *Jineterismo* (prostitution), the near eradication of which had been a symbol of Cuba's revolutionary emancipation (Pagés 2008).

These factors contributed to the costs of the energy and economic crisis being borne unequally. Energy injustices therefore increased. As mentioned above, those living in the worst poverty in Cuba were also without energy resources. Because energy is a way to extend human labor, the scarcity of energy resources implies greater reliance on human labor and beasts of burden. And because Cuba was not prepared for the collapse of the Soviet Union in advance, shortages and new difficulties in daily life were introduced. This disproportionately affected women, especially at the household level. Women took on much of the extra labor required to ensure household survival. Also

Afro-Cubans suffered disproportionately as a result of the increasing deterioration of housing and neighborhood infrastructure during the 1990s because they already lived in the housing projects in most need of renovation or replacement. Reforms that took place to try and alleviate the crisis also introduced inequalities. The sectors of the economy that were given priority for energy resources, such as tourism, benefitted the economy at large as a result of the state capture of revenues. However, inequalities also increased as a result of employment discrimination in these sectors, meaning not everyone benefitted the same way from the re-orientation of resources to new sectors.

Raising these points brings out contradictions, in terms of energy justice, of the second energy revolution. While inequalities grew, environmental gains made during this period are indisputable, and the transformation of agriculture helped Cuba maintain their safety net. Cuba avoided losing many major social achievements by focusing intently on maintaining a basic safety net to the extent possible, even in the midst of severe shortages. The government committed increasing resources to social services and even increased wages in this sector. Cubans worked together to make changes, as in the case of agricultural reform, and the survival of the social fabric during this period is remarkable. This could never happen during such an energy crisis in a capitalist country where civilian government spending is generally held down (even capped as a percentage of GDP in the U.S. case) as a result of the resistant oligarchy (Baran and Sweezy 1966, 175; Foster, Holleman, and McChesney 2008, note 11; Foster and McChesney 2009). Cuba's efforts during the *special period* thus represent the strengths of the revolution and also remaining areas of challenge that constrain the achievement of full equality, and thus energy justice, in Cuba.

The third energy revolution, the prospects according to Cubans

This section primarily reports the results of interviews conducted in Cuba with two energy scientists, one of whom works on renewable energy and conservation, and is also a writer/journalist covering energy issues in Cuba for a popular audience. His writing is part of his engagement with environmental education. Another is a physicist that has worked mainly on conventional energy developments but now is focused on solar. I interviewed another man involved in environmental education, especially teaching permaculture methods to children and adults throughout the country. One of the women that I interviewed was involved in planning and administration, including the implementation of environmental programs, especially in Havana. I also interviewed a woman working in the ministry of trade.

This section builds on the scholarship of others, as did the previous sections, and participant observation in Cuba. The questions I asked my interviewees revolved around what recent changes in the economy and the energy sector mean in terms of Cuba's energy future. I also asked how these would impact Cuba's environmental gains and the levels of social inequality in the country. The interviews were only semi-structured and went into other subjects about environmental education, social philosophy in science, the U.S. blockade, the future of Cuba's international relations, the global economic crisis and Cuba, the aging of the revolution and Cuba's infrastructure, what Fidel Castro's death might mean, political reform in the country, and views on neoliberal reforms in other parts of the world. Here I focus on the elements of the interviews most relevant for explaining Cuba's third energy revolution and the implications for understanding energy justice in the present period.

Political economic change and development needs: Limited liberalization and aging infrastructure

In the latter half of the 1990s Cuba's economy improved with the foreign exchange generated by tourism, as well as other sectors opened to foreign investment, and as a result of Cuba's internal development, especially in the area of services. Energy consumption grew with the resuscitation of the economy. In 1999 Hugo Chávez was elected in Venezuela and formed an alliance with Cuba, leading soon after to the import, once again, of oil resources from South America, but this time in exchange for Cuban services, especially doctors. This started to transform the country. I asked the interviewees what they saw as the most important changes and what they mean for their work and for the society and their environmental programs. The permaculturalist I spent time with described the basic transition in the economy in the past fifteen years, how Cuba initiated sustainability programs, and how now there is a re-opening of the economy and greater options for import:

> Before the 1990s we had several business agreements with the Soviet Union and the Eastern Bloc then we didn't have that and there was a period when we had more closed sectors and all of these beautiful processes of sustainability were started. Then there was this period when we started to receive some goods from Venezuela in exchange for ALBA, in exchange for doctors, things like that. [These] allow the country to even bring some imports and things. And even now this creates our stuff from China and some other places but you know sooner or later you have to pay for it, all of these things…so the situation is like high prices for food and high prices for different things in the market.

This interviewee saw one the biggest changes in the economy to be the proliferation of small businesses and the new foreign partnerships. However, in the short-term he believes these have slowed down because of the global financial crisis:

> There are some agreements with other countries, but the "lineamientos económicos"…the economic guidelines are trying to open more [of] the economy but I don't think in the short term there will be a lot of investment or privatization or opening the country to that…I may be wrong but in the short term I don't think that is going to change.

Two major sectors of the economy that are open include the tourist sector and oil, where Spanish companies like Petrobras and Repsol have made investments. However, this interviewee sees the most significant change as the increase in the amount of self-employment: "In my opinion, the biggest changes are not addressed more toward foreign investment, but to trying to explore more our national industries and the real intention is self-employment and little business in the country." He went on to say, "I know that there are plans…" and he waved his hands wide in the air to illustrate how big the government's plans are, but said "honestly, in a time of crisis, I don't expect a lot of foreign investment." (He was referring to the global economic crisis, which has slowed down the development of joint ventures in the economy.)

The woman I spoke with in the ministry of trade was more focused on foreign direct investment. Of course, this is her area of work. She identified the current economic development priorities as: (1) increasing luxury tourism by building better resorts and golf courses, (2) further development of ecotourism, (3) medical tourism, (4) nickel-mining, (5) the export and internal use of recently discovered oil reserves, (6) explore potential for nuclear energy development, (7) the pharmaceutical and biotech industry, and services, including Cuba's renowned medical teams, sports advisors, environmental experts, etc. She did say that "we don't want to develop at any cost," but that Cuba had too many unmet needs internally and there is pressure to improve the economy. Within

the tourist sector, while ecotourism has been the sector that gets the most attention, it doesn't generate enough money. She said that "everyone that comes to Cuba now loves Cuba, loves the environment, but doesn't have any money." So, building golf courses, and so forth are meant to attract bigger spenders. She said "with low wages for twenty years, Cubans want more income, they want life to be easier." Even the most committed in the country are ready for changes because the old model is unsustainable. Cuba and North Korea are the last command economies in the world and it isn't working. Cuba does not want to be like the United States, but they do want change. The sectors listed above are seen as having some of the greatest economic potential for generating foreign exchange and employment. The Cuban government always retains at least a 51% or greater ownership in any joint venture. A journalist I met, who is not one of the interviewees listed here, said that the story of Cuba is not the command economy working well because there have been a lot of problems with that. The story is that it is an independent country, free from the U.S. in spite of the embargo, as well as all other foreign powers. This freedom has made all successes possible.

Immediate development needs identified by a woman I interviewed who worked in urban planning, with an environmental focus, were related to outdated, inefficient infrastructure. She said one of the main challenges is that the revolution is now over fifty years old, and years of economic crisis have left infrastructure and housing in bad shape. She said that Havana ranks low in terms of livability amongst other cities of its size. Every day at least three houses collapse. Eighty percent of the city was built before 1958. Losses in water supply of around fifty percent increase energy demands in this sector. Energy waste occurs through losses that result from outdated technology and the need to

replace parts of the grid. There are also still people without access to electricity, or with insufficient access. There needs to be a lot of restoration at the community level of buildings, schools, parks, hospitals, everything.

One of the biggest debates in Cuba today, which has arisen especially as a result of the inequalities that were discussed earlier as having been exacerbated during the special period, is the debate over the future character of the social safety net. One interviewee, the permaculturalist explains this debate here:

> Without any doubt, there will be a change of what Cuba has now and that is a debate in the society you know. For example, Cuba was very based on egalitarian thinking, everyone has there ration card. Right now there are more arguments about if it is better to subsidize people, not everybody but…you can see, for example, the person that plays in a salsa band, goes to Europe twice a year and makes a lot of money and he has a ration card. It doesn't make too much sense.
>
> So there are some debates in the society about preserving equity, [which] is not the same as égalité. Equity in my opinion is more opportunities, more access and you can get something if you really need it and égalité is like everybody is the same but everybody is not the same…it is a debate in the society there are some people that are more old-fashioned- they say that even during the worst part of the special period all of those what we call the conquers of the revolution education, health and some other things stayed the same at great cost you know financially and…it is a discussion in the society.

In a country where equality regularly polls as one of the highest values, these kinds of debates permeate discussions of energy policy as well.

Conventional energy, the environment, and society

The political economic changes Cuba is experiencing are related to the developments in the energy sector. Many policy-makers see the deep-water drilling and

the development of nuclear as potentially the only options for lifting the Cuban economy. However, as the woman in trade said, there are environmental concerns and there is debate over the potential costs. At the major environmental conference I attended, the director of the International Atomic Energy Agency, Denis Flory, was invited to speak as an obvious attempt to convince the environmentalists present that nuclear was a good idea. His speech was out of place among the other talks that day in the main auditorium. However, it sent a clear signal that policy-makers are promoting nuclear. All of my interviewees, on the other hand, saw nuclear as a bad idea and premature, given oil developments might already make Cuba a net exporter.

Everyone that I interviewed thought that some energy development would be good for the country. Cuba is faced with an aging infrastructure that one interviewee discussed as reaching crisis proportions in terms of housing and water and electricity distribution. They also were concerned that life be easier for Cubans in terms of transportation, health and education facilities, etc. Therefore, no one I interviewed was against fossil fuels per se. In social terms, everyone I interviewed was concerned that social needs be the priority of energy development. As the woman working trade said, "oil is primarily for export, rather than to use much more energy at home, the money will go to address the needs of the people." The permaculturalist with whom I spoke discussed this in a similar way. He said that just because there will be more energy "we are not spending energy like drunken [sailors]…Energy developments, like oil, are more central government projects so the profits should become part of the government finances and distributed equally, to the extent this happens…(shrugs)?" This environmentalist identified one of the main struggles regarding this development for activists will be to

implement stronger legislation that requires a portion of the oil revenues to go toward projects geared to reduce Cuba's dependence on fossil fuel. He said, "it will be desirable to take some of the inputs of the money from the energy and [make it]… law [that it] should be used for renewable energies, that is something which we will fight for in the future…this is something that needs to be the law, no?"

The urban planner noted that most Cubans aren't major oil consumers. However, in Havana there has been a major influx of fancy new cars bought with remittances by wealthy Cubans and for use by tourists. She said, "for the first time, Cuba has smog." This diverts resources toward road development and brings new air pollution related illnesses. The cars and smog in Havana for one interviewee were symbolic excesses that indicated the country was at a crossroads. This planner saw too much accommodation to tourists and those with money. Fuel is too expensive for most Cubans: according to the permaculturalist "one dollar twenty cents a liter for diesel, this is very expensive, especially for Cubans."

In environmental terms, no one I interviewed saw fossil fuel development in Cuba as having much impact on global warming, because they consider any potential development as sure to be insignificant in global terms. Both the woman in trade and the permaculturalist emphasized Cuba's carbon footprint is less than "zero point zero, zero, zero." I think in fact (I heard at the conference), that Cuba emits .09% of world emissions. They are concerned about global warming, but feel they are limited in their contribution to solutions given they are not major polluters, nor do they expect to be. Thus, their environmental concerns about oil developments were focused in other areas.

Cubans remember the economic and ecological catastrophe of previous oil spills off Cuba's shores and are concerned about the possibility of offshore spills undermining decades of work to keep Cuba's mangrove forests intact and the tourist industry. This seems to be the biggest concern regarding oil. I attended a small meeting that included a presentation by the top official in the Ministry of Science, Technology and the Environment. She said that when the BP spill happened she had to check her blood pressure twice a day. However, she maintained the importance of oil developments and emphasized the embargo and how there are few options to overcome the strangulation of such economic policies of the U.S. In terms of criticism of Cuba for this, she said that in the U.S. "it is important to take your own advice before giving it to everyone else." She was referring to the comments she has received from people from the U.S. at conferences.

The scientists I spoke with who are involved in conservation see Cuba's having the greatest area of intact mangrove forests and healthy coral reefs in the Caribbean as a major, but fragile, achievement. As once scientists said, "a disaster like BP in Cuba would be much worse" because of the size of the country, the lack of resources to handle such a crisis, the ecosystem loss, and the economic dependence on the coasts. This scientist explained how oil coats the roots of mangrove trees and actually suffocates them, and how dangerous this is in a hurricane prone nation because mangroves help protect the island in case of such extreme weather. These potential problems are exacerbated by the fact that the U.S. and Cuba have not formed any agreements about how to handle crises and have still had insufficient scientific exchange. So, Cubans worry about cooperation in event of a disaster in Cuban or U.S. waters.

