

Key challenges to ecological modernization theory

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Articles

KEY CHALLENGES TO ECOLOGICAL MODERNIZATION THEORY

Institutional Efficacy, Case Study Evidence, Units of Analysis,
and the Pace of Eco-Efficiency

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We raise four challenges to the claim of ecological modernization theory (EMT) that continued modernization is necessary for ecological sustainability. First, EMT needs to go beyond merely demonstrating that societies modify their institutions in reaction to environmental problems and show that such modifications lead to ecological improvements. Second, EMT must show that late stages of modernizing processes lead to the ecological transformation of production and consumption at relatively high frequency. Third, EMT must demonstrate that industries or firms that are reducing their direct impact on the environment are not contributing to the expansion of negative impacts by other industries or firms. Fourth, EMT must show not only that economies are becoming more resource efficient but also that the pace of increase in efficiency exceeds the pace of increase in overall production. In this article, we review the existing evidence and find that EMT has insufficiently addressed these four issues.

Keywords: *Ecological Modernization Theory; case study evidence; eco-efficiency; STIRPAT research program; death penalty fallacy*

Ecological modernization theory (EMT) has emerged as a prominent neoliberal theory and one of the leading theories in environmental sociology. The tradition has established a clear theoretical and empirical program, has evolved through various stages of development, and has engaged the critiques of scholars from a variety of perspectives (Fisher & Freudenburg, 2001; Mol & Sonnenfeld, 2000a, 2000b; Mol & Spaargaren, 2000). Most generally, "the aim of Ecological Modernization Theory has been to analyze how contemporary industrialized societies deal with environmental crises" (Mol & Sonnenfeld 2000a, p. 5). EMT theorizes that continued industrial development, rather than inevitably continuing to degrade the environment, offers the best option for escaping from the global ecological challenge. Mol (1995), clearly articulating this expectation,

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states that “the only possible way *out* of the ecological crisis is by going further *into* the process of modernization” (emphases in original) (p. 42).¹

Central to EMT is the view that the era of late modernity offers promise that industrialization, technological development, economic growth, and capitalism are not only potentially compatible with ecological sustainability but also may be key drivers of environmental reform (Cohen, 1997, 1999; Mol, 1995, 1996, 2001, 2002; Mol & Sonnenfeld, 2000a; Mol & Spaargaren, 2000; Spaargaren, 1997, 2000; Spaargaren & Mol, 1992).² EMT is, therefore, a distinct counterpoint to theories from political economy (e.g., O’Connor, 1994; Schnaiberg, 1980) and “de-modernization” perspectives (e.g., Commoner, 1971; Devall & Sessions, 1985).

In sum, EMT suggests the possibility that inherent in the process of late modernization are self-referential mechanisms—such as the need to internalize environmental impacts in order to ensure future production inputs—that have the potential to lead to ecological sustainability. It argues for the potential of attaining sustainability from within—a greening of business as usual—thereby avoiding such challenging alternatives as radical structural or value changes in society. The pivotal question, then, is the extent to which such expectations are justified. In part, EMT’s commitment to the modernization project and its potential for sustainable capitalism stems from a belief that “all major, fundamental alternatives to the present economic order have proved infeasible according to various (economic, environmental, and social) criteria” (Mol & Spaargaren, 2000, p. 23). We take an alternative view in arguing that our options remain open and that the future is not set. Although it offers considerable hope for achieving sustainability, embedded in the propositions of EMT is a significant risk, the risk of complacency about alternative approaches to understanding and addressing the global environmental challenge. Hence, it is essential to put EMT to the most rigorous evaluations, lest the global community invest in a theory that cannot be supported. The central issue, then, is whether EMT’s claims are theoretically coherent and empirically valid.³

Our task here is to assess the substantive validity of the key claim of EMT that modernization is compatible with ecological sustainability. We identify four key challenges to EMT that are derived from this key claim and that call into question whether highly modernized societies can adequately address the global environmental challenge without radical structural change. These four challenges deal with (a) the logic of institutional claims, (b) appropriate methods for assessing probabilistic processes, (c) appropriate units of analysis for assessing empirical predictions, and (d) the pace of eco-efficient transformation of production (i.e., superindustrialization⁴). These challenges stem from the logical and empirical implications of EMT’s claims (particularly Challenge a), scientific methodological standards (particularly Challenges b and c), and the basic empirical evidence needed to support the claim of compatibility between the institutions of modernity and environmental protection (Challenge d). We do not argue that these are the only criteria by which the theory should be evaluated, only that they raise important issues that need to be addressed if EMT’s claim regarding the compatibility of modernization and sustainability is to be retained. Furthermore, here we are not challenging *all* claims of EMT, only those dealing with the purported potential beneficial effects of further modernization on ecological sustainability. We engage the claims of EMT and then elaborate and assess each of the aforementioned challenges.

THE QUESTION OF INSTITUTIONAL EFFICACY: THE DEATH PENALTY FALLACY

We assess the logic of institutional efficacy via an analogy. The United States, unlike nearly all other developed nations, permits capital punishment. There is little doubt that support for the death penalty is at least in part due to public concern about the prevalence of crime and the means of deterrence. Nonetheless, there is no convincing evidence that capital punishment deters crime more than other types of punishments for capital crimes (Paternoster, 1991; Radelet & Borg, 2000).⁵ This example raises an important distinction between societies' reactions to a social problem and the effect of those reactions on the problem itself. Acknowledging that some societies support capital punishment because they wish to deter crime is very different from arguing that capital punishment does in fact deter crime.

