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A Role for State Planning

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**A ROLE FOR STATE PLANNING:
INTERGENERATIONAL EQUITY AND ADAPTIVE
MANAGEMENT**

*Fred Bosselman**

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The State government's policies have a major impact on growth management, whether or not you try to embody those policies in something called a comprehensive plan. My recommendation is that the State concentrate, not on the preparation of a document that would try to comprehensively restate all State policies, but on the creation of an organization that would conduct ongoing reviews of State policies and recommend revisions to adapt them to changing conditions. Such an Adaptive Planning Organization (APO) would need to be particularly responsive to the needs of future generations. The term APO is my own attempt to create a generic term that leaves open the issue of where such an organization should fit into the legal structure.

I. INTRODUCTION

In making these suggestions, I am trying to incorporate two ideas that have been widely discussed in the professional literature during the 1990s: "intergenerational equity" and "adaptive management." Intergenerational equity refers to the principle that present generations should consider the impact of our actions on future generations, so that our development policies achieve objectives that can be sustained over the long run. Adaptive management refers to a style of planning in which the planners constantly reevaluate the goals, objectives, and strategies based on feedback that reflects changing external conditions.

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Setting aside the devilish details of these concepts, most people would agree that they have considerable merit. But on the surface, at least, they seem contradictory. How can we plan for future generations without adopting long-range plans? After all, a generation is approximately thirty years.

It may be possible, however, to set up a planning process that is both adaptive and intergenerational. In this Article, I would like to explore the idea of whether it is feasible to expect that a governmental organization might be able to implement an adaptive, intergenerational planning system.

Part II explores why it is important to make long-range plans despite the difficulties of doing so. It looks at some of the developing advances in economic theory that are overcoming the prejudices of the old classical economists against such plans.

Part III briefly reviews some of the literature in economics, ecology, management, and law on adaptation in planning and management. It concludes that growing scientific awareness of cycles of environmental change, combined with major advances in technology, suggest that adaptive planning will continue to be necessary if we are to produce meaningful results.

Part IV sets out the germ of an idea for an APO that might be able to overcome the apparent contradictions between intergenerational equity and adaptive management.

II. INTERGENERATIONAL EQUITY

Are we being fair to future generations? The proponents of intergenerational equity argue that we should not satisfy our own desires at the expense of those who will come after us.¹ They say that we should develop our resources in a sustainable manner so that "we meet the needs of the present without compromising the ability of future generations to meet their own needs."²

In a sustainable economy, the fish catch does not exceed the sustainable yield of fisheries, the amount of water pumped from underground aquifers does not exceed aquifer recharge, soil erosion does not exceed the natural rate of new soil formation, tree cutting does not exceed tree planting, and carbon emissions do not exceed the capacity of nature to fix atmospheric

1. The classic treatment of intergenerational equity remains. Edith Brown Weiss, *Intergenerational Equity: A Legal Framework for Global Environmental Change*, in ENVIRONMENTAL CHANGE AND INTERNATIONAL LAW: NEW CHALLENGES AND DIMENSIONS 385 (Edith Brown Weiss ed., 1991).

2. WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT, OUR COMMON FUTURE 43 (United Nations 1987).

CO₂. A sustainable economy does not destroy plant and animal species faster than new ones evolve.³

In many respects, however, Americans are not giving adequate attention to the needs of future generations. We selfishly gratify our immediate desires without undertaking the effort to make sure that the needs of future generations will be satisfied. Let us consider some examples.

In the United States, we have cut back sharply on major public works projects.⁴ Our public investment in infrastructure dropped by about fifty percent from 1970 to 1995 according to Lester Thurow, and

has fallen to the point where the stock of public capital is now declining relative to the GDP — falling from [fifty-five] to [forty] percent of GDP in the last decade. Less is being invested in public infrastructure in the United States than in any of the [developed] countries — one third as much as Japan.⁵