Every person I interviewed was very concerned about nuclear development and saw it as a completely bad idea. Two of the interviewees had some education in the Soviet Union and remember well the experience of Chernobyl. One scientist just shook their head at the thought of nuclear in Cuba. This interviewee sees nuclear "as the biggest mistake of policymakers with energy today." Another interviewee saw the development of nuclear as a capitulation to an energy-intensive, consumption-oriented life style. One fear expressed in this interview was that nuclear represents the undermining of the values of the Cuban revolution, where achievement was defined in terms of education and culture, rather than consumption. He said, "it is not worth it." All of the interviewees discussed the fact that Cuba is an island nation and that in the face of disaster, as the physicist I interviewed said, "there is no where to go." The interviewees also see nuclear as further centralization, rather than decentralization of the energy grid and consider this a major problem. Every interviewee talked about the importance of decentralization to increase efficiency and energy conservation, reduce environmental impact, and increase security in case one power plant is damaged by hurricane or attack. "All it takes is one" natural or manmade to cause radical damage if a nuclear installment is affected, emphasized the physicist.

Some energy scientists refer to the availability of energy again after the Soviet collapse as the "third stage" in Cuba's energy development since the revolution, consisting of better energy programs and planning and increased development of internal energy resources (IAEA 2008). However, one of my interviewees referred to the early 2000s—when renewable energy projects picked up and there was increasing emphasis on conservation and efficiency not just as necessary (as in the *special period*) but as

ecological achievements—as the third energy revolution in Cuba. This energy revolution is seen as currently underway, competing in some ways with more conventional energy development, and part of Cuba's broader environmental movement.

The third energy revolution

Drawing from all of my interviews, I identified the following four themes as recurrent descriptions of what one scientist called the necessary third Cuban energy revolution: (1) conservation of energy, which Fidel likened to finding a great oil deposit; (2) energy efficiency, which in Cuba means something very different than in the U.S. since it is not geared toward profit; (3) anti-consumerist cultural change; and (4) the development of renewables, especially wind and solar. Many reforms in these directions were made early in the revolution. Some were the result of the special period. In the late 1990s, for example, the Cuban government introduced more efficiency programs affecting industry and households, promoted bicycle use, and increased the use of bagasse from sugarcane for fuel oil. Solar and wind energy developments have also increased.

Environmentalists find themselves challenging two common views amongst policy-makers in Cuba. They are promoting appropriate technology and alternative energy that it is considered by some passé, simply an experiment, the need for which is obviated by renewed conventional energy availability, and they struggle to overcome the perception that it is too expensive, or that you can only work on these issues by going big, with the most expensive technology. As the permaculturalist put it, "the conventional approach to renewable energy is that you need very expensive wind turbines…there are

lot of gadgets on the market, solar panels, things like that cost a lot of money" but he emphasized other options that work.

The two Cuban energy scientists, the planner, and the permaculturalist all emphasized that small, localized, low-tech solutions joined with more high-tech solutions when possible (like wind turbines and bigger solar installments), can solve a lot of problems faster than big centralized projects, using less energy, and saving money. The planner said that it is a matter of convincing "office revolutionaries" that Cuba's successes with smaller scale, more sustainable solutions should "no longer be seen as an experiment. It is now an experience." She pointed out successes like the installation of solar water heaters, the replacement of inefficient lighting and appliances, and the educational campaigns as having saved Cuba a lot of energy with relatively little expense or inconvenience. The permaculturalist also emphasized that,

> there has been a lot of decentralized, for example, micro-hydro, I'm not talking like a hydro-electric dam, that doesn't make sense in times of climate change..[there are] things that can be made by hand, it is established science and appropriate technology but people they don't consider it, when they think when they think of renewables they think hybrids, electric cars and things like that.

Cubans are also "trying to expand more in wind energy…there are couple of installations to use tides and currents...there are some experiences also with temperature gradients in the ocean" (permaculturalist). However, the distribution of solar water heaters and the use of animal traction in agriculture are low-tech alternatives to dependence on conventional energy in households and the food system and expensive renewable technology.

One energy scientist asked me what energy source I thought they had in greatest abundance. Before I could suggest anything he said "el sol," the sun. It is everywhere and

he noted evenly distributed in Cuba throughout the year and geographically. There has also already been success with solar, especially in electrifying rural areas. So, there is hope in developing more in this area, though this requires resources. With the solar projects in particular, you really hear the united social and ecological commitments of these scientists and environmental activists. Discussing the role of renewable energy in environmental change, the permaculturalist said (echoing the two energy scientists I spoke with earlier)

> The other part that…for me [matters most] is that there are 100,00 houses in Cuba without electricity because they are so isolated that it doesn't make any sense to put them on the grid because 1 km of the grid is $6,000, and then it would be very vulnerable to rain, [other weather] and things like that" "the idea is to power those houses through renewable energies" the family doctor clinics, video rooms (structures with t.v., a refrigerator for the community to share) , and schools already have power in these communities. Now, when people express the desire for more energy, they ask for solar panels, not electricity."

The physicist pointed out that in Cuba, the expenses associated with implementing projects is much lower than other countries because the scientists and enginneers are state employees, "and this our routine work" he said. Because of the Cuban education system, there is also a high level of technical skill in the country, meaning that if alternative energy developments were emphasized more, Cuba could be a leader in innovations in this regard.

The main external limit placed on further developments of solar and other renewable projects that require more equipment and so forth is the blockade. "The blockade makes it very difficult" as one of the energy scientists said. The permaculturalist gave the following example of the limitations imposed: "the generator of

the wind turbine, 95% of it is made in the U.S., we cannot import it or use it, things like that. Those constraints are very clear. Nevertheless, he sees "that for a country like Cuba, [there are] a lot of very promising things: biomass, you know from bagasse, is very promising…and when I say biomass, you know I am not saying 'biofuel' or things like." The energy scientist who is also a journalist wrote especially about the need for more education programs for Cubans on energy. He wanted to see people "think in energy" to prevent waste and include the communities in innovations given that they know their habits and needs better than anyone.

The future of the third energy revolution

For the people I interviewed, the extent to which environmental reforms will take priority in the future is unclear as is the extent to which these will be offset by environmentally destructive economic reforms and the development of conventional energy. It is clear that environmentalists in Cuba are committed to keeping up their work, emphasizing social justice and ecology in the policies and practices they promote. They do have support in Cuba, relative to other countries. The government emphasizes environmental achievements and continues to support them through the legal structure and materially, even if the influence of environmentalists in policy-making is not as strong as they would like.

The focus on education and collaboration is recurrent in my interview notes. These are in fact seen as the greatest hope for a more sustainable future. One interviewee emphasized that with all of the environmental knowledge developing around the world, and with the urgent environmental and social crises we face, sharing information and working together to develop new projects should be the first priority of international

relations. Interviewees understand the barriers to such cooperation represented by the United States. As one energy scientist put it, “the only two things Cuba and the United States have in common” in terms of international relations “is that they both send troops around the world and are fighting terrorism.” The difference ends there, as Cuba sends doctors rather than soldiers and the terrorist threat facing Cuba always emanates from the United States. All Cubans, including those people I interviewed, emphasized international cooperation must be on equal terms and this can never occur so long as the U.S. has domination as its goal. They also emphasized the ways in which the U.S. embargo distorts energy and environmental policy in Cuba, making it unclear what would be possible if the embargo were lifted. The discovery of oil led to one minister I heard speak say that she was very curious how transnationals would respond when the first oil gush appears in Cuba. In the U.S., indeed, business reports have already expressed enthusiasm over the fact that Cuba could come to resemble Ecuador or Colombia in terms of its energy exports (Piñon and Benjamin-Alvarado 2010, 21-22).

Socially, as mentioned before, the Cubans I interviewed see the introduction of inequalities within the country, and the gradual development of what we call conspicuous consumption (amongst tourists and wealthier Cubans), as eroding social solidarity and creating more pressure for energy-intensive development. Inequality coupled with the crisis of an aging leadership, which one interviewee saw as representing the failure to bring younger people into the revolution and the paternalism of the dominant political party, has made policymakers more desperate to bring prosperity to a somewhat disaffected population.

In the face of these policy priorities, the environmentalists with whom I spoke saw their task as continuing to work toward convincing policy-makers that ecological reforms are necessary for the long-term health of the society rather than temporary measures to deal with the crisis or boutique, showcase experiments. They also work toward social provisioning in energy policy, understanding that the inequalities in Cuba today are not sustainable. Environmentalists clearly put a lot of effort toward educating their own populations and building bridges with environmentalists abroad. In sum they were optimistic that Cuba will not abandon what it has learned, though more lessons may be required.

Cuba's energy justice lessons

One of the clearest lessons of the first energy revolution in Cuba is that when the economy is re-oriented toward meeting human needs, it is possible to accomplish much more, with much less energy use per capita. Even when energy resources were more readily available, Cuba still managed to develop on a smaller per capita energy budget than other countries. Cuba's experience in the first thirty years of the revolution show that great strides can be made toward overcoming historical burdens of oppression and inequality without the same level of ecological degradation and GDP found in other countries with far fewer achievements in human development.

A related lesson of this period is the necessity of Cuba's assertion of sovereignty and the ongoing need to struggle against imperialism if there is any hope of meaningful ecological and social change. Cuba is one of the only modern countries in the world to completely extricate Big Oil. As explained in this dissertation, the re-orientation of the Cuban economy could not have been possible if Standard Oil, Esso, and Texaco had their

way. The case of Ecuador, explored in the previous chapter, tragically illustrates this point. By significantly overcoming internal inequalities and throwing off imperialist exploitation Cuba went a long way toward healing the social rift of the pre-socialist era.

The lessons of the second energy revolution are well studied in the environmental literature. In the face of Cuba's own version of peak oil, Cuba's response teaches us that we do not have to fall apart in the face of climate change, settle for risk avoidance rather than social change, or simply document our destruction of the planet and social inequality in ever more exquisite scientific detail. As analysts and activists have noted, Cuba represents an alternative model of how to handle crises, which will confront us all, even if they develop more gradually than did Cuba's. As Bill McKibben wrote, echoing the insight of many others:

> There's always at least the possibility, however, that larger sections of the world might be in for "Special Periods" of their own. Climate change, or the end of cheap oil, or the depletion of irrigation water, or the chaos of really widespread terrorism, or some other malign force might begin to make us pay more attention to the absolute bottom-line question of how we get our dinner (a question that only a very few people, for a very short period of time, have ever been able to ignore). No one's predicting a collapse like the one Cuba endured—probably no modern economy has ever undergone such a shock. But if things got gradually harder? After all, our planet is an island, too. It's somehow useful to know that someone has already run the experiment. (McKibben 2005)

McKibben wrote these words before the financial crisis hit in 2007, when things became immediately harder, rather than gradually.

Throughout the capitalist world austerity measures are proposed to deal with the financial crisis, while bank executives are given "golden parachutes" (Foster and Magdoff 2008), and we are told that economic crises preclude the possibility of

addressing environmental crises like climate change. During Cuba's energy and economic crisis social spending increased and the energy resources they had were devoted to solving social problems and maintaining the social safety net. The entire food system was transformed according to agroecological principles to support these efforts. In this way, Cuba illustrated to the world that it could not be beat in a time of crisis, but could actually move the revolution forward in a significant way, working to overcome the ecological rift of the previous energy regime.

Another lesson from this period is that the social solidarity engendered during the first thirty years of the revolution as a result of strides toward equality and the significant gains in social provisioning and human development, made possible the best outcomes of the *special period*. What would happen in the United States if such an energy crisis occurred? We are nowhere near to developing the social consciousness or the economic or ecological priorities that helped Cuba survive in the 1990s. Who would suffer most? All social scientists have to do is look at the current crisis and ask who bears the burdens. A crisis like Cuba's would have frightening and dramatic results in a country like the U.S. because we are not ready for it, in spite of, or because of our riches.

A final lesson from both the second and third periods of energy revolution in Cuba is that to the extent to which revolution is incomplete, contradictions emerge during times of crisis. Gender, race, and class inequalities increased during the *special period*, even if they were not as deep or did not have the same consequences as inequality in other societies. In a country where equality consistently polls as one of the highest values, these growing inequalities have presented political challenges, among others, for Cuba today. As discussed in the previous sections, these inequalities have implications for the

ongoing revolutionary social and ecological projects started in Cuba. Energy injustices have arisen both in terms of who paid the highest costs of the energy crisis and who benefits most from increased energy availability.

One of the greatest hopes in Cuba today remains the persistence of the revolutionary ideals and the commitment of so many people in the country to what I call here, healing the ecological and social rift. Amongst energy scientists and other environmentalists this is reflected in the obvious commitment to what I outline in this thesis as energy justice. In their work, the goals of social equality, human development and ecological change are intertwined. They are committed to social and ecological provisioning and reproduction as the highest priority. It has been because of this orientation of values and practices in Cuba that the achievements for which they are most famous have been possible.

As social scientists in the U.S., Cuba's example, lived in a very real way, begs the questions: What are our commitments? And what does this mean regarding the ends to which our work is put? We are in the middle of an energy crisis, which is perhaps most terribly represented by the wars in the Middle East and climate change. As social scientists we need to help define the energy crisis today in energy justice terms and make it politically unfeasible for those in power to continue destructive policies and claim that "there is no alternative" in times of crisis. Theoretical tools for such a redefinition are presented throughout this dissertation. The lessons from Cuba show that the struggle for energy justice is not utopian in times of crisis, it is necessary.