As we have established in the introductory discussion, a key premise of the EMT argument is that the stages of late modernization can produce institutional structures promoting ecological sustainability. The burden of proof for this claim rests on the need to address whether the logic of the argument is (a) simply that the institutions of late modernity change in response to environmental challenges, or whether it is (b) the stronger argument that institutional changes in late modernity help resolve environmental problems and lead to sustainability. The error of conflating the first argument with the second could be called the "death penalty fallacy." If EMT, on one hand, is merely making the first argument, then it has little to say about ecological crises and environmental sustainability (its purported project) other than that societies react to these issues with institutional structures that convey the impression of solving environmental problems. If this is the case, "*Ecological Modernization Theory*" is something of a misnomer and another name, such as "*Institutional Modernization Theory*," might be more appropriate. The central question of Mol's (1995) prominent study—"How, and to what extent, do environmental considerations trigger the ongoing transformation of the central, production-related, institutions of modern societies?" (p. 4)—suggests a commitment primarily to the first argument (although his previously quoted statement suggests he is also committed to the second argument).

On the other hand, if EMT is making the second argument—that institutional modernization actually helps to reduce environmental problems and bring about a transition to sustainability—then it attracts the burden of looking beyond changes in the structure of institutions and actually demonstrating positive environmental outcomes stemming from modernization. It must provide a theoretical specification of the connections between institution building and environmental outcomes. Stated differently, to avoid being guilty of the death penalty fallacy, EMT must demonstrate the efficacy of the institutions of late modernity, not just their ecological reorientation. It must also demonstrate this if it is truly about *ecological* modernization rather than merely about *institutional* responses to environmental problems.

To illustrate problems associated with assuming a connection between institutional form and environmental outcomes, we consider the role of the nation-state in environmental management and address issues regarding a mesolevel of analysis (i.e., organizations and industries) in following sections.⁶ Frank, Hironaka, and Schofer (2000) have convincingly demonstrated that over the course of the twentieth century, nation-states progressively accepted greater responsibility for environmental management, supporting the weaker first argument above. However, Buttel

(2000b) makes the point that even though Frank et al.'s (2000) "data do show a long-term pattern of diffusion [among nation-states] of [ecologically oriented] organizational forms, there is no evidence that this diffusion is effecting actual [environmental] outcomes" (p. 118). This leaves open the question at the heart of the second, stronger argument: Does "state environmentalism" (i.e., governmental support for environmental protection) lead to a decisive move to sustainability?

Our own extensive STIRPAT research program (York, Rosa, & Dietz, 2003)⁷ has failed, to date, to find any effect of state environmentalism (as indicated by environmental treaty ratification⁸) on aggregate national environmental impacts as measured by the "ecological footprint" (Wackernagel & Rees, 1996; Wackernagel et al., 1999), a composite indicator of resource consumption and waste production.⁹ We have also not found any beneficial effect from "political modernization" (i.e., political freedom and civil liberties) on a variety of environmental impacts (Rosa, York, & Dietz, 2001; York, Rosa, & Dietz 2003). Additionally, contrary to predictions of EMT, we have consistently found in analyses of a diversity of environmental impacts that the most highly modernized nations (as indicated by per capita GDP, urbanization, and economic structure) have the highest environmental impacts (Rosa & York, 2002; Rosa et al., 2001; York et al., 2003, in press, unpublished, 2003—see also Shi, 2003). Furthermore, in a comparison of European Union (EU) member states—those often assumed to be the most "ecologically modern"—with other national groupings, we did not find an "EU effect" on national impacts when controlling for other factors (Rosa & York, 2002). In fact, since EU nations have high levels of affluence, they tend to have some of the highest per capita environmental impacts in the world.

These findings receive further support in a straightforward assessment of the relationship between state environmentalism and environmental degradation. For 154 nations, the correlation between a ratification index—consisting of 22 multilateral environmental treaties through April 1999 (data from Roberts & Vásquez 2002)—and per capita emissions of carbon dioxide is positive ($r = .338, p < .001$). Thus, nations most likely to support environmental treaties are also the nations with the highest impact on the global environment.¹⁰ When looking at only the wealthiest 24 nations¹¹—arguably exemplars of late modernity—the correlation is even higher ($r = .425, p < .05$), indicating that, even among the most "modern" nations, state environmentalism does not contribute to genuine environmental reform.¹² These results are not encouraging regarding the efficacy of the institutions of modernity to solve environmental problems.

THE QUESTION OF FREQUENCY: CASE STUDY EVIDENCE AND STOCHASTIC PROCESSES

One major trend in the history of science in the twentieth century was a broad and general shift from a deterministic view of the social and natural world (i.e., the Newtonian clock-work universe) to a probabilistic view (i.e., "God plays dice"). The development of statistics that allow for modeling stochastic processes was an important part of this transformation (Salsburg, 2002). Assessing probabilistic processes requires making observations of multiple cases selected via probability sampling procedures, rather than simply studying a small selection of individual cases in detail.

Arguments over the health effects of smoking go straight to the heart of questions about how to assess processes with probabilistic, rather than deterministic, outcomes. We are all perhaps familiar with stories of someone's grandfather who

smoked three packs of cigarettes a day for most of his life and lived to be 98 years old. One could also point to cases, as the tobacco industry has, of people who have never smoked and yet developed lung cancer at the age of 30. Although interesting, such stories tell us little about the effect of smoking on cancer, other than that not all people who smoke develop cancer and that not all people who develop cancer smoke. The important question is whether smoking increases the *likelihood* of developing cancer (or other health problems). This is a question about the *frequency* of cancer in smokers relative to nonsmokers.