3. LESTER BROWN ET AL., *STATE OF THE WORLD 1999*, at 15-16 (1999). Although the term “sustainability” has a modern ring, the idea behind it has been the official government policy in the United States for most of the last century. The early European settlers of America thought the country’s resources were so extensive that there was no need to worry about exhausting them, but with the disappearance of such resources as the white pine forests and the bison towards the end of the nineteenth century, it became apparent that even a large country could exhaust its resources. Theodore Roosevelt was the leader of a conservation movement that became official government policy when he took office. Under his leadership, conservation became defined as “foresight and restraint in the exploitation of the physical sources of wealth as necessary for the perpetuity of civilization and the welfare of present and future generations.” SEAN DENNIS CASHMAN, *AMERICA IN THE AGE OF THE TITANS 78* (N.Y.U. Press, 1988). He promoted sustained yield management of the national forests and soil conservation by farmers as part of a long-range conservation strategy. *Id.* Most of his successors continued to honor conservation as a national objective, although they varied in the importance they placed on it. Although conservation has usually been a well-accepted national objective in the United States, its implementation has produced numerous distributional controversies. When exploitation of resources is postponed, jobs that would otherwise have been created are lost. To people who are trained in lumbering or mining, for example, the economic impact of these losses is immediate and severe. Sympathy for their circumstances has often modified conservation policies that otherwise might have been adopted. But modern science and technology have expanded the possibilities of sustainability in ways that Roosevelt’s generation could not have anticipated. See generally J.B. Ruhl, *Sustainable Development: A Five-Dimensional Algorithm for Environmental Law*, 18 *STAN. ENVTL. L.J.* 31 (1999).

4. Ricardo Alonso-Zaldivar, *Nation’s Infrastructure Crumbling, Report Says*, *LOS ANGELES TIMES*, March 8, 2001, at A9 (American Society of Civil Engineers gives United States infrastructure a D+).

5. LESTER THUROW, *THE FUTURE OF CAPITALISM 291* (1996).

Whether the increased public spending projected in the more recent federal budgets⁶ will begin to reverse this trend, this remains to be seen.

Private infrastructure also has been cut back. Although we continue to use more electricity to meet our current needs, investment in new power plants has fallen below the curve.⁷ The failure of nuclear power to meet the economic expectations that it would be “too cheap to meter” left utility executives afraid to invest in generating facilities.⁸ We now hope to meet future needs with smaller-scale natural gas-fired generators,⁹ but the doubling of the price of natural gas over the past year has raised questions about that strategy.¹⁰

6. The Bureau of Transportation Statistics reports that expenditures on highway and street construction in the United States rose from about 40 billion dollars per year in 1995 to between 45 to 50 billion dollars (in constant dollars) per year in 1999-2000, at www.bts.gov/transtu/indicators/Economy/html/Public_Expenditures_on_Construction_of_Highways_and_Streets.html.

7. See Chris Holly, *Richardson Plays Blackout Card in Urging Senate Action on Restructuring*, 28 ENERGY DAILY 71 (2000).

8.

The nuclear power plant debacle destroyed the status quo ante in the electricity industry. In the 1970s, with enthusiastic encouragement from State and federal regulators, utilities began construction of over one hundred nuclear power plants. Utilities and regulators predicted continuation of the historic pattern of a doubling in electricity demand every decade. Moreover, nuclear plants were expected to drive the cost of electricity to new lows. The massive nuclear construction program, predicated on forecasts of low costs and high demand, became instead an economic nightmare for all concerned. Actual costs of nuclear power plants vastly exceeded estimates, sometimes by as much as one thousand percent. At the same time, electric rate increases dramatically slowed the growth in demand for electricity. As the power plants approached completion, it became apparent that they were both unneeded and extravagantly expensive. Consumers were outraged at the huge rate increases that would result from letting utilities recover their massive investments in nuclear power plants. Regulators and their political superiors responded to the outpouring of populist sentiment by disallowing tens of billions of dollars in utility investments — approximately twenty percent of total utility investments in nuclear power plants. Most utilities suffered significant financial harm from these disallowances. . . . The unwillingness of utilities to invest in new power plants created a void that must be filled with a new industry structure and new forms of government oversight.

Bernard S. Black & Richard J. Pierce, Jr., *The Choice Between Markets and Central Planning in Regulating the U.S. Electricity Industry*, 93 COLUM. L. REV. 1339 (1993).

9. As of January 1, 1999, the EIA reported that the total planned capacity additions of U.S. utilities by energy source amounted to 27,943 MW, of which 25,401 MW were natural gas, at <http://www.eia.doe.gov/cneaf/electricity/ipp/t1p01.txt>.

10. “The natural gas futures price hit \$5.31 per million Btus Wednesday on the New York Mercantile Exchange, more than double its low this year of \$2.17 on January 5 and up about 62 cents over the last month.” USA TODAY, Sept. 28, 2000, at 1B.

Rarely will you see a new highway being built. During the 1980s, we diverted our gasoline taxes from highway construction to highway repairs.¹¹ As a result, between 1981 and 1989 the national highway mileage increased by only 0.6% while the total vehicle miles driven went up by over 33%.¹² In Florida, between 1994 and 1997, the population of the State grew by about 6%.¹³ The number of highway miles grew by less than 1%.¹⁴