CHAPTER V

THE ENERGY JUSTICE REVOLUTION

Today the dominant perspective on energy in the United States defines energy crises as crises of supply to fuel economic growth. According to this perspective the main challenges are the geopolitical control of resources and the need for investment in technological development to increase the diversity of energy sources available to the market. When questions of the environment or social inequality are raised, technology, increased efficiency, and keeping supply high to maintain low energy prices are the chosen answers. The dominance of this view is represented in the popularity today of Daniel Yergin, a former business professor, and now "America's most influential energy pundit" (Garner 2011). The *New York Times* review of his latest book said that "in the [last] two decades…Mr. Yergin, operating as a kind of one-man think tank, has had a virtual monopoly on the subject of energy and geopolitics." Moreover, "such is his influence that one half expects his competitors to file antitrust litigation against him" (Garner 2011). The fact that a business perspective would be more popular than a view from the social or natural sciences is not surprising in the U.S. context, though the consequences are grim.

Yergin promotes optimism in the face of climate change because we are all historical witnesses to the "great revolution." He defines this energy revolution as the development of "technology and finding technologies that provide answers. We have been doing that for two-and-a-half centuries. And I don't see why we will stop" (Yergin 2011a). This faith in technology and efficiency keeps Yergin in "an optimistic frame of

mind" (Yergin 2011a). The global energy quest, the subject of his most recent bestselling book, is truly a quest for continued capital dominance and expansion of the energy supply to fulfill the destiny of the globalized free market (Yergin 2011b). It is a triumphant story, similar to his Pulitzer-winning book *The Prize,* of the United States securing energy resources around the globe through war, business, and political maneuvering. What this has meant for people or the environment in countries like Ecuador, Nigeria, or Iraq, are not even a question. Environmental problems, like climate change, will be handled via technology and efficiency gains. In Yergin's view on the global energy scenario now and in the future, "all is for the best in the best of all possible worlds" (Baran and Sweezy 1966, 1).

Yergin's view of energy revolution, then, is the process of technological innovation that occurs in any case under capitalism. In other words—business as usual. The point of the energy revolution is provisioning for future economic growth. Yergin sits on the U.S. Department of Energy's committee that reviews the environmental impact of energy developments, such as hydraulic fracturing (fracking) to extract gas and oil from shale rock deep underground. He is also on the U.S. Secretary of Energy's advisory board. Outside of these official responsibilities, he is the founder of an energy consulting agency. When asked about the environmental problems associated with fracking, Yergin replies that jobs will be created and the environmental issues will be managed, "and that means technology" (2011b). He sees the extraction of shale oil as the "biggest innovation probably in 30 years," an energy "revolution" (Yergin 2011c). The environmental research is actually less optimistic that this is the kind of revolution we need:

> Preliminary research from Duke University seemed to indicate that indeed methane was showing up in drinking water; in December, the EPA released its first thorough study, conducted in the Wyoming town of Pavilion, where residents had reported brown, undrinkable water after nearby fracking operations. The EPA concluded that the presence in the water of synthetic compounds such as glycol ethers and the assortment of "other organic components" were "the result of direct mixing of hydraulic fracking fluids with ground water," and told local residents to stop drinking from their wells…the evidence from Pavilion was a powerful indictment of the industry, and it led several leading doctors to call for a moratorium on fracking pending more health research.
>
> A second concern has to do with the damage being done to rivers and streams—and the water supply for homes and industries—by the briny soup that pours out of the fracking wells in large volume. Most of the chemical-laced slick water injected down the well will stay belowground, but for every million gallons, 200,000 to 400,000 gallons will be regurgitated back to the surface, bringing with it…not only the chemicals it included in the first place, but traces of the oil-laced drilling mud, and all the other noxious stuff that was already trapped down there in the rock: iron and chromium, radium and salt—lots of salt. (McKibben 2012)

These consequences of fracking and others have led James Hansen, the world's foremost climate scientist, to refer to fracking, like mountaintop removal mining, and oil extraction from tar sands, as "extreme energy."

Extreme energy represents the innovative response to, what for capitalism, is a supply-side and geopolitical energy crisis. Whether sociologists define the problem in this way, or whether they are less optimistic about environmental crises than Yergin, the focus in the sociological literature on energy remains stuck within the limited technological vision that Yergin represents. That technological change dominates the sociological literature on energy and climate change was demonstrated in Chapter One of this thesis. The absence of concern about economic growth or social equality was also

demonstrated. The argument of this thesis thus represents an attempt to broaden the theoretical basis of the critical sociology of energy, building on previous critical work and energy studies generally, widening the frame of analysis.

As the preceding chapters demonstrate, if looked at through a different lens, which brings into focus issues of social inequality within and between nations, and ecology, the energy regime of capital no longer appears a mere technological problem. It is a problem of social organization conditioned by the values and priorities, under capitalism, of accumulation. And that is the bottom line. Technological development might have a role to play in positive social and environmental change, but only if it is harnessed by a new social metabolic order with a fundamentally transformed energy regime based on the requirements of human and ecological reproduction. There would have to be a revolutionary shift in priorities for this to occur, such as what took place in Cuba, but even deeper and on a global scale, and a redistribution of power, technology, and resources, such as that called for by the ecological debt movement led by Ecuadorans. A new value system, such as that proposed by Odum, and has been called for by feminist ecologists, would replace prices in energy decision-making. Only under these circumstances will technology be part of a strategy toward broader socio-ecological change intended to heal the ecological and social rift of capitalism. This would be a real energy revolution, and should be one whose goal is the achievement of energy justice.

Post-racial, gender-neutral, green capitalism?

The current denial in social science, and amongst energy pundits, of the deep social and ecological rift at the heart of capitalism, which is impossible to transcend within the system, is only the current manifestation of long history of putting a happy

face on a legal and global organized crime ring that will stop at nothing to make money. History has proven this shamelessness. An early observer of capitalist globalization wrote:

> Capital eschews no profit, or very small profit…With adequate profit, capital is very bold. A certain 10 per cent will ensure its employment anywhere; 20 per cent will make it ready to trample on all human laws; 300 per cent, and there is not a crime at which it will scruple, not a risk it will not run, even to the chance of its owner being hanged. If turbulence and strife will bring a profit, it will freely encourage both. Smuggling and the slave-trade have amply proved all that is stated here. (T.J. Dunning quoted in Marx [1867] 1990, 926, note 15)

As Marilyn Waring noted twenty years ago, under this system, when there is an environmental catastrophe, like the Exxon Valdez oil spill in Alaska, or the current BP oil spill in the Gulf, companies make an enormous profit cleaning up, or at least professing to do so. GDP goes up. If someone is sick, if they die a long, drawn-out death from cancer, there is profit to be made. There is no money to be made in human and ecological health and well-being. If communities grow their own food, the global food market significantly decreases; if people walk rather than drive, the oil and car companies don't make money. If education is free, who benefits? Maybe most people, and the society at large, maybe even the environment, but not necessarily the shareholders. Therefore, it is much more economically efficient to let the market shape education. Today students take out larger and larger loans to buy more expensive books, to get less education engendered by fewer teachers. This is capitalist efficiency. The surplus is efficiently transferred from one segment of the population to another, those at the top. The same goes for letting the market shape energy policy. Those arguing today for market intervention in the climate crisis often fail to mention that it is absolutely already the market shaping energy policy.

This is precisely the problem. It is very efficient for the market to extract oil at bargain prices from countries without militaries to stop them. It is very efficient, in terms of profit, to have the most vulnerable in society pay the costs of energy production, and to keep polluting, all the while terrifying people that new energy developments might be their only chance of economic survival. Nevermind where the real money goes and what happens with the boom goes bust.

The current version of capitalist ideology, which absorbs energy scholars (and even environmental socialists) often unwittingly, was consciously shaped to co-opt the language of social movements seeking freedom from the yolk of capitalism and imperialism. It is no surprise that the market would co-opt green rhetoric today. Economists having the greatest ideological influence on political debates and social science today, the architects of neoliberal ideology, have sought to re-write the history of capitalist development as "the constitution of liberty," and the basis of free society (Hayek 1960; Friedman 1962; Van Horn, Mirowski, and Stapleford, eds. 2011). There can be no acknowledgement of slavery, racism, sexism, or ecological destruction among other issues, because all of these undermine the basic thesis neoliberal writers actively promote as political ideology. To make their argument, these writers must present capitalism as raising all boats, color-blind, gender-neutral, and free of class coercion, the globalization of which results in a "flat," happy world, even if it is hot (Friedman 2005, 2008). Unfortunately, these ideas dominate the political sphere, and contemporary notions of organizational, community, and national development. In academia, many "theorists celebrate the alleged leveling of social differences owing to globalization"

(Pellow 2007, 41). The blinders imposed by this view continue to infect energy studies despite the work of critical energy scholars.

Spreading capitalism thus becomes the solution for poverty associated with inequalities caused by oppression based on race, class, gender, and position in the world system, as well as the solution to environmental and energy crises. This is the basic modernization thesis. *The Ecological Modernization Reader* (Mol, Sonnenfeld, and Spaargaren 2009) presents these systematized views regarding the environmental crisis, which are increasingly influential in environmental sociology. York and Rosa (2003) and Foster (2012) have pointed out the empirical, theoretical, and philosophical roots of, and problems associated with this perspective as a basis for understanding ecological and social crises and solutions. But, we can expect this view to persist as long as social relations remain intact because the logic of modernization is seductive precisely because it is the logic of capitalism (Foster 1999b, 2002, 2009, 2012). The processes of capitalism, including its ideological developments, are the "background conditions" in which those integrated into the market economy live, as fish swim in water, they are the "social gravity" we might naturally feel is right, but don't necessarily see, as much a part of our lives as the air we breathe (York and Clark 2006).

In contrast to the modernization thesis, environmental justice scholars, among other critical theorists and activists have sought to expose the mythological basis of neoliberalism and transcend the system. The work of environmental justice scholars, feminist ecologists, and ecological rift theorists, marshaling the empirical evidence, represent powerful critiques of the modernization thesis. Taken together with the insights in existing critical work on energy, they provide an alternative approach to energy that

belies the notion that "there is no alternative." They share a common commitment, as social scientists and activists, to reality. Part of this reality is that "actual class and racial inequalities around the global and between North and South have only worsened in the past half-century—the same period during which the late modern state of capitalism took hold" (Pellow 2007, 41). Despite views that we live in a post-racial society, (or one where "men are finished and women are taking over" [Sohn 2011]), in fact economic globalization has "seriously undermined the gains of the civil rights and labor movement and the general antiracist struggle in the United States and undercut the global benefits of the anticolonial struggles occurring throughout the global South" (Pellow 2007, 43). Moreover, economic globalization and the intensified spread of ecological destruction "are intimately linked because the TNCs [transnational corporations] themselves were the ones creating and pushing both globalization and toxins on the world markets, facilitating greater control over nations, communities, human bodies, and the natural world itself"(43).

Today, neoliberal mythology has severely hindered the development of a wider environmental justice consciousness in the broader public, and amongst activists and academics. In energy studies this view is especially pronounced in the focus on technology, carbon markets, voluntary certification schemes, and alternative energies that basically allow business to continue as usual (Foster 2002, 9-25; Rogers 2010; Holleman 2012). The critical literature emerging from what I call an energy justice perspective in ecological rift theory, systems ecology, feminist and critical human ecology, and environmental justice scholarship has drawn out the social and ecological crises of the current energy regime. This is in contrast to too many well-intentioned scholars and

activists who buy into the main tenets of the modernization thesis, and thus are reluctant to break with capitalism as a system, or worse, they promote it, ignoring or ignorant of the enormous costs. This has led to the view that our task as environmentalists is getting economics to "internalize the externalities," to bring under the pricing system the work of natural systems and human services (labor). For energy this means carbon markets and trade in other forms of pollution and raising energy prices. While it is clear that as long as we have this system, goals should include wealth redistribution and businesses shouldering the costs of their polluting practices, long-term, internalizing more of the world in the market system is a total death strategy. The logic of the market is clear. An energy justice movement, with the intention of healing the ecological rift and transcending social injustice, on the other hand has as its base the goal of "externalizing the internalities." This is an ecological and social imperative.

Understanding the nature of the current system, Daniel Yergin's worse-than-nothing approach to energy is the logical response of capital. Carbon markets and the new biotech boom also make sense. If the point is accumulation, sources of profit must be found at every turn and crises represent especially ripe opportunities (Klein 2007). The problem today is not capitalism's lack of response to the climate crisis, capital was never developed as a system geared toward ecological reproduction or meeting human needs. It is a system geared toward profit at all cost and can have no rational response. The problem is that capitalism organizes so many of our productive activities in the first place. The sooner this is recognized, the sooner we can start thinking of real alternatives, and understand ourselves as subjects, not merely objects of the system, as protagonists of our own future. We can move beyond playing the passive consumers of the next product

capitalism has on offer, green or otherwise, packaged as a solution to energy crises. Examples like the carbon market schemes, or Daniel Yergin's view of what constitutes energy revolution, make clear "that there's no way we can just subcontract our environmental conscience to the new breed of green marketers" (McKibben 2010).