Some of the most prominent work in EMT has relied on case study evidence to demonstrate the positive effects of modernizing processes on environmental problems (Mol, 1995; Sonnenfeld, 1998). These studies are certainly valuable for detailing processes that may occur in specific industries, but they cannot yet speak to the general premises of EMT regarding the presumed effects of modernization (political, economic, or otherwise) on environmental sustainability. They can only do so under either of two conditions: by taking a deterministic view of causality (an increasingly untenable position in the twenty-first century) or by making the argument that the selected cases are the early and representative examples of a process that is still unfolding. Otherwise, pointing to environmental improvements in a single industry in a specific region or country, as both Mol (1995) and Sonnenfeld (1998) do, may no more demonstrate that modernization is good for the environment than does pointing to a healthy 98-year-old smoker demonstrate that smoking is good for one's health. At issue is whether modernization tends to increase or decrease environmental problems, a question that can properly be addressed only through an examination of a sufficient variety of cases.¹³

Andersen's (2002) work examining Eastern European nations after the collapse of the Soviet Union shows that over the 1990s, the environmental performance of eight Eastern European nations (Poland, Czech Republic, Slovakia, Romania, Russia, Estonia, Lithuania, and Ukraine) varied substantially. Andersen takes this as a sign that the nations with the best environmental performance out of this group are "ecologically modernizing," and then engages in a post hoc analysis to assess the factors responsible for these changes. Andersen thus improves somewhat on single case studies but still relies on a limited sample and fails to consider stochastic processes. This approach fails to recognize the potential for stochastic variance—that is, the diversity in environmental performance among nations may not reflect specific identifiable differences in major causal factors but rather mere chance or the fortuitous and ephemeral combination of individually minor and unsubstantial forces. Consider that if one were to toss eight six-sided dice, typically some would come up with high values and some with low values, but one would not rush to the conclusion that the ones with high values are in some way special. Nonetheless, Andersen draws a conclusion similar to this regarding the differences in performance of the eight nations he examines. This example points to one viable approach to the problem, namely the importance of statistical analyses that attempt to discern distinct patterns while taking into consideration stochastic variance.

Simply demonstrating that some nations (or industries or organizations) do better than others with respect to environmental responsibility does not address the claim central to EMT that modernization is an important force in bringing about sustainability. It merely shows that there is variability among modern societies or among sectors within modern societies in their degree of impact on the environment, not that any of these societies are sustainable or even marginally better than less modernized societies. Most important, such analyses do not demonstrate a clear trend toward sustainability with the advanced stages of modernization.

Demodernization theories and theories from political economy have also raised issues about the cases selected for study. For example, Schnaiberg, Pellow, and Weinberg (2002) make the point that the use of hand-picked case studies by ecological modernization (EM) theorists “makes it hard to distinguish between an ‘epidemic of reports’ and a ‘report of an epidemic’ of EM transformations” (p. 28). This raises the question of whether in fact *ecological improvements* in modern societies, industries, and firms are widespread. It may be instead simply that *reports* about the few examples that exist of ecological improvements are widespread. Furthermore, Schnaiberg et al. note that EM theorists interpret any sign of environmental reform as an indication that societies are “fully” moving in the direction of sustainability, whereas others may see such examples as “only” a minor change in the generally unsustainable practices of modern societies. For their part, Schnaiberg and colleagues have presented examples more indicative of ecological subversion in modernity than genuine ecological reform (Gould, Schnaiberg, & Weinberg, 1996; Pellow, Schnaiberg, & Weinberg, 2000; Schnaiberg & Gould, 1994; Weinberg, Schnaiberg, & Gould, 1995). EM theorists, then, have generally failed to refute the claims from demodernization and political economy perspectives that capitalism and modernization are incompatible with ecological sustainability.

THE SEARCH FOR ECOLOGICAL MODERNIZATION: UNITS OF ANALYSIS AND THE “NETHERLANDS FALLACY”

A key insight from sociology is that different processes occur at different levels of aggregation. This suggests that researchers need to be thoughtful in selecting their units of analysis and be cautious in interpreting the results of analyses. In the context of assessing EMT, this raises the question of where researchers should look for ecological modernization—at the level of the consumer, the organization, the industry, the nation, or the globe? There is not a single correct answer, of course, since the unit of analysis will depend on the specific research question. Nonetheless, we argue that in focusing on individual organizations and sectors within an economy (as, for example, do Mol, 1995 and Sonnenfeld, 1998), EM theorists may miss processes occurring at a more macro level.

Consider a situation where two people, after sharing a single residence for some time, decide to live separately, so one person moves out and establishes a new household. It is likely that energy use in the original household will decrease since there presumably will be a decline in hot water use, cooking, and so forth. However, it is unlikely that energy use will be cut in half, since some aspects of household energy use, such as climate control, are not dramatically affected by the number of residents (Lutzenhiser, 1997; Lutzenhiser & Hackett, 1993). If one were to focus exclusively on the original household, one would conclude that the separation of the two roommates helped reduce energy consumption. Is this an instance of ecologically sensitive lifestyle transformation? Of course not, because the person who moved out, establishing a new household, probably contributed to a net increase in energy consumption—that is, the combined energy consumption of the two households will likely exceed the energy consumption of the original single household, although the energy consumption of each new household may be less than that of the original household. The effect of this process would be visible at a greater level of aggregation—one would clearly see that decreasing the number of residents per household and thereby increasing the number of households has detrimental ecological consequences (see Liu, Daily, Ehrlich, & Luck, 2003)—although this effect

would not be readily apparent if one were to focus exclusively on the individual household.