Energy and social inequality, the challenges of our generation

The social and ecological costs of our energy regime today are clear, though the ways these are both the result of and exacerbate social inequality and oppression are often misunderstood or ignored. While the future is unwritten, projections, if business continues as usual, indicate environmental and social catastrophe with much of the damage irreversible. Without significant social change, we should prepare for, among other depredations, increased warfare to secure energy resources to meet increased demand. The most recent British Ministry of Defence *Strategic Trends* report suggests that nations will increasingly use energy security "to challenge conventional interpretations on the legality of the use of force" (108). Environmentally and socially destructive energy sectors are projected to grow the next thirty years, such as nuclear energy and biofuel, while expected fossil fuel demand also goes only one way, up:

> Global Energy use has approximately doubled over the last 30 years and, by 2040, demand is likely to grow by more than half again. Despite concerns over climate change, demand is likely to remain positively correlated to economic growth with fossil fuels, meeting more than 80% of this increase. Urban areas will be responsible for over 75% of total demand. (*Strategic Trends*, 106)

Even a U.S. government official has recognized publicly that "our patterns of energy use create geopolitical instability. The ways we use energy are disrupting the climate system and threaten terrifying disruptions in decades to come" (Sandalow 2009).

These realities only partially illustrate energy's extensive contribution to what K. William Kapp (1950) referred to as capitalism's systemic "unpaid costs." As Anderson (1976) put it: "the growth society operates as if it had tunnel vision and nearsightedness; the accumulation of capital is pursued without regard for the side-effects or for long-range consequences, leaving to nature and the larger community these uncalculated costs" (140). Prefiguring contemporary discussions and movement framing, Anderson referred to these accumulated unpaid costs, or externalities as "the ecological debt," the result of the exploitation of both nature and humans for the sake of economic growth at all costs (142-43), undermining the natural and social conditions of production.

As indicated previously, with energy demand expected only to increase as the economy expands, the "unpaid costs" associated with its extraction and use will continue to accumulate, but on a scale heretofore unseen. The science is clear that if we do not severely curtail energy use, we will cross critical thresholds in the biosphere's ability to recycle waste and regulate the earth's temperature. The consequences of crossing such planetary boundaries will be irreversible (Hansen 2009; Solomon, et al. 2009; Cullen 2010; Foster 2011).

This is a new juncture in humanity's relation to the rest of nature. However, the costs of climate change, among other environmental crises generated by energy production and use, which is driven largely by economic growth, already are visited upon communities and other social groups in a dramatically unequal way—this we may understand as a defining feature of energy injustice. This social inequality, indeed, is a necessary feature of capitalism, making human exploitation and the assault on the environment possible, and energy injustice inevitable in the current system:

"Environmental deterioration will continue so long as there is a class system, since the profits of environmental neglect accrue primarily to one class whereas the costs are borne primarily by another" (Anderson 1976, 139). Scholars studying the ecological and social rift of capitalism, including those working on environmental racism and feminist ecology, have expanded the understanding of how these processes are gendered and racialized. Work on unequal ecological exchange amply has demonstrated that inequality between nations and regions also increases the burdens of environmental injustice. Studies from all of these perspectives have drawn out inequalities embedded in our current patterns of energy decision-making, extraction, use, and waste disposal, documenting energy injustice through various theoretical lenses.

In sum, our current globalized ecological crises are inconceivable if it were not possible to externalize the costs of the current system onto the oppressed, vulnerable ecosystems, and future generations. It is equally inconceivable that we will make the social changes necessary to overcome these crises without an end to the racism, sexism, heterosexism, ethnocentrism, and class inequalities that create serious barriers both to diagnosing the energy problem correctly as a social problem and to the forging of egalitarian alliances to mount an adequate challenge to the status quo. "Thus, to attend to the problems of social inequality is also to attend to the problem of environmental degradation" (Anderson 1976, 139). Moreover, we must overcome the generational chauvinism of capitalism that says "après moi, le deluge"!

Problems associated with our energy regime are especially dramatic and represent one of the most formidable obstacles to realizing a society that functions within ecological limits and free of oppression. Energy studies thus provide an avenue in which

the problems of the system may be viewed through the lens of one of the limiting factors of social and ecological change: our energy regime. This makes the critical sociology of energy a perfect site for more inclusive theory that shines light on the workings of the system as a whole and the relationship of its parts.

Recap: Energy justice and a sociology of energy for survival

In 1988, Rosa, Machlis, and Keating called for renewed attention to energy by sociologists given "that energy plays a crucial role, perhaps *the* crucial role, in the link between societies and their biophysical environments" (155). They noted that energy is a persistent predicament for all societies, a "chronic problem that requires continuous attention and that, if there is a sustained lapse in attention, can turn into a crisis" (168). Climate change, representing precisely the kind of crisis scholars have anticipated for over 100 years, though they were treated as so many Cassandras for saying so, indeed has renewed scholarly attention to energy. However, sociology as a discipline still pays little attention to energy. Several explanations for this were offered throughout this study. These include persistent disciplinary boundaries, specialization within sociology, and the lack of penetration of ecological concerns into the discipline as a whole. Other reasons are related to the blinders imposed by capitalist ideology, including the pervasiveness of modernization perspectives in social science, economic reductionism, and the related denial of social inequality and ecological degradation as inherent and functional aspects of the capitalist system. Moreover, as many critical scholars have pointed out, the experiences and insights of too many people are left out of our theoretical developments. Our "analytical tools carry sociological bias, that is to say, as long as its constructs are formulated in the absence of inputs by class, race, and sex-gendered others" (Salleh 2010,

215). Perspectives are too often missing from people of the global South, poor people, people of color, women, lgbt people, and other historically oppressed and disenfranchised social groups. The experience of other countries, like Cuba, which has defied capitalist logic in so many ways, especially while experiencing its own version of peak oil, is rarely treated seriously in the mainstream literature (Hernández 2002). This reflects that fact that social science has a long way to go toward becoming a people's science with a basis in ecology (Lewontin and Levins 2007, 98).

Without theoretical starting points that make the invisible visible, it is difficult for empirical work to proceed that is focused on the interface between social inequalities and ecological depredations, or energy injustices, of the current energy regime. Therefore, much contemporary work on energy, especially that beholden to the dominate ideology, such as modernization perspectives, is neither truly sociological nor ecological. It therefore does not offer a good starting point for energy studies.

The theoretical perspective offered here builds on the work of environmental sociologists such as feminist ecologists, environmental justice scholars, and energy scholars, suggesting these have much to offer energy scholars by way of theoretical starting points. It also builds on ecological theory through the case study of Ecuador and includes insights from my own research in Cuba. The point in this thesis is to put these developments in a context in which they may complement one another so that they may inform the further development of the sociology of energy. This context is the ecological rift theory of environmental sociology. This approach to the sociology of energy thus begins with the general recognition that the social system inevitably "confronts natural systems and affects their ability to sustain life" (Clark and York 2005, 395-96). The

global patterns of ecological destruction, which threaten entire biospheric systems, and have resulted in species and cultural extinction at unprecedented rates, "can be attributed in each and every case to a primary cause: the current pattern of global socioeconomic development, that is the capitalist mode of production and its expansionary tendencies" (Foster, Clark, and York 2010, 18). The ecohistorical period of capitalism is defined by these depredations. "The whole problem can be called 'the global ecological rift,' referring to the overall break in the human relation to nature arising from an alienated system of capital accumulation without end" (18). The modern energy regime is foundational to capitalist development, as the classical theorists already understood. Indeed, no energy regime in history can be understood outside of the broader social contexts that drive energy developments and structure their outcomes. Energy regimes reflect the social and ecological priorities of any society. And, in a dialectical manner, "key features of social structure and change are conditioned by the availability of energy, the technical means for converting energy into usable forms, and the ways energy is ultimately used" (Rosa, Machlis, and Keating 1988, 149).

Moreover, from this perspective, it is understood that "the ecological rift is, at bottom, the product of a social rift: the domination of human being by human being. The driving force is a society based on class, inequality, and acquisition without end. At the global level it is represented by…the imperial division between…North and South, rich and poor countries" (Foster, Clark, and York 2010, 47). This interface identified between ecological degradation, oppression, and inequality, indicate the centrality of environmental justice within the broader ecological rift theory in environmental sociology. The further development of the ecological rift framework, as presented in this

study, illustrates the way in which the ecological rift is inherently bound with the development of the modern race, gender, class, and colonial order of capitalism. Developed in this way, it both complements and draws extensively on the work of feminist ecologists and other environmental justice scholars. Feminist ecologists have called for such further theoretical integration in environmental sociology, citing the ecological rift framework as a basis for such a synthesis (Salleh 2010). This study explicates the links between the ecological and social rift. On this basis, energy injustice, as the interface between social inequalities and ecological depredations of the modern energy regime are made clear and the social limitations to facing energy crises, such as climate change, are more recognizable.

A sociology of energy concerned with energy justice works toward exposing the inequalities embedded in the modern energy regime, and better explaining historical trends. For example, with an energy justice perspective it is much easier to see why it is not the type of energy that is the problem, it is the role of energy in capitalist development that drives the abuses we associate with oil, for example.

Lacking an energy justice perspective, it took a long time for environmentalists and academics in wealthy countries to see the social and ecological tragedies of biofuel developments, a popular 'alternative' energy. By the time reports emerged documenting the routine ecological and social abuses in the biofuel industry, it already had received enough policy support to entrench its growth as a fuel sector for the foreseeable future (Holleman 2012). Moreover, as York (2012) has made clear, 'alternative energy' does not displace fossil fuel demand, and therefore cannot address climate change, but only adds to an ever-growing energy throughput with major ecological and social

consequences. The case of biofuel, as an example of this, proves that it is impossible to understand social energy choices without linking critical ecology and social thought. It also is impossible to solve ecological crises, like global climate change, without addressing social inequality. As Anderson (1976) wrote, "the fact is that environmental degradation and social inequality are interrelated in numerous ways and neither can be reversed without fundamentally altering the course of the other" (139).

Feminist ecologists and Marxist scholars, among others, have linked ecological and social degradation to the immorality of capitalism, "which unabashedly celebrates wealth while commonly ignoring poverty and environmental destruction generated in its wake" (Foster 2002, 88; see also Waring 1999 and Salleh 2010). This immorality "is in fact so institutionalized in society that it hardly appears immoral at all. Nevertheless all other moral standards and bases of community are forced to give way before it" (88):

> If land—is turned into mere real estate to be bought and sold by the highest bidder, if the commons are enclosed and then exploited outside of any collective restraints, it is due to this reduction of everything to mere economic value…In a society of this kind, people are forced to regard everything about them—the land, the rivers, the natural resources of the earth, as well as their own labor power—as mere commodities, to be exploited for greater gain. (Foster 2002, 88)

These scholars have emphasized the need to transcend this system of institutionalized immorality, which treats the reproductive work of humans and nature as value-less. This is in spite of the fact that capitalism is in the end dependent upon these labors. As noted above, the immorality of capitalism is reflected in its economic reductionism wherein the bottom line is always the primary basis for assessing the worth any activity, person, or the environment.

Transcending this economic reductionism requires methods of assessment based on completely different theoretical and methodological tools, reflecting an alternative morality. This requires replacing the focus on economic efficiency, with what Salleh (2010) calls "eco-sufficiency," which emphasizes the long-term provisioning of social and ecological reproduction and has nothing to do with exchange value, prices, or the bottom line of capital. Salleh proposes the concept of metabolic value as new criteria for assessment. Metabolic value refers to the "intrinsic capacity for organic reproduction" of ecosystems and the regenerative labor done off capitalism's accounting books especially by women, peasants, etc. "in supporting ecological integrity and the social metabolism" (210, 212). Howard T. Odum's work in systems ecology reflects just such a system of assessment in terms of metabolic value, or what Odum calls *emergy*.

Odum developed *emergy* analysis as a framework for understanding the economy in ecological accounting terms focused on the long-term provisioning necessary for the reproduction of ecosystems and egalitarian social development. Emergy analysis provides a basis for understanding economic processes, such as trade, individual commodities, and entire societies, in terms of their ecological and social costs. This is accomplished by bringing the reproductive work of humans and ecosystems under a common ecological, non-exchange oriented accounting framework, making this invisible embodied energy visible.

In this study emergy analysis is brought into social science as an alternative methodology and theoretical framework for understanding ecological exchange and sustainability. Odum's work provides a material basis for a wider conception of sustainability, and its violation in the form of unequal exchange, connecting social and

ecological injustice. Emergy helps make sense, in ecological terms, of the magnitude of the accumulated debts associated with the ecological rift of capitalism and the modern energy regime. Emergy analysis thus provides further empirical evidence of the enormity of the ecological debt owed by the North to the South, and between extractive regions within countries and the wealthier areas they supply. Odum's work on Ecuador illustrates the strength of emergy analysis as an approach to making sense of energy flows and inequalities within the modern energy regime. Emergy can help us evaluate and develop real energy alternatives, with ecology and equality as the criteria.

This thesis attempts a broader understanding of the enormous social and ecological costs of the capitalist system's energy regime, and also provides insight into alternatives, in this case, Cuba. If the modern energy regime's costs are disproportionately born by the poor, people of color, and women, as well as entire ecosystems and the biosphere as a whole, what do alternatives look like? Cuba is one of the only modern countries in the world to completely extricate Big Oil. As explained in this study, the re-orientation of the Cuban economy could not have been possible if Standard Oil, Esso, and Texaco had their way. During the energy crisis of the 1990s, Cuba became known worldwide for its survival of its own version of peak oil and its transformation of its agricultural and food systems based on ecological principles. However, Cubans also suffered during this period a great deal, and inequalities lingering after the revolution became exacerbated.

Today, Cuba faces prospects of a vast increase in its energy supply, so much that it may for the first time become a net oil-exporting nation. This has raised questions regarding the extent to which this development will be used, as previously in Cuba, to

raise the level of equality in Cuba, or whether this will initiate a transformation of the relationships between Cuba and foreign investors, challenging Cuba's social gains and sovereignty. These energy developments also have led to increased environmental degradation in Cuba, with the future of nuclear and off-shore drilling still unclear. Though it is not completely independent of the system, or free of the burdens it imposes, Cuba continues to offer lessons in terms of what a society can do, working in solidarity, under a different set of social, economic, and ecological priorities.

The various insights provided in this study as a whole helps broaden the theoretical basis that already exists in environmental sociology for defining the energy crisis in sociological and ecological terms. Climate change represents an opening for sociologists, as more funding is available, and research programs are developing globally that support sociological work on climate change and energy. While it is easier to fall in step with the dominant perspective that defines energy as a technical engineering or economic problem, and puts hope in efficiency, it is unethical in a world-community sense in the face of the ecological and social disasters engendered by the modern energy regime. Sociologists have the theoretical and methodological tools to challenge the dominant view, and assert the social scientific realities of the energy crises, as James Hansen and other climate scientists have gone to great lengths to do around the world, from the perspective of their own disciplines. Some sociologists, of course, already do this, but they are clearly in the minority. Important for the current era, the approach outlined here allows for the conceptualization of the relationship between the accumulation of environmental and social degradation and the accumulation of capital, which is the driving force organizing productive relations across the globe. In further

developing the critical sociology of energy, which does not abstract away our ability to observe the relationships between oppression, exploitation and the political economy of energy, as well as the ecological impact of energy choices, this theoretical space is crucial.

The question from this perspective is not how do we keep the system from failing, by making possible constant energy infusions, but what will happen if the system survives? What will happen if capitalism persists another fifty years? As social scientists, this is something we can answer and we should. We should also not refrain from critique of the perspective dominating energy studies that ignores the implications of the diversity of social and ecological science. As Lewontin and Levins (2007) wrote, "we should not pretend or aspire to a bland neutrality but proclaim as our working hypothesis: all theories are wrong that promote, justify, or tolerate injustice" (99). They write that the "optimal condition for science is one foot in the university and one foot in the community in struggle, so that we have the richness and complexity of theory coming from the particular and the comparative view, and the generalizations that only some distance form the particular provide" (98). The sociology of energy, with energy justice at its heart, is the theoretical basis for just such a science of energy.

This approach to energy studies draws on theoretical developments that are complementary as a result of shared commitments to uniting materialist social and ecological analyses and connecting theory and praxis, moving back and forth between the academy and experience on the ground. Such groundwork furthers the focus on energy justice in sociology. This focus makes possible a more relevant contribution to the struggle for the next energy revolution, which is necessarily part of a larger

transformation of the social metabolic order, transcending the social and ecological rift of capitalism. In other words, sociology should re-orient itself to provide for the scientific needs of the energy justice revolution, the components of which are perhaps best outlined in the Acuerdo de los Pueblos (People's Agreement) of 2010, also called the Cochabamba Protocol. Ariel Salleh argues in her most recent book that "the case for leadership by the South is stronger than any moral position based on a 'we are not the polluters' argument. Many of these communities have invented models of economics that protect ecological sustainability" (Salleh 2009, 7). The People's Agreement reflects the importance of this leadership, which builds on an advanced understanding of the interface between inequality and ecological depredations, in the struggle for energy justice.

In April of 2010 the people of the global South and their allies concerned with the ecological and social crises of this ecohistorical period held a major gathering in Tiquipaya, Bolívia, just outside of Cochabamba. An agreement was reached on the priorities of the Global Movement of Peoples for Mother Earth. This agreement calls for the immediate reduction of emissions, an end to militarism and the domination of the world's people by the rich, and the repayment of the ecological debts associated with the history of imperialism and ecological degradation of capitalism. It focuses on the need for a re-orientation of our activities to address, what we call, the ecological and social rift of capitalism, and retrain our efforts to the restoration of the earth and our communities. Restoration, which involves the redress of ecological and social debts, is necessary to begin anew the relations between human beings and between human beings and the rest of the biosphere, of which we are only a part. Only under such new relations can the long-term provisioning for social and ecological reproduction be realized. To these ends

the agreement calls for the implementation of a legal framework that protects the rights of mother earth and the sovereignty of the world's peoples, and makes it possible to bring those responsible for the crimes of oppression and ecological degradation to justice. It calls for a real binding, enforceable agreement based on an environmental justice framework, unlike the Kyoto protocol, and the favored "voluntary mechanisms" of governments and business for not addressing climate change. The protocol is clear that the struggle against climate change is the struggle against oppression, and a struggle for ecological and social restoration and recovery, in other words it is a struggle for energy justice.

REFERENCES CITED

Alekseev. G.N. (1978) 1986. *Energy and Entropy*. Moscow: Mir Publishers.

Allen, Katie. 2010. "Friends of the Earth Urges End to 'Land Grab' for Biofuels." *The Guardian*, August 30. Accessed January 15, 2011. http://www.guardian.co.uk/ environment/2010/aug/30/ biofuels-land-grab-friends-of-the-earth.

Altieri, Miguel A. 2002. "The Principles and Strategies of Agro-ecology in Cuba." In *Sustainable Agriculture and Resistance: Transforming Food Production in Cuba*, edited by Fernando Funes, Luis Garcia, Martin Bourque, Nilda Perez, and Peter Rosset, xi-xiii. Oakland, CA: Food First Books.

Altieri, Miguel A. and Fernando R. Funes-Monzote. 2012. "The Paradox of Cuban Agriculture." *Monthly Review* 63 (8). Accessed May 3, 2012. http://monthlyreview.org/2012/01/01/the-paradox-of-cuban-agriculture.

Amin, Samir. 1976. *Unequal Development: An Essay on the Social Formation of Peripheral Capitalism*. New York: Monthly Review Press.

———. [1978] 2010. *The Law of Worldwide Value*. New York: Monthly Review Press.

Anderson, Charles H. 1976. *The Sociology of Survival: Social Problems of Growth*. Homewood, IL: The Dorsey Press.

Anzaldúa, Gloria, and AnaLouise Keating. 2002. *This Bridge We Call Home: Radical Visions for Transformation*. New York: Routledge.

Argüelles, María del Carmen Zabala. 2010. "Poverty and Vulnerability in Cuba Today." *Socialism and Democracy* 24 (1): 109-26.

Bagchi, Amiya Kumar. 2005. *Perilous Passage: Mankind and the Global Ascendancy of Capital*. Lanham, Md: Rowman & Littlefield Publishers.

Baran, Paul A. and Paul M. Sweezy. *Monopoly Capital: An Essay on the Economic and Social Order*. New York: Monthly Review Press.

Bazilian, Morgan. 2009. "Technology in the UN Climate Change Negotiations: Moving Beyond Abstraction." Policy brief, September 2. Harvard Project on International Climate Agreements, Belfer Center for Science and International Affairs, Harvard Kennedy School, Harvard University.

Bell, Karen. 2011. "Environmental Justice in Cuba." *Critical Social Policy* 31 (2): 241-65.

Bell, Michael Mayerfeld. 1998. *An Invitation to Environmental Sociology*. Thousand Oaks, CA: Sage Publications.

Brolin, John. 2006. *The Bias of the World: Theories of Unequal Exchange in History*. PhD diss., Lund University. Lund, Sweden: Studdentlitteratur.

Brownhill, Leigh and Terisa E. Turner. 2009. "Women and the Abuja Declaration for Energy Sovereignty." In *Eco-Sufficiency and Global Justice*, edited by Ariel Salleh, 230-50. New York: Pluto Press.

Büchs, Milena, Nicholas Bardsley, and Sebastian Duwe. "Who Bears the Brunt? Distributional Effects of Climate Change Mitigation Policies." *Critical Social Policy* 31 (2): 285-307.

Bullard, Robert D. 1983. "Solid Waste Sites and the Houston Black Community." *Sociological Inquiry* 53:273-88.

———.1992. "The Politics of Race and Pollution." Interview in *Multinational Monitor* 14 (6). Accessed March 31, 2012. http://www.multinationalmonitor.org/hyper/ issues/1992/06/ mm0692_01.html

———. 1994. *Dumping in Dixie: Race, Class, and Environmental Quality*. Boulder: Westview Press.

———. 1999. "Environmental Justice: An Interview with Robert Bullard." By Errol Schweizer. *Earth First! Journal* (July). Accessed February 27, 2011. http://www.ejnet.org/ej/bullard.html.

———. 2002. "Confronting Global Environmental Racism in the Twenty-First Century." *Global Dialogue* 4 (1). Accessed January 12, 2011. http://www.worlddialogue.org/content.php?id=179.

Bunker, Stephen G. 1984. "Modes of Extraction, Unequal Exchange, and the Progressive Underdevelopment of an Extreme Periphery: The Brazilian Amazon, 1600-1980." *American Journal of Sociology* 89 (5): 1017-64.

———.1985. *Underdeveloping the Amazon: Extraction, Unequal Exchange, and the Failure of the Modern State*. Urbana: University of Illinois Press.

———.2005. "How Ecologically Uneven Developments Put the Spin on the Treadmill of Production." *Organization & Environment* 18 (1): 38-54.

Burkett, Paul. 1999. *Marx and Nature: A Red and Green Perspective*. New York: St. Martin's Press.

———.2005. “Marx’s Vision of Sustainable Human Development.” *Monthly Review* 57 (5). Accessed January 10, 2011. http://monthlyreview.org/2005/10/01/marxs-vision-of-sustainable-human-development.

———.2006. *Marxism and Ecological Economics: Toward a Red and Green Political Economy*. Leiden: Brill.

Burket, Paul and John Bellamy Foster. 2006. “Metabolism, Energy and Entropy in Marx’s Critique of Political Economy: Beyond the Podolinsky Myth.” *Theory and Society* 35:109-56.

Buttel, Frederick H. 1976. "Social Science and the Environment: Competing Theories.” *Social Science Quarterly* 57 (2): 307-23.

Catton, William R. 1980. Overshoot: The Ecological Basis of Revolutionary Change. Chicago: University of Illinois Press.

Catton, William R. and Riley E. Dunlap. 1978a. "Environmental Sociology: A New Paradigm." *The American Sociologist* 13:41-49.

———. 1978b. "Paradigms, Theories and the Primacy of the HEP-NEP Distinction." *The American Sociologist* 13:256-59.

Clark, Brett, and John Foster. 2009. "Ecological Imperialism and the Global Metabolic Rift." *International Journal of Comparative Sociology* 50 (3-4): 311-34.

Clark, Brett, Andrew K. Jorgenson, and Jeffrey Kentor. 2010. "Militarization and Energy Consumption." *International Journal of Sociology* 40 (2): 23-43.

Clark, Brett, and Richard York. 2005. "Carbon Metabolism: Global Capitalism, Climate Change, and the Biospheric Rift." *Theory and Society* 34 (4): 391-428.

———.2008. “Rifts and Shifts: Getting to the Root of Environmental Crises.” *Monthly Review* 60 (6). Accessed January 15, 2011. http://monthlyreview.org/2008/11/01/rifts-and-shifts-getting-to-the-root-of-environmental-crises

Clausen, Rebecca. 2007. “Healing the Rift: Metabolic Restoration in Cuban Agriculture.” *Monthly Review*. 59 (2). Accessed February 25, 2011. http://monthlyreview.org/2007/05/01/healing-the-rift.

Clausen, Rebecca and Brett Clark. 2005. “The Metabolic Rift and Marine Ecology.” *Organization and Environment* 18 (4): 422-44.

Cleveland, Cutler. 1987. “Biophysical Economics: Historical Perspectives and Current Research Trends.” *Ecological Modelling* 38 (1-2): 47-73.

Cole, Luke W. and Sheila Foster. 2001. *From the Ground Up: Environmental Racism and the Rise of the Environmental Justice Movement*. New York: New York University Press.

Collier, Paul, and Benedikt Goderis. 2007. *Commodity Prices, Growth, and the Natural Resource Curse Reconciling a Conundrum*. Oxford: University of Oxford, Centre for the Study of African Economies.

Commoner, Barry. 1977. *The Poverty of Power: Energy and the Economic Crisis.* New York: Bantam Books.

Companioni, Nelso, Yanet Ojeda Hernández, Egidio Páez, and Catherine Murphy 2002. "The Growth of Urban Agriculture." In *Sustainable Agriculture and Resistance: Transforming Food Production in Cuba*, edited by Fernando Funes, Luis García, Martin Bourque, Nilda Pérez, and Peter Rosset, 220-36. Oakland, CA: Food First Books.

Connell, R., and James Messerschmidt. 2005. "Hegemonic Masculinity." *Gender & Society* 19 (6): 829-59.