The argument from political economy regarding the degradation of the environment resulting from the incessant expansion of production—Schnaiberg's (1980) "treadmill of production" and O'Connor's (1994) "second contradiction of capitalism"—is an argument principally about entire economies rather than individual organizations or industries within economies. This is a point that EM critiques of political economy tend to miss and one that is obscured by analyses of individual organizations or industries. In capitalist economies, and to a varying extent in other political economies, profit generated in one business or industry is free to be invested in other areas of the economy. Therefore, when focusing on one part of an economy, such as the Dutch chemical industry (Mol, 1995) or the Thai pulp industry (Sonnenfeld, 1998), it may be misleading to interpret rising profits coupled with declining resource use *in that sector* as a genuine instance of ecological improvement, because the profits generated in a specific industry may be invested elsewhere and therefore contribute substantially to expanding production and concomitant resource use and pollution in the economy as a whole.¹⁴

One way of addressing this problem is through analyses at greater levels of aggregation. Focusing on the nation-state may help avoid this problem to some extent. However, profit flows between nations as it does between economic sectors within a nation, and therefore a nation may reduce its impact on the environment within its borders simply by importing resources and exporting waste. Ehrlich and Holdren (1971) refer to the error of assuming that national environmental impacts are contained within national borders as the "Netherlands fallacy," in reference to the fact that a large share of the resources consumed in the Netherlands comes from elsewhere. Therefore, demonstrating that environmental conditions are improving within a nation (or within specific industries or organizations) is insufficient for establishing the existence of genuine progress toward sustainability. Sonnenfeld (2000) makes this point succinctly when he asks, "Is ecological modernization in advanced industrial societies dependent upon increased materialization elsewhere?" (p. 254)

Of course, at the global level, such "impact shuffling" will not be missed, but at this level, it is difficult to assess the factors leading to changes in impacts (one reason being that there is only one case, the entire world). In our STIRPAT research program, we have dealt with this problem by using a *consumption*-based indicator of impacts, the ecological footprint, that allocates responsibility for environmental degradation to the nation that consumes the products generated from extraction and manufacturing (York et al., 2002a, 2003, unpublished).¹⁵ The point here is simply that reductions in the resource intensity of a single industry may or may not be indicative of the total effect of the economic processes in that industry on the environment. This point suggests that EM researchers need to more carefully consider the units of analysis they use to assess their theory and how responsibility for resource use is allocated (e.g., to the producer or consumer).

HARES AND TORTOISES: THE PACE OF ECO-EFFICIENCY

Although the primary focus of EMT appears to be institutional transformation, the theory is also committed to a claim that an ecologically sustainable transformation of production and consumption can be achieved (Mol, 1995; Spaargaren,

1997). As Cohen (1997) wrote, “a key element in executing this transformation is a switchover to the use of cleaner, more efficient, and less resource intensive technologies through a process of ‘super industrialization’” (p. 109). Although not identical to industrial ecology (Graedel & Allenby, 1995) or the factor X (see Hawken, Lovins, & Lovins, 1999; White, 2002)¹⁶ traditions, EMT clearly shares their assumption that dramatic improvements in eco-efficiency and the dematerialization of production are feasible (for example, see Cohen, 1999, p. 104; Mol, 1995, pp. 37-40; Mol, 2001, pp. 47-48, 56; Mol, 2002, p. 93; Spaargaren & Mol, 1992, p. 335).¹⁷ Therefore, the question of the potential pace of the ecological transformation of production is important for the validation of EMT.

Virtually everyone is familiar with the story of the race between the hare and the tortoise. The hare can run very fast, but does so sporadically, often wasting time going nowhere, while the tortoise moves ahead at a slow but steady pace—and, of course, in the end the race is won by the tortoise. A central question before EMT, or any theory purporting to show ecological transformation, is whether the hare of institutional and technological transformation can outpace the tortoise of relentless growth. That is to say, if modernization does in fact lead to greater eco-efficiency in production, as EM theorists suggest is possible (Cohen, 1999), do the improvements in efficiency outweigh the expansion of production that comes with modernity? A singular focus on efficiency (resource consumption or waste generation per unit of economic activity) can fail to consider the relationship between efficiency and rising production. It may appear that a nation is dematerializing because its energy use per unit of GDP declines, when, in fact, the nation is expanding its energy use with a scale of production that increases more rapidly than efficiency improves.

William Stanley Jevons (1865/2001) in his classic book *The Coal Question* observed that increases in the efficiency of coal use were associated with more rather than less coal consumption, because the improved efficiency made coal more cost effective as an energy source and therefore more desirable to consumers. This has come to be known as the Jevons Paradox, a situation where greater efficiency in resource use leads to increased consumption of that resource (Clark & Foster, 2001). Schnaiberg & Gould (1994) make a similar argument along these lines in their analysis of the political economy of production. Due to the profit motive, producers have an incentive to continually expand production. In the logic of this system, “the treadmill of production” (Schnaiberg, 1980), gains in efficiency lead to greater profits, due to lower costs per unit of production. These profits are typically invested into expanding production further to generate yet more profit. In such a system, efficiency leads, perversely, to expanded production and therefore greater resource consumption.

Bunker (1996) has empirically shown this to be generally true in his analysis of historical changes in the resource intensity of economies; economies become more efficient in their use of resources as they develop, but growth in production outstrips savings from efficiency. Similarly, in a careful analysis of the material intensity of five modern economies (Austria, Germany, Japan, the Netherlands, and the United States) from the period 1975 to 1996, Matthews et al. (2000) “found no evidence of an absolute reduction in resource throughput in any of the countries studied,” but rather that “total quantities of conventional wastes, emissions, and discharges . . . increased by between 16 percent and 29 percent” (p. vii). These results indicate that modern economies are not dematerializing in any absolute sense.

Our own work has led to similar conclusions. In cross-sectional analyses of nations, we have consistently found that the most developed nations tend to be more

efficient than other nations in resource use, but they also tend to consume the most resources and have the greatest environmental impacts (York et al., 2003). In other words, total environmental impacts generally increase monotonically with economic development, but not quite proportionately due to improvements in efficiency.¹⁸ Note, however, that in an analysis of combined impacts from energy use, including fossil fuel, fuel wood, nuclear power, and hydropower, we found that the impact per unit of production *increased* with total production, so that the total impact from energy increased at an escalating pace with development (York et al., 2003, unpublished). These results seriously challenge claims that modernized nations are dematerializing and clearly fail to support a central proposition of EMT. EM theorists need to be much more precise in the specification of their argument that ecological modernization reduces energy and resource consumption, because, although in some cases the resource or energy use per unit of production decreases in modernized nations, total resource and energy consumption typically increase in such nations.