Cooper, Richard S., Joan F. Kennelly, and Pedro Orduñez-Garcia. 2006. "Health in Cuba." *International Journal of Epidemiology* 35:817-24.

Cottrell, Fred. 1955. *Energy and Society: The Relation Between Energy, Social Changes, and Economic Development.* New York: McGraw-Hill.

Craige, Betty Jean. 2001. *Eugene Odum: Ecosystem Ecologist and Environmentalist.* Athens, GA: University of Georgia Press.

Cullen, Heidi. 2010. *The Weather of the Future: Heat Waves, Extreme Storms, and Other Scenes from a Climate-Changed Planet*. New York: Harper Collins.

Daly, Herman, ed. 1973. *Toward a Steady-State Economy*. San Francisco: W.H. Freeman.

———.1977. *Steady State Economics*. San Francisco: W.H. Freeman.

David, P. A., and G. Wright. 1997. "Increasing Returns and the Genesis of American Resource Abundance." *Industrial and Corporate Change* 6 (2): 203-46.

Davis, Angela Y. 1983. *Women, Race & Class*. New York: Vintage Books.

Deere, Carmen Diana and Cheryl R. Doss. 2008. "Gender and the Distribution of Wealth in Developing Countries." In *Personal Wealth From a Global Perspective*, edited by James B. Davies, 353-72. Oxford: Oxford University Press.

De La Fuente, Alejandro. 2008. “Recreateing Racism: Race and Discrimination in Cuba’s Special Period.” In *A Contemporary Cuba Reader: Reinventing the Revolution*, edited by Philip Brenner, Marguerite Rose Jiménez, John M. Kirk, and William M. LeoGrande, 316-25. New York: Rowman and Littlefield Publishers, Inc.

DeVincenzo King, Danielle Marie. 2006. *Emergy Accounting of the Resource Basis of Nations, Human Well-Being and International Debt*. PhD diss., University of Florida. Gainesville, FL: University of Florida.

Domhoff, G.William. 2009. “The Power Elite and their Challengers: The Role of Nonprofits in American Social Conflict.” *American Behavioral Scientist* 52 (7): 955-73.

Du Bois, W. E. B. (1903) 1989. *The Souls of Black Folk*. New York: Bantam Books.

Dunbar-Ortiz, Roxanne. 2003. “Cowboys and Indians: The Grid of History.” *Monthly Review* 55 (3). Accessed December 15, 2010. http://monthlyreview.org/2003/07/01/the-grid-of-history-cowboys-and-indians.

Dunlap, Riley E. 2010. “Climate Change and Rural Sociology: Broadening the Research Agenda.” *Rural Sociology* 75 (1): 17–27.

Ehrenreich, Barbara, and Arlie Russell Hochschild. 2003. *Global Woman: Nannies, Maids, and Sex Workers in the New Economy*. New York: Metropolitan Books.

Emmanuel, Arghiri. 1972. *Unequal Exchange: A Study of the Imperialism of Trade*. New York: Monthly Review Press.

Engels, Friedrich. (1845) 1958. *The Condition of the Working Class in England*. Oxford: B. Blackwell.

Energy Information Administration (EIA). 2008. “Greenhouse Gases, Climate Change, and Energy.” Washington D.C.: U.S. Department of Energy/Energy Information Administration. Brochure #DOE/EIA-X012.

Ergas, Christina, York, Richard. 2012. “Women’s Status and Carbon Dioxide Emissions: A Quantitative Cross-National Analysis.” *Social Science Research*. Accessed May 4, 2012. http://dx.doi.org/10.1016/j.ssresearch.2012.03.008.

Faber, Daniel. 2007. “A More ‘Productive’ Environmental Justice Politics: Movement Alliances in Massachusetts for Clean Production and Regional Equity.” In *Environmental Justice and Environmentalism*, edited by Ronald Sandler and Phaedra C. Pezzullo, 135-64. Cambridge, MA: MIT Press.

Ferrett, Grant. 2007. “Biofuels ‘Crime Against Humanity.’” *BBC News*, October 27. Accessed December 15, 2010. http://news.bbc.co.uk/2/hi/7065061.stm.

Fisher, Dana R., and William R. Freudenburg. 2001. "Ecological modernization and its critics: Assessing the Past and Looking Toward the Future." *Society and Natural Resources* 14:701–09.

Fleites-Lear, Marisela. 2000. “Women, Family, and the Cuban Revolution: A Personal and Socio-political Analysis.” In *Cuban Transitions at the Millennium*, edited by Eloise Linger and John Cotman, 33-54. Largo, Maryland: International Development Options.

Foster, John Bellamy. 1999a. "Marx's Theory of Metabolic Rift: Classical Foundations for Environmental Sociology.” *American Journal of Sociology* 105 (2): 366-405.

———. 1999b. *The Vulnerable Planet: A Short Economic History of the Environment*. New York: Monthly Review.

———.2000a. *Marx's Ecology: Materialism and Nature*. New York: Monthly Review Press.

———.2000b. “Marx’s Ecological Value Analysis.” *Monthly Review* 52 (September). Accessed January 10, 2011. http://monthlyreview.org/2000/09/01/marxs-ecological-value-analysis

———.2002. *Ecology Against Capitalism*. New York: Monthly Review Press.

———.2006. *Naked Imperialism*. New York: Monthly Review Press.

———. 2009. *The Ecological Revolution: Making Peace with the Planet*. New York: Monthly Review Press.

———.2011a. “Occupy Denialism: Toward Ecological and Social Revolution.” *Mrzine.org*, November 11. Accessed February 14, 2012. http://mrzine.monthlyreview.org/2011/foster111111.html.

———.2011. “Capitalism and the Accumulation of Catastrophe.” *Monthly Review* 63 (December). Accessed March 15, 2012. http://monthlyreview.org/2011/12/01/capitalism-and-the-accumulation-of-catastrophe.

———.2011. “Capitalism and Environmental Catastrophe.” *Mrzine.org,* October 29. Accessed December 12, 2011. http://mrzine.monthlyreview.org/2011/foster291011.html.

———.2012. “The Planetary Rift and the New Human Exemptionalism: A Political-Economic Critique of Ecological Modernization Theory,” Paper to be presented to Panel on Global Climate Change and Other Environmental Distruptions, the Political Economy of the World System Section, Annual Conference of the American Sociological Association Conference, Denver.

Foster, John Bellamy and Brett Clark and Richard York. 2009. "The Midas Effect: A Critique of Climate Change Economics." *Development and Change* 40 (6): 1085-97.

———.2010. *The Ecological Rift: Capitalism’s War on the Earth*. New York: Monthly Review Press.

Foster, John Bellamy and Paul Burkett. 2004. “Ecological Economics and Classical Marxism: The ‘Podolinsky Business’ Reconsidered.” *Organization & Environment* (17) 1: 32-60.

———.2006. “Metabolism, Energy, and Entropy in Marx’s Critique of Political Economy: Beyond the Podolinsky Myth.” *Theory and Society* 35:109-56.

Foster, John Bellamy, and Hannah Holleman. 2012. “Weber and the Environment: Classical Foundations for a Postexemptionalist Sociology.” *American Journal of Sociology* 117 (6). http://www.jstor.org/page/journal/amerjsoci/about.html.

Foster, John Bellamy, Hannah Holleman, Robert W. McChesney. 2008. “The U.S. Imperial Triangle and Military Spending.” *Monthly Review* 60 (5). Accessed February 15, 2011. http://monthlyreview.org/2008/10/01/the-u-s-imperial-triangle-and-military-spending.

Foster, John Bellamy and Robert W. McChesney. 2009. “A New New Deal Under Obama?” *Monthly Review* 60 (9). Accessed December 15, 2010. http://monthlyreview.org/2009/02/01/a-new-new-deal-under-obama.

Foster, John Bellamy and Fred Magdoff. 2008. “Financial Implosion and Stagnation.” *Monthly Review* 60 (7). Accessed January 25, 2011. http://monthlyreview.org/2008/12/01/financial-implosion-and-stagnation.

Foster, John Bellamy, and Henryk Szlajfer. (1984) 2009. *The Faltering Economy: The Problem of Accumulation Under Monopoly Capitalism*. New York: Monthly Review Press.

Foster, John Bellamy, Brett Clark and Richard York. 2010. *The Ecological Rift: Capitalism’s War on the Earth*. New York: Monthly Review Press.

Fracchia, Joseph. 2008. “The Capitalist Labour-Process and the Body in Pain: the Corporeal Depths of Marx’s Concept of Immiseration.” *Historical Materialism* 16:35–66.

Friedman, Thomas L. 1999. “A Manifesto for the Fast World.” *The New York Times Magazine*, March 28. Accessed September 15, 2011. www.nytimes.com/1999/03/28/magazine/a-manifesto-for-the-fast-world.html?pagewanted=all&src=pm

———.2005. *The World is Flat: A Brief History of the Twenty-First Century*. New York: Farrar, Straus and Giroux.

———. 2008. *Hot, Flat, and Crowded: Why We Need a Green Revolution—And How It Can Renew America*. New York: Farrar, Straus and Giroux.

Fuente, Alejandro de la. 2008. “Recreating Racism: Race and Discrimination in Cuba’s Special Period.” In *A Contemporary Cuba Reader: Reinventing the Revolution*, edited by Philip Brenner, Marguerite Rose Jiménez, John M. Kirk, and William M. LeoGRANDE, 316-25. New York: Rowman and Littlefield Publishers, Inc.

Fukuyama, Francis. 2006. “The Clash of Cultures and American Hegemony.” *The American Interest* (September/October). Accessed April 25, 2012. http://www.the-american-interest.com/article.cfm?piece=178.

Funes, Fernando and Pasture Forage Research Institute. 2002. “The Organic Farming Movement in Cuba.” In *Sustainable Agriculture and Resistance: Transforming Food Production in Cuba*, edited by Fernando Funes, Luis Garcia, Martin Bourque, Nilda Perez, and Peter Rosset, 1-26. Oakland, CA: Food First Books.

Garner, Dwight. 2011. “Visions of an Age When Oil Isn’t King.” *New York Times,* September 20. Accessed April 15, 2012. http://www.nytimes.com/2011/09/21/books/the-quest-by-daniel-yergin-review.html.

Georgescu-Roegen, N. 1975. “Energy and Economic Myths.” *Southern Economic Journal* 41:347-81.

Golley, Frank Benjamin. 1993. *A History of the Ecosystem Concept in Ecology*. New Haven, CT: Yale University Press.

Gronewold, Nathaniel. 2009. “Who Will Profit from Climate Change?” *Scientific American.com*, April 2. Accessed April 29, 2012. http://www.scientificamerican.com/article.cfm?id=profit-from-climate-change.

Hagen, Joel B. 1992. *An Entangled Bank: The Origins of Ecosystem Ecology*. New Brunswick, NJ: Rutgers University Press.

Haila, Yrjö, and Richard Levins. 1992. *Humanity and Nature: Ecology, Science, and Society*. London: Pluto Press.

Hall, Charles A.S., ed. 1995. *Maximum Power: The Ideas and Applications of H.T. Odum*. Niwot, Colorado: University of Colorado Press.

Hammond, Matthew B. 1931. "Economic Conflict as a Regulating Force in International Affairs." *The American Economic Review* 21 (1): 1-9.

Hansen, James E. 2009. *Storms of My Grandchildren: The Truth About the Coming Climate Catastrophe and Our Last Chance to Save Humanity*. New York: Bloomsbury USA.

———. 2010. "Global Warming Time Bomb: How to Avert Disaster." Transcript of public talk delivered for the Wayne Morse Center for Law and Politics, October 16. Eugene, Oregon.

Hayek, Friedrich A. von. 1960. *The Constitution of Liberty*. Chicago: University of Chicago Press.

Holleman, Hannah. 2012. "Energy Policy and Environmental Possibilities: Biofuels and Key Protagonists of Ecological Change." *Rural Sociology* 77(2): 280-307.

Ho, Mae-Wan. 2008. "Organic Agriculture and Localized Food & Energy Systems for Mitigating Climate Change." *Institute of Science and Society Report*, October 15. Accessed April 20, 2012. http://www.i-sis.org.uk/OAMCC.php.

Hornborg, Alf. 2001. *The Power of the Machine: Global Inequalities of Economy, Technology, and Environment.* Walnut Creek, CA: AltaMira Press.

———.2003. "The Unequal Exchange of Time and Space: Toward a Non-Normative Ecological Theory of Exploitation." *Journal of Ecological Anthropology* 7:4-10.

———.2009. "Zero-Sum World : Challenges in Conceptualizing Environmental Load Displacement and Ecologically Unequal Exchange in the World-System." *International Journal of Comparative Sociology* 50:237-62.

Huberman, Leo, and Paul M. Sweezy. 1961. *Cuba: Anatomy of a Revolution*. New York: Monthly Review Press.

Hymer. Stephen. 2011. "Robinson Crusoe and the Secret of Primitive Accumulation." *Monthly Review* 63(4). Accessed April 20, 2012. http://monthlyreview.org/2011/09/01/robinson-crusoe-and-the-secret-of-primitive-accumulation.

International Atomic Energy Agency (IAEA). 2008. *Cuba: A Country Profile on Sustainable Energy Development*. Vienna, Austria: International Atomic Energy Agency.