These results put EMT in somewhat of a bind. To validate the theory, EM theorists must either (a) demonstrate that modernization does in fact lead to reductions in energy and resource consumption (a challenging task in light of the evidence presented above) or (b) dramatically scale back their claims regarding the supposed beneficial effects of modernization on the environment. Because EM theorists are imprecise about this key proposition, it is difficult to be certain as to their specific argument. The quote from Mol (1995) presented at the beginning of this article suggests that EMT does indeed claim that modernization contributes to the development of environmental sustainability. On the other hand, Mol (2002) has also indicated that EMT is only about “relative improvements” in environmental conditions rather than “absolute sustainability” (p. 97). The problem for EMT is that if it takes the modest “relative improvements” option, its grand claim “that the only possible way *out* of the ecological crisis is by going further *into* the process of modernization” (Mol, 1995, p. 42) must be replaced with claims far more restricted in scope (and therefore general relevance). EM theorists simply cannot claim simultaneously that (a) they are only making the modest argument that there is merely room for “relative improvement” in modern societies and that (b) modernization is the *only possible way out* of the ecological crisis. If EMT can only establish the first claim, ecological modernization is not a clear way out of the ecological crisis at all but rather may be only the way to delay some of its most consequential outcomes.

CONCLUSION AND DIRECTIONS FOR FUTURE RESEARCH

The emergence of EMT has stimulated a considerable amount of hope that within modernization we will find the seeds for its own rejuvenation, its ecological sustainability. It has also stimulated a great deal of debate and research in environmental sociology. On this ground alone, EM theorists have performed a remarkable service to the discipline. Furthermore, EMT has helped to develop theory regarding the social structural changes occurring in late modernity. In particular, EM theorists have pointed to the complexity of modernity, rejecting overly simplistic views that collapse the dynamism of modernization into a single dimension (see, for example, Mol, 2001). Nonetheless, despite the valuable scholarly contributions of EM theorists, EMT has failed thus far to provide a convincing case that late modernization is compatible with, let alone essential to, the development of ecological sustainability.

In this article, we noted four issues in which EMT is logically or methodologically challenged or in which empirical evidence fails to support, or contradicts outright, its expectations. First, EM theorists have failed to explicate the theoretical expectation connecting emergent institutions of modernity with genuine environmental reform. Simply demonstrating that institutions arise purporting to address environmental issues does not mean that such reactions lead to environmental improvements. We presented evidence indicating that the ecological orientation of institutions is insufficient to lead to environmental reform. If EMT is only about how the institutions of modernity change in response to environmental problems, it has little to say about the factors that drive environmental degradation or those that contribute to sustainability. If it is meant to be more than this, it attracts the burden of more refined theoretical specification.

Second, we pointed to the limitations of case studies, a principal method among EM theorists, for establishing the general effect of modernization on the environment. Case studies, clearly appropriate for in-depth understanding, must be representative of the general process being theorized if they are to validate theory. Even if they are representative, they cannot assess stochastic processes nor properly answer questions about the relative frequency of various outcomes. Third, we argued that a focus on individual organizations or industries cannot address critiques of EMT from political economy because the latter theories address economy-wide processes rather than processes specific to any single sector or actor within an economy. Ecological improvements in one sector may come at the expense of increased ecological impacts in another. Fourth, we noted the importance of distinguishing between trends in *efficiency* (i.e., impact per unit of production) and *total* resource consumption and waste production. Although evidence generally (but not entirely) supports the assertion that economies become more efficient as they modernize, the weight of evidence clearly indicates that modernization leads to increases in total environmental impacts. Therefore, in an absolute sense, modernization leads to supermaterialization rather than dematerialization.

The challenges we raised suggest that EM theorists need to more clearly specify the focus, propositions, and empirical predictions of the theory. EM theorists would do well to be cautious about making claims regarding the potential for further modernization as the precursor of ecological sustainability, since such claims lack empirical support. EMT has more to say about the institutional transformations occurring in late modernity than the consequences of those transformations for the biophysical environment. As Buttel (2000a) argues, EMT's best hope for theoretical development involves focusing on politics and the state. Limiting its focus to the social processes occurring in late modernity would allow EMT to build on its strengths and would eliminate its greatest weakness—that is, the untenable claim that modernization is necessary for ecological sustainability.

The four challenges we raised suggest important directions for future research. First, an assessment of the connection between various institutional forms and environmental outcomes is particularly necessary at several levels, including the nation-state and the organization. Researchers should not assume that an appearance of environmental commitment necessarily corresponds with ecologically sustainable outcomes without further evidence. An analysis of the effectiveness of various specific environmental policies would be especially valuable. Second, researchers should focus on assessing how common ecologically induced transformations are in modernized societies. Are the examples that EM theorists point to only unusual exceptions or do they truly represent a general process occurring in

late modernity? Representative samples and statistical analyses that take account of stochastic processes are necessary to address this question.

Third, both on theoretical and empirical grounds, it is important to determine the different processes occurring at different levels of aggregation. For example, how do apparent ecologically motivated transformations at the organizational level influence processes occurring in society as a whole? Does reducing the resource and energy consumption in one organization necessitate increases in resource and energy use elsewhere? Researchers should recognize the possibility that trends at one level of aggregation may not directly correspond to trends at another level. Furthermore, researchers should take into account the fact that organizations and economic sectors are not independent of one another but rather are connected through various networks. Fourth, are there examples of absolute reductions in material and energy use in late modern societies (and if so, how common are they?) or does modernization only lead to dematerialization per unit of production? There is a dramatic difference between these two possibilities that needs to be addressed both theoretically and empirically. Absolute reductions in resource and energy use are necessary for sustainability, whereas merely reducing the material and energy intensity per unit of production (relative improvements) may only slow the process of environmental degradation but not alter it fundamentally. Addressing these issues will help to clarify the general applicability and relevance of EMT.