Ingwersen, Wesley W. 2011. "Emergy as a Life Cycle Assessment Indicator: A Gold Mining Case Study." *Journal of Industrial Ecology* 15 (4): 550-66.

Jollands, Nigel. 2006. "Concepts of Efficiency in Ecological Economics: Sisyphus and the Decision Maker." *Ecological Economics* 56:359-72.

Jorgenson, Andrew K. 2010. "World-Economic Integration, Supply Depots, and Environmental Degradation: A Study of Ecologically Unequal Exchange, Foreign Investment Dependence, and Deforestation in Less Developed Countries." *Critical Sociology* 36 (3): 453-77.

Kakela, Peter J. 1978. "Iron Ore: Energy, Labor, and Capital Changes with Technology." *Science* 202:1151-57.

Kapp, K. William. 1950. *The Social Costs of Private Enterprise*. Cambridge, MA: Harvard University Press.

King, Toni C., Lenora Barnes-Wright, Nancy E. Gibson, Lakesia D. Johnson, Valerie Lee, Betty M. Lovelace, Sonya Turner, and Durene E. Wheeler. 2002. "Andrea's Third Shift: The Invisible Work of African-American Women in Higher Education." In *This Bridge We Call Home*, edited by Gloria E. Anzuldúa and AnaLouise Keating, 403-14. New York: Routledge.

Klare, Michael. 2011. "America's Oil-Fueled Collapse." *Salon.com*, September 15. Accessed January 10, 2012. http://www.salon.com/2011/09/15/ america_oil_decline/.

Klein, Naomi. 2007. *The Shock Doctrine: The Rise of Disaster capitalism*. New York: Metropolitan Books/Henry Holt.

———.2012. Interview with Naomi Klein. Accessed January 15, 2012. http://wn.com/ecological_debt.

Koont, Sinan. 2009. "The Urban Agriculture of Havana." *Monthly Review* 60(8). Accessed February 15, 2012. http://monthlyreview.org/2009/01/01/the-urban-agriculture-of-havana.

———.2011. *Sustainable Urban Agriculture in Cuba.* Gainesville: University Press of Florida.

Kraft, Robin. 2009. "Pondering Ecuador's Yasuni Proposal." *Ecosystem Marketplace*, August 7. Accessed January 12, 2012. http://www.ecosystemmarketplace.com.

Lamrani, Salim, ed. 2005. *Superpower Principles: U.S. Terrorism Against Cuba*. Monroe, ME: Common Courage Press.

Lawrence, Kirk. 2009. "The Thermodynamics of Unequal Exchange." *International Journal of Comparative Sociology* 50 (3-4): 335-59.

Leacock, Eleanor Burke. 1981. *Myths of Male Dominance: Collected Articles on Women Cross-Culturally*. New York: Monthly Review Press.

Levins, Richard. 2005. "How Cuba is Going Ecological." *Capitalism, Nature, Socialism* 16 (3): 7-26.

Lewontin, Richard, and Richard Levins. 2007. *Biology Under the Influence: Dialectical Essays on Ecology, Agriculture, and Health*. New York: Monthly Review Press.

Longo, Stefano B. 2012. "Mediterranean Rift: Socio-Ecological Transformations in the Sicilian Bluefin Tuna Fishery." *Critical Sociology* 38 (3): 417-36.

Longo, Stefano B. and Rebecca Clausen. 2011. "The Tragedy of the Commodity: The Overexploitation of the Mediterranean Bluefin Tuna Fishery." *Organization and Environment* 24:312-28.

Lorde, Audre. 1984. *Sister Outsider*. New York: Crossing Press.

Lovins, Amory. 1977. *Soft Energy Paths*. Cambridge, MA: Ballinger.

Lugones, Maria. 2008. "Heterosexualism and the Colonial / Modern Gender System." *Hypatia* 22 (1): 186-209.

Lutzenhiser, Loren. 1994. "Sociology, Energy and Interdisciplinary Environmental Science." *The American Sociologist* (Spring): 58-79.

Magdoff, Harry. 1978. *Imperialism: From the Colonial Age to the Present.* New York: Monthly Review Press.

———. 2003. *Imperialism Without Colonies*. New York: Monthly Review.

Magdoff, Fred, and John Bellamy Foster. 2011. *What Every Environmentalist Needs to Know About Capitalism: A Citizen's Guide to Capitalism and the Environment*. New York: Monthly Review Press.

Mancus, Philip. 2007. "Nitrogen Fertilizer Dependency and Its Contradictions: A Theoretical Exploration of Social-Ecological Metabolism." *Rural Sociology* 72 (2): 269-88.

Martínez-Alier, Joan. 1987. *Ecological Economics: Energy, Environment, and Society*. Oxford [Oxfordshire]: Basil Blackwell.

———.2002. *The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation*. Northhampton, MA: Edward Elgar Pub.

Marx, Karl. (1867) 1990. *Capital: A Critique of Political Economy*. New York: Penguin Books.

Marx, Karl and Friedrich Engels. (1848) 1998. *The Communist Manifesto*. New York: Monthly Review Press.

Mazur, Allan and Eugene Rosa. 1974. "Energy and Life-style." *Science* 186:607-10.

McCright, Aaron. M. and Riley. E. Dunlap. 2010. "Anti-reflexivity : The American Conservative Movement's Success in Undermining Climate Science and Policy." *Theory, Culture and Society* 27 (2-3): 100-33.

McKibben, Bill. 2005. "The Cuban Diet: What Will You Be Eating when the Revolution Comes?" *Harper's Magazine*, April. Accessed April 25, 2012. http://www.harpers.org/archive/2005/04/0080501.

———.2010. Cover blurb for Heather Rogers's *Green Gone Wrong* (see Rogers 2010).

———. 2012. "Why Not to Frack?" *The New York Review of Books*, March 8. Accessed April 26. http://www.nybooks.com/articles/archives/2012/mar/08/why-not-frack/?pagination=false.

McKinnon, Andrew M. 2010."Energy and Society: Herbert Spencer's 'Energetic Sociology' of Social Evolution and Beyond." *Journal of Classical Sociology* 10 (4): 439-55.

Meadows, Donnella H., Dennis L. Meadows, Jørgen Randers, and William W. Behrens, III. 1972. *The Limits to Growth*. New York: Universe Books.

Mészáros, István. 2012. "Structural Crisis Needs Structural Change." *Monthly Review* 63 (10). Accessed May 2, 2012. http://monthlyreview.org/2012/03/01/structural-crisis-needs-structural-change.

Milanović, Branko. 2005. *Worlds Apart: Measuring International and Global Inequality*. Princeton, N.J.: Princeton University Press.

———.2009. *Global Inequality and the Global Inequality Extraction Ratio the Story of the Past Two Centuries*. Washington, D.C.: World Bank.

———.2011. "A Short History of Global Inequality: The Past Two Centuries." *Explorations in Economic History* 48 (4): 494-506.

Mills, C. Wright. 1960. *Listen, Yankee: The Revolution in Cuba*. New York: Ballantine Books.

Minority Rights Group International (MRG). 2012. Accessed May 1. http://www.minorityrights.org/7057/a-show-of-hands/abdon-nababan.html.

Mirowski, Philip. 1988. "Energy and Energetics in Economic Theory: A Review Essay." *Journal of Economic Issues* 22 (3): 811-30.

Mol, Arthur P.J. 2002. "Ecological Modernization and the Global Economy." *Global Environmental Politics* 2 (2): 92-115.

Mol, Arthur P.J. and Martin Jänicke. 2009. "The Origins and Theoretical Foundations of Ecological Modernisation Theory." In *The Ecological Modernisation Reader*, edited by Arthur P.J. Mol, David A. Sonnenfield, and Gert Spaargaren, 17-27. London: Routledge.

Mol, A. P. J., David Allan Sonnenfeld, and Gert Spaargaren. 2009. *The Ecological Modernisation Reader: Environmental Reform in Theory and Practice*. London: Routledge.

Morgan, Faith, Eugene Murphy, Megan Quinn, and Bruce Corner. 2006. *The Power of Community How Cuba Survived Peak Oil*. Yellow Springs, Ohio: Community Service.

Mumford, Lewis. 1934. *Technics and Civilization*. New York: Harcourt, Brace and Company.

Nagel, Joane, Jeffrey Broadbent, Thomas Dietz. 2009. *Sociological Perspectives on Global Climate Change*. Arlington, VA: National Science Foundation.

NEF. 2009. *The Unhappy Planet Index 2.0*. London: New Economics Foundation.

Norgaard, Kari Marie. 2011. *Living in Denial: Climate Change, Emotions, and Everyday Life*. Cambridge, Mass: MIT Press.

Núñez Jiménez, Antonio. 1961. *¡Patria o Muerte!* La Habana, Cuba: Instituto Nacional de Reforma Agraria.

Odum, Eugene P. 1997. *Ecology: A Bridge Between Science and Society*. Sunderland, MA: Sinauer Associates.

Odum, Howard T. 1974. *Energy, Economics & Ecology*. Denver, CO: Environmental Action Reprint Service.

———.1996. *Environmental Accounting: Emergy and Environmental Decision-Making*. New York: John Wiley and Sons.

———.2007. *Environment, Power, and Society for the Twenty-First Century: The Hierarchy of Energy*. New York: Columbia University Press.

Odum, Howard T. and Jan E. Arding. 1991. *Emergy Analysis of Shrimp Mariculture in Ecuador.* Narragansett, RI: Coastal Resources Center, University of Rhode Island.

Odum, Howard T. and Eugene P. Odum. 2000. "The Energetic Basis for Valuation of Ecosystem Services." *Ecosystems* 3 (1): 21-23.

Oreskes, Naomi. 2004. "Beyond the Ivory Tower: The Scientific Consensus on Climate Change." *Science* 306 (5702): 1686.

Ortiz, Santiago. 2011. "La Vulnerabilidad del Liderazgo de la Revolución Ciudadana y de la Institucionalidad en Ecuador." *Íconos* 39:25-34.

Ortiz T., Pablo. 2011. "Capitalismo Extractivo, Minería y Derechos: ¿Pueden cohabitar?" *Íconos* 39:11-23.

Osha, Sanya. 2006. "Birth of the Ogoni Protest Movement." *Journal of Asian and African Studies* 41 (1/2): 13-38.

Pagés, Raisa. 2008. "The Status of Cuban Women: From Economically Dependent to Independent." In *A Contemporary Cuba Reader: Reinventing the Revolution.* Edited by Philip Brenner, Marguerite Rose Jiménez, John M. Kirk, and William M. LeoGrande, 311-15. New York: Rowman and Littlefield Publishers, Inc.

Park, Angela. 2009. *Everybody's Movement: Environmental Justice and Climate Change*. Washington, D.C.: Environmental Support Center.

Peet, John. 1992. *Energy and the Ecological Economics of Sustainability.* Washington, D.C.: Island Press.

Pellow, David Naguib. 2000. "Toward a Theory of Environmental Injustice." *American Behavioral Scientist* 43 (4): 581-601.

———. 2007. *Resisting Global Toxics: Transnational Movements for Environmental Justice*. Cambridge, MA: MIT Press.

Pellow, David N., Adam Weinberg, and Allan Schnaiberg. 2005. "The Environmental Justice Movement: Equitable Allocation of the Costs and Benefits of Environmental Management Outcomes," In *Environmental Sociology, from Analysis to Action*, 240-52. Lanham Maryland: Rowman & Littlefield Publishers.

Pérez, David, Ileana López, and Ilse Berdellans. 2005. "Evaluation of Energy Policy in Cuba Using ISED." *Natural Resources Forum* 29 (4): 298-307.

Pérez-López, Jorge F. 1981."Energy Production, Imports, and Consumption in Revolutionary Cuba." *Latin American Research Review* 16 (3): 111-37.

Perkins, John. 2004. *Confessions of an Economic Hit Man*. San Francisco: Berrett-Koehler Publishers, Inc.

Piñon, Jorge R. and Jonathan Benjamin-Alvarado. 2010. "Extracting Cuba's Oil and Gas: Challenges and Opportunities." In *Cuba's Energy Future: Strategic Approaches to Cooperation*, edited by Jonathan Benjamin-Alvarado, 21-47. Washington, D.C.: Brookings Institute.

Premat, Adriana. 2005. "Moving Between the Plan and the Ground: Shifting Perspectives on Urban Agriculture in Havana, Cuba." In *Agropolis: The Social, Political and Environmental Dimensions of Urban Agriculture*, edited by Luc J. A. Mougeot, 153-85. Sterling, VA: Earthscan and the International Development Research Centre (IDRC).

Preobrazhensky, Evgenii Alexeyevich. (1926) 1965. *The New Economics*. Oxford: Oxford University Press.

Prieto, Rodrigo Espina and Pablo Rodríguez Ruiz. 2010. "Race and Inequality in Cuba Today." *Socialism and Democracy* 24 (1): 161-77.

Pulido, Laura. 2001. "Rethinking Environmental Racism: White Privilege and Urban Development in Southern California." *Annals of the Association of American Geographers* 90 (1): 12-40.

Pulver, Simone. 2007. "Making Sense of Corporate Environmentalism." *Organization and Environment* 20 (1): 44-83.

Radkau, Joachim. 1996. "Energy—Genie or Genius?" *History Today* 46 (11): 14-19.