The evidence we have reviewed provides good reasons to be skeptical of the claim of EMT that going further into modernity can lead to sustainability. Given the demonstrated logical, methodological, and empirical inadequacies of EMT, the validity of its claim that continued modernization is the only way out of the environmental crisis (or a way out at all) is suspect. Thus, EM theorists appear to be premature in dismissing other approaches as not feasible. We caution against an uncritical commitment to the EM project because it may blind us to other options that have greater potential for bringing about ecological sustainability.

NOTES

1. Ecological modernization (EM) theorists commonly write declarations similar to this. For example, Spaargaren and Mol (1992) write that ecological modernization theory (EMT) holds the "conviction that the only possible way out of the ecological crisis is by going further into industrialization" (p. 336, see also Spaargaren, 1997, p. 169; Mol, 1996, p. 305). Furthermore, Spaargaren (1997) writes that "the environmental crisis can and should be overcome by a further modernization of the existing institutions of modern society" (p. 25).

2. It is important to recognize, however, that EMT has changed somewhat since its inception in the 1980s. Originally, technological optimism was central to EMT and the theory was clearly procapitalist (Mol & Spaargaren 2000). Since that time, the theory has become more subtle. Theorists generally do not argue that modernization will surely lead to sustainability, only that the potential exists within the institutions of late modernity to transform production and consumption along ecologically sustainable lines. Furthermore, EM theorists emphasize the dynamism of the institutions of modernity (e.g., capitalism) and therefore are not necessarily arguing that at all previous times these institutions were compatible with sustainability. Nor do they argue that capitalism is necessary for sustainability, only that its characteristics are always changing and can serve to foster ecological transformation in the right context.

3. Some scholars have already made incisive critiques of its theoretical foundations and central theoretical tenets (Blühdorn, 2000; Buttel, 2000a; O'Connor, 1994).

4. Cohen (1999) describes superindustrialization as a "new industrial revolution [that] entails the design and implementation of ecologically efficient manufacturing processes that

will override the need for corrective treatment of pollutants and other harmful byproducts” (p. 105).

5. Radelet and Borg (2000) write that “the vast majority of deterrence studies have failed to support the hypothesis that the death penalty is a more effective deterrent to criminal homicides than long imprisonment” (p. 45).

6. The nation-state is an appropriate focus for analyses of ecological modernization. Buttel (2000a) argues that “a full-blown theory of ecological modernization must ultimately be a theory of politics and the state” (p. 57).

7. The STIRPAT project is an empirical research program aimed at assessing the driving forces of environmental impacts (Dietz & Rosa, 1994, 1997; Rosa & Dietz, 1998).

8. Environmental treaty ratification is a commonly used indicator of state commitment to environmental protection (Dietz & Kalof, 1992; Frank, 1999; Roberts, 1996; Roberts & Vásquez, 2002).

9. We recognize that human impacts on the environment cannot be measured solely by a one-dimensional indicator. One of the challenges of assessing environmental quality (and sustainability more generally) is deciding the types of impacts on which to focus attention. The modernization process has not only expanded the scale of human influence on the environment, but it has also led to qualitative changes in how societies affect the biosphere. We have elsewhere discussed the importance of recognizing these tradeoffs and qualitative differences (York, Rosa, & Dietz, 2002b, pp. 25-27). Here, we discuss the general patterns we have found in our analyses of a diversity of impacts and note some exceptions below.

10. Carbon dioxide data are from the World Resources Institute (2000), and are for 1996. We used Index B from Roberts and Vásquez (2002), which is the principal component of a factor analysis of treaty ratifications. Using Index A, which is simply a count of the number of treaties ratified, in our analysis yields virtually identical results.

11. We examined all nations where the 1996 per capita GDP in purchasing power parity was greater than US\$20,000.

12. There could be another message in these findings more favorable to EMT. The positive correlations between treaty ratification and environmental impacts might reflect the self-awareness of nations of their own degradation and of the need to commit to policies designed to reverse the process. It could very well be the case that the treaties have not been in effect long enough to ascertain whether they are producing manifest improvements. Nevertheless, it remains for EMT to argue this position.

13. Fisher and Freudenburg (2001) make a similar point, suggesting that “there is a good deal to be said for considering more than a few cases that may represent little more than end-points on a continuum” (p. 705).

14. A similar problem that we do not discuss at length here because we have addressed it elsewhere (York et al., 2002b, 2003) relates to trade-offs between different types of impacts. For example, a nation (or industry) may appear to be ecologically modernizing because it reduces its use of fossil fuel. However, if this reduction in fossil fuel use comes at the expense of increased nuclear waste, dammed rivers, and so forth, it would be misleading to identify it as an instance of progress toward sustainability.

15. See Rothman’s (1998) argument in support of using consumption-based indicators of impact in empirical analyses.

16. Factor X refers to the claim that efficiency of resource use can be increased by X-fold. The classic of this tradition is Factor Four (von Weizsäcker, Lovins, & Lovins, 1998), although factors much greater than four have also been proposed (Hawken, Lovins, & Lovins, 1999).

17. Huber (2000) draws an explicit connection between EMT and industrial ecology. He argues that industrial ecology goes beyond mere improvements in efficiency, focusing rather on the qualitative transformation of production so that waste is largely eliminated by being reincorporated into the production process. Nonetheless, key to the development of industrial ecology is a dematerialization of production.

18. Note that some local impacts, such as air and water pollution, may decline in the later stages of development (Nordström & Vaughan, 1999; Stern, 1998), although, as our work has shown, global impacts continually escalate.

REFERENCES

- Andersen, M. S. (2002). Ecological modernization or subversion? The effects of Europeanization on Eastern Europe. *American Behavioral Scientist*, 45(9), 1394-1416.
- Blühdorn, I. (2000). Ecological modernization and post-ecologist politics. In G. Spaargaren, A. P. J. Mol, & F. H. Buttel (Eds.), *Environment and global modernity* (pp. 209-228). London: Sage.
- Bunker, S. G. (1996). Raw material and the global economy: Oversights and distortions in industrial ecology. *Society and Natural Resources*, 9, 419-429.
- Buttel, F. H. (2000a). Ecological modernization as social theory. *Geoforum*, 31, 57-65.
- Buttel, F. H. (2000b). World society, the nation-state, and environmental protection: Comment on Frank, Hironaka, and Schofer. *American Sociological Review*, 65, 117-121.
- Clark, B., & Foster, J. B. (2001). William Stanley Jevons and *The Coal Question*: An introduction to Jevons's "Of the economy of fuel." *Organization & Environment*, 14(1), 93-98.
- Cohen, M. (1997). Risk Society and ecological modernisation: Alternative visions for post-industrial nations. *Futures*, 29(2), 105-119.
- Cohen, M. (1999). Sustainable development and ecological modernization: National capacity for rigorous environmental reform. In D. Requier-Desjardins, C. Spash, & J. van der Straaten (Eds.), *Environmental policy and societal aims* (pp. 103-128). Dordrecht: Kluwer.
- Commoner, B. (1971). *The closing circle*. New York: Knopf.
- Devall, B., & Sessions, G. (1985). *Deep ecology: Living as if nature mattered*. Salt Lake City: Peregrine Smith.
- Dietz, T., & Kalof, L. (1992). Environmentalism among nations states. *Social Indicators Research*, 26, 353-366.
- Dietz, T., & Rosa, E. A. (1994). Rethinking the environmental impacts of population, affluence and technology. *Human Ecology Review*, 1, 277-300.
- Dietz, T., & Rosa, E. A. (1997). Effects of population and affluence on CO₂ emissions. *Proceedings of the National Academy of Sciences of the USA*, 94, 175-179.
- Ehrlich, P., & Holdren, J. (1971). Impact of population growth. *Science*, 171, 1212-1217.
- Fisher, D. R., & Freudenburg, W. R. (2001). Ecological modernization and its critics: Assessing the past and looking toward the future. *Society and Natural Resources*, 14, 701-709.
- Frank, D. J. (1999). The social bases of environmental treaty ratification, 1900-1990. *Sociological Inquiry*, 69, 523-550.
- Frank, D. J., Hironaka, A., & Schofer, E. (2000). The nation-state and the natural environment over the twentieth century. *American Sociological Review*, 65(1), 96-116.
- Gould, K. A., Schnaiberg, A., & Weinberg, A. S. (1996). *Local environmental struggles: Citizen activism in the treadmill of production*. New York: Cambridge University Press.
- Graedel, T., & Allenby, B. (1995). *Industrial ecology*. Englewood Cliffs, NJ: Prentice Hall.
- Hawken, P., Lovins, A., & Lovins, L.H. (1999). *Natural capitalism: Creating the next industrial revolution*. New York: Little, Brown and Company.
- Huber, J. (2000). Towards industrial ecology: Sustainable development as a concept of ecological modernization. *Journal of Environmental Policy & Planning*, 2, 269-285.
- Jevons, W. S. (1865/2001). Of the economy of fuel. *Organization & Environment*, 14(1), 99-104.
- Liu, J., Daily, G. C., Ehrlich, P. R., & Luck, G. W. (2003). Effects of household dynamics on resource consumption and biodiversity. *Nature*, 421, 530-533.
- Lutzenhiser, L. (1997). Social structure, culture and technology: Modeling the driving forces of household energy consumption. In P. C. Stern, T. Dietz, V. W. Ruttan, R. H. Socolow,

- & J. Sweeney (Eds.), *Environmentally significant consumption: Research directions* (pp. 77-91). Washington, DC: National Academy Press.
- Lutzenhiser, L., & Hackett, B. (1993). Social stratification and environmental degradation: Understanding household CO₂ production. *Social Problems*, 40(1), 50-73.
- Matthews, E., Amann, C., Bringezu, S., Fischer-Kowalski, M., Hüttler, W., Kleijn, R., et al. (2000). *The weight of nations: Material outflows from industrial economies*. Washington, DC: World Resources Institute.
- Mol, A. P. J. (1995). *The refinement of production: Ecological modernization theory and the chemical industry*. Utrecht, Netherlands: Van Arkel.
- Mol, A. P. J. (1996). Ecological modernisation and institutional reflexivity: Environmental reform in the late modern age. *Environmental Politics*, 5(2), 302-323.
- Mol, A. P. J. (2001). *Globalization and environmental reform*. Cambridge, MA: MIT Press.
- Mol, A. P. J. (2002). Ecological modernization and the global economy. *Global Environmental Politics*, 2(2), 92-115.
- Mol, A. P. J., & Sonnenfeld, D. A. (2000a). Ecological modernization around the world: An introduction. In A. P. J. Mol & D. A. Sonnenfeld (Eds.), *Ecological modernization around the world: Perspectives and critical debates* (pp. 3-14). London: Frank Cass.
- Mol, A. P. J., & Sonnenfeld, D. A. (Eds.). (2000b). *Ecological modernization around the world: Perspectives and critical debates*. London: Frank Cass.
- Mol, A. P. J., & Spaargaren, G. (2000). Ecological modernization theory in debate: A review. In A. P. J. Mol & D. A. Sonnenfeld (Eds.), *Ecological modernization around the world: Perspectives and critical debates* (pp. 17-49). London: Frank Cass.
- Nordström, H., & Vaughan, S. (1999). *Trade and environment*. Geneva, Switzerland: World Trade Organization.
- O'Connor, J. (1994). Is sustainable capitalism possible? In M. O'Connor (Ed.), *Is capitalism sustainable? Political economy and the politics of ecology* (pp. 152-175). New York: Guilford Press.
- Paternoster, R. (1991). *Capital punishment in America*. New York: Lexington Books.
- Pellow, D. N., Schnaiberg, A., & Weinberg, A. S. (2000). Putting the ecological modernization thesis to the test: The promises and performances of urban recycling. In A. P. J. Mol & D. A. Sonnenfeld (Eds.), *Ecological modernization around the world: Perspectives and critical debates* (pp. 109-137). London: Frank Cass.
- Radelet, M. L., & Borg, M. J. (2000). The changing nature of death penalty debates. *Annual Review of Sociology*, 26, 43-61.
- Roberts, J. T. (1996). Predicting participation in environmental treaties: A world system analysis. *Sociological Inquiry*, 66(1), 38-57.
- Roberts, J. T., & Vásquez, A. A. (2002, March). *State environmentalism revisited: Structural predictors of nations' propensity to sign environmental treaties or who signs environmental treaties and why? A world-system analysis*. Paper presented at International Studies Association conference, New Orleans, LA.
- Rosa, E. A., & Dietz, T. (1998). Climate change and society: Speculation, construction and scientific investigation. *International Sociology*, 13(4), 421-455.
- Rosa, E. A., & York, R. (2002, July). *Internal and external sources of environmental impacts: A comparative analysis of the EU with other nation groupings*. Paper presented at the European Union in International Affairs Conference, sponsored by the National European Centre, at the Australian National University, Canberra, Australia.
- Rosa, E. A., York, R., & Dietz, T. (2001, July). *Modernization and the environment: Modeling the impacts of economic development*. Paper presented at the International Sociological Association RC-24 "New Natures, New Cultures, New Technologies" conference, Cambridge University, Cambridge, England.
- Rothman, D. S. (1998). Environmental Kuznets curves—Real progress or passing the buck? *Ecological Economics*, 25, 177-194.
- Salsburg, D. (2002). *The lady tasting tea: How statistics revolutionized science in the twentieth century*. New York: Owl Books.