Raby, Diana. 2009. "Why Cuba Still Matters." *Monthly Review*. Vol. 60 (8). Accessed April 29, 2012. http://monthlyreview.org/2009/01/01/why-cuba-still-matters.

Rice, James. 2009. "The Transnational Organization of Production and Uneven Environmental Degradation and Change in the World Economy." *International Journal of Comparative Sociology* 50 (3-4): 215-36.

Rodney, W. 1982. *How Europe Underdeveloped Africa*. Washington D.C.: Howard University Press.

Roediger, David R. 1991. *The Wages of Whiteness: Race and the Making of the American Working Class*. London: Verso.

Rogers, Heather. 2010. *Green Gone Wrong: How our Economy is Undermining the Environmental Revolution*. New York: Scribner.

Rosa, Eugene A., Gary E. Machlis, and Kenneth M. Keating. 1988. "Energy and Society." *Annual Review of Sociology* 14:149-72.

Rosset, Peter M. 1999. "Food and Justice in the New Millennium." In *The Paradox of Plenty: Hunger in a Bountiful World*, edited by Douglas M. Boucher, 330-36. Oakland, CA: Food First Books.

———.2000. "Cuba: A Successful Case Study of Sustainable Agriculture." In *Hungry for Profit: The Agribusiness Threat to Farmers, Food, and the Environment*, edited by Fred Magdoff, John Bellamy Foster, and Frederick H. Buttel, 203-14. New York: Monthly Review Press.

Rosset, Peter, and Medea Benjamin. 1994. *The Greening of the Revolution: Cuba's Experiment with Organic Agriculture*. Melbourne, Australia: Ocean.

Rosset, Peter M. and Shea Cunningham. 1994. "The Greening of Cuba: Organic Farming Offers Hope in the Midst of Crisis." In *The Paradox of Plenty: Hunger in a Bountiful World*, edited by Douglas M. Boucher, 290-96. Oakland, CA: Food First Books.

Royal Swedish Academy of Sciences (RSAS). 1987. "The Crafoord Prizewinners 1987 Eugene P. Odum and Howard T. Odum." Press release listed under *The Crafoord Prize*, September 1. Accessed February 19, 2012. http://www.crafoordprize.se.

Salleh, Ariel, ed. 2009. *Eco-Sufficiency and Global Justice*. New York: Pluto Press.

———.2010. "From Metabolic Rift to Metabolic Value: Reflections on Environmental Sociology and the Alternative Globalization Movement." *Organization and Environment* 23 (2): 205-19.

Sandalow, David. 2009. "President Obama's Energy and Climate Policy." Remarks Delivered to Beijing Energy Club, June 9. Accessed January 20, 2011. http://energy.gov/pi/office-policy-and-international-affairs/downloads/remarks-david-sandalow-assistant-secretary.

Schnaiberg, Allan. 1980. *The Environment, From Surplus to Scarcity*. New York: Oxford University Press.

———.2005. "The Economy and the Environment." In *The Handbook of Economic Sociology*, edited by Neil J. Smelser, Richard Swedberg, 703-26. Princeton: Princeton University Press.

Shiva, Vandana. 1997. *Biopiracy: The Plunder of Nature and Knowledge*. Boston: South End Press.

———. 2002. *Water Wars: Privatization, Pollution, and Profit*. Cambridge, MA: South End Press.

———.2005. *Earth Democracy: Justice, Sustainability, and Peace*. Cambridge, MA: South End Press.

Sinclair, Minor and Martha Thompson. 2008. "Going Against the Grain: Agricultural Crisis and Transformation." In *A Contemporary Cuba Reader: Reinventing the Revolution*, edited by Philip Brenner, Marguerite Rose Jiménez, John M. Kirk, and William M. LeoGrande, 156-67. New York: Rowman and Littlefield Publishers, Inc.

Sohn, Emily. 2011. "Is This the End of Men or the Beginning of Women?" *DisoveryNews.com*, September 20. Accessed January 29, 2012. http://news.discovery.com/human/women-men-workplace-110920.html

Solomon, Susan, Gian-Kasper Plattner, Reto Knutti, and Pierre Friedlingstein. 2009. "Irreversible Climate Change Due to Carbon Dioxide Emissions." *Proceedings of the National Academy of Sciences* 106 (6): 1704-09.

Sonnenfeld, David A. 2009 "Contradictions of Ecological Modernisation: Pulp and Paper Manufacturing in Southeast Asia." In *The Ecological Modernisation Reader*, edited by Arthur P. J. Mol, David A. Sonnenfield, and Gert Spaargaren, 372-93. London, England: Routledge.

Spaargaren, Gert and Arthur P.J. Mol . 2009 "Sociology, Environment, and Modernity: Ecological Modernization as a Theory of Social Change." In *The Ecological Modernisation Reader*, edited by Arthur P. J. Mol, David A. Sonnenfield, and Gert Spaargaren, 56-79. London, England: Routledge.

Spitzner, Meike. 2009. "How Global Warming is Gendered." In *Eco-Sufficiency and Global Justice*, edited by Ariel Salleh, 218-29. New York: Pluto Press.

Stricker, Pamela. 2010. "Bringing Social Justice Back in: Cuba Revitalizes Sustainable Development." *Local Environment* 15 (2): 185-97.

Taylor, Doreceta E. 2000. “The Rise of the Environmental Justice Paradigm: Injustice Framing and the Social Construction of Environmental Discourses.” *American Behavioral Scientist* 43:508-80.

———. 2002. *Race, Class, Gender, and American Environmentalism*. Portland, OR: U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Station.

Torras, Mariano. 2003. *Welfare, Inequality and Resource Depletion: A Reassessment of Brazilian Economic Growth*. Aldershot, Hants, England: Ashgate.

U.N. 2005. *The Millenium Development Goals: A Latin American and Caribbean Perspective*. Santiago: United Nations.

———.2008. “Biofuel Production is ‘Criminal Path’ Leading to Global Food Crisis.” *U.N. News Centre*, News Release, April 28. Accessed January 15, 2011. http://www.un.org/apps/news/story.asp?NewsID=26478&Cr=food&Cr1=ziegler

UNESCO. 2005. *Education for All Global Monitoring Report-Human Development Report.* Paris: United Nations Educational, Scientific and Cultural Organization.

U.N. General Assembly. 2011. “Speakers Denounce Cuban Embargo as ‘Sad Echo’ of Failed Cold War Politics; General Assembly, for Twentieth Year, Demands Lifting of Economic Blockade.” Press Release, October 25. Accessed January 29, 2012. http://www.un.org/News/Press/docs/2011/ga11162.doc.htm.

U.N.D.P. 2010. *Regional Human Development Report for Latin America and the Carribean*. New York: United Nations Development Programme.

———.2011. “International Human Development Indicators.” Accessed March 26, 2012. http://hdrstats.undp.org/en/countries/profiles/CUB.html.

———.2012. “Gender Inequality Index and Related Indicators.” Accessed March 26, 2012. http://hdr.undp.org/en/statistics/gii/.

U.N. Women Watch. 2012. *Women, Gender Equity, and Climate Change.* Accessed April 12, 2012. http://www.un.org/womenwatch/feature/climate_change/.

United States Census. 2011. “The Hispanic Population: 2010.” Washington D.C.: United States Census.

U.S. Department of State. 1961-63. *Foreign Relations of the United States 1961-63*, *Volume X Cuba, 1961-62*. Washington, D.C.: United States Government Printing Office. Department of State publication 10409. Accessed March 31, 2012. http://www.state.gov/www/about_state/history/frusX/.

Van der Ploeg, Frederick. 2011. "Natural Resources: Curse or Blessing?" *Journal of Economic Literature* 49 (2): 366-420.

Van de Ven, Johannes. 2010. "Ecuador's Yasuní-ITT Trust Fund – A Paradigmatic Shift in Global Development Cooperation." *Johanne van de Ven* (blog), August 12. Accessed December 20, 2011. http://johannesvandeven.blogspot.com/2010/08/ecuadors-yasuni-national-park.html.

Van Horn, Robert, Philip Mirowski, and Thomas A. Stapleford. 2011. *Building Chicago Economics New Perspectives on the History of America's Most Powerful Economics Program*. Cambridge: Cambridge University Press.

Vigil, María López. 2008. "Heroines of the Special Period." In *A Contemporary Cuba Reader: Reinventing the Revolution*, edited by Philip Brenner, Marguerite Rose Jiménez, John M. Kirk, and William M. LeoGrande, 309-10. New York: Rowman and Littlefield Publishers, Inc.

Waitzkin, Howard. 2000. *The Second Sickness: Contradictions of Capitalist Health Care*. Lanham, MD: Rowman & Littlefield.

Waring, Marilyn. 1990. *If Women Counted: A New Feminist Economics*. San Francisco: Harper & Row.

Waugh, Caleb Joseph. 2011. *Framing the Climate Debate: Knowledge Affirmation vs. Risk Mitigation.* Cambridge, MA: Massachusetts Institute of Technology, Engineering Systems Division. ESD Working Paper Series. ESD-WP-2011-03.

Weber, Max. (1905/1920) 1930. *The Protestant Ethic and the Spirit of Capitalism*. London: George Allen and Unwin.

_____. 1946. *From Max Weber*. New York: Oxford University Press.

_____. 1949. *The Methodology of the Social Sciences*. New York: Free Press.

_____. (1909) 1984. "'Energetic' Theories of Culture." *Mid-American Review of Sociology* 9 (2): 33-58.

_____. (1919-20) 2003. *General Economic History*. Mineola, New York: Dover.

_____. (1905/1920) 2009. *The Protestant Ethic and the Spirit of Capitalism with Other Writings on the Rise of the West*. London: George Allen and Unwin.

Webler, Thomas, and Seth B. Tuler. 2010. "Getting the Engineering Right Is Not Always Enough: Researching the Human Dimensions of the New Energy Technologies." *Energy Policy* 38 (6): 2690–91.

Whittle, Daniel, and Orlando Rey Santos. 2006.“Protecting Cuba's Environment: Efforts to Design and Implement Effective Environmental Laws and Policies in Cuba.” *Cuban Studies* 37:73-103.

Williamson, Harold F. 1945. "Prophecies of Scarcity or Exhaustion of Natural Resources in the United States." *The American Economic Review* 35 (2): 97-109.

Wittman, Hannah. 2009. "Reworking the Metabolic Rift: La Vía Campesina, Agrarian Citizenship, and Food Sovereignty." *Journal of Peasant Studies* 36 (4): 805-26.

Women’s Research Center. 1981. *Energy Development and Social Institutions: Community Research from the Perspective of Women in Northern Communities Impacted by the Alaska Highway Gas Pipeline.* Vancouver: The Center.

Wright, Gavin, and Jesse Czelusta. 2004. "Why Economies Slow: The Myth of the Resource Curse." *Challenge* 47 (2): 6-38.

Wright, Julia. 2009. *Sustainable Agriculture and Food Security in an Era of Oil Scarcity Lessons from Cuba*. London: Earthscan.

WWF. 2006. *Living Planet Report*. Washington, D.C.: World Wildlife Fund.

Yergin, Daniel. 2011a. “Author Daniel Yergin on U.S. Need for a ‘Diversified Energy Portfolio.’” *PBS Newshour*, December 23. Accessed May 1, 2012. http://www.pbs.org/newshour/bb/world/july-dec11/yergin_12-23.html.

————.2011b. *The Quest: Energy, Security and the Remaking of the Modern World*. New York: Penguin Press.

———.2011c. “Daniel Yergin Examines America’s ‘Quest’ for Energy.” *NPR.org.* Accessed May 1, 2012. http://www.npr.org/2011/09/20/140606249/daniel-yergin-examines-americas-quest-for-energy.

York, Richard. 2010. “Three Lessons from Trends in CO2 Emissions and Energy Use in the United States.” *Society and Natural Resources: An International Journal* 23 (12): 1244-52.

———.2012. “Do Alternative Energy Sources Displace Fossil Fuels?” *Nature Climate Change.* doi:10.1038/nclimate1451.

York, Richard, and Brett Clark. 2006. "Marxism, Positivism, and Scientific Sociology: Social Gravity and Historicity." *The Sociological Quarterly* 47 (3): 425-50.

York, Richard, and Philip Mancus. 2009. "Critical Human Ecology: Historical Materialism and Natural Laws.” *Sociological Theory* 27 (2): 122-49.

York, Richard, and Rosa, Eugene A. 2003. "Key Challenges to Ecological Modernization Theory." *Organization and Environment* 16 (3): 273-88.

York, Richard, Eugene A Rosa, and Thomas Dietz. 2003a. "Footprints on the Earth: The Environmental Consequences of Modernity." *American Sociological Review* 68 (2): 279-300.

———.2003b. "A Rift in Modernity? Assessing the Anthropogenic Sources of Global Climate Change with the STIRPAT Model." *International Journal of Sociology and Social Policy* 23 (10): 31-51.

York, Richard, Christina Ergas, Eugene A. Rosa, and Thomas Dietz. 2011. "It's a Material World: Trends in Material Extraction in China, India, Indonesia, and Japan." *Nature and Culture* 6 (2): 103-22.

Ziegler, Jean. 2011. *Destruction Massive: Géopolitique de la Faim*. Paris: Seuil.