- Schnaiberg, A. (1980). *The environment: From surplus to scarcity*. New York: Oxford University Press.
- Schnaiberg, A., & Gould, K. A. (1994). *Environment and society: The enduring conflict*. New York: St. Martin's Press.
- Schnaiberg, A., Pellow, D. N., & Weinberg, A. (2002). The treadmill of production and the environmental state. In A. P. J. Mol & F. H. Buttel (Eds.), *The environmental state under pressure* (pp. 15-32). London: Elsevier Science.
- Shi, A. (2003). The impact of population pressure on global carbon dioxide emissions, 1975-1996: Evidence from pooled cross-country data. *Ecological Economics*, 44, 29-42.
- Sonnenfeld, D. A. (1998). From brown to green? Late industrialization, social conflict, and adoption of environmental technologies in Thailand's pulp industry. *Organization & Environment*, 11(1), 59-87.
- Sonnenfeld, D. A. (2000). Contradictions of ecological modernization: Pulp and paper manufacturing in South-east Asia. In A. P. J. Mol & D. A. Sonnenfeld (Eds.), *Ecological modernization around the world: Perspectives and critical debates* (pp. 235-256). London: Frank Cass.
- Spaargaren, G. (1997). *The ecological modernization of production and consumption: Essays in environmental sociology*. Doctoral dissertation, Wageningen University, Wageningen, Netherlands.
- Spaargaren, G. (2000). Ecological modernization theory and domestic consumption. *Journal of Environmental Policy & Planning*, 2, 323-335.
- Spaargaren, G., & Mol, A. P. J. (1992). Sociology, environment and modernity: Ecological modernization as a theory of social change. *Society and Natural Resources*, 5, 323-344.
- Stern, D. I. (1998). Progress on the environmental Kuznets curve? *Environment and Development Economics*, 3, 173-196.
- Von Weizsäcker, E., Lovins, A., & Lovins, L. H. (1998). *Factor Four: Doubling wealth, halving resource use*. London: Earthscan.
- Wackernagel, M., Onisto, L., Bello, P., Linares, A. C., Falfan, I. S. L., García, J. M., et al. (1999). National natural capital accounting with the ecological footprint concept. *Ecological Economics*, 29, 375-390.
- Wackernagel, M., & Rees, W. (1996). *Our ecological footprint: Reducing human impact on the earth*. Gabriola Island, B.C., Canada: New Society.
- Weinberg, A., Schnaiberg, A., & Gould, K. A. (1995). Recycling: Conserving resources for accelerating the treadmill of production? In L. Freese (Ed.), *Advances in human ecology* (Vol. 4, pp. 173-205). Greenwich, CT: JAI Press.
- White, D. F. (2002). A green industrial revolution? Sustainable technological innovation in a global age. *Environmental Politics*, 11(2), 1-26.
- World Resources Institute. (2000). *World resources 2000-2001: People and ecosystems: The fraying web of life*. New York: Oxford University Press.
- York, R., Rosa, E. A., & Dietz, T. (2002a, April). *Eco-efficiency to the rescue? A cross-national analysis of environmental impact per unit of production*. Paper presented at the Annual Pacific Sociological Association Meeting, Vancouver, Canada.
- York, R., Rosa, E. A., & Dietz, T. (2002b). Bridging environmental science with environmental policy: Plasticity of population, affluence, and technology. *Social Science Quarterly*, 83(1), 18-34.
- York, R., Rosa, E. A., & Dietz, T. (2003). Footprints on the earth: The environmental consequences of modernity. *American Sociological Review*, 68(2), 279-300.
- York, R., Rosa, E. A., & Dietz, T. (in press). A rift in modernity? Assessing the anthropogenic sources of global climate change with the STIRPAT model. *International Journal of Sociology and Social Policy*.
- York, R., Rosa, E. A., & Dietz, T. (2003). *STIRPAT, IPAT, and ImPACT: Analytic tools for modeling the driving forces of environmental impacts*. Unpublished manuscript available from first author, sociology department, University of Oregon.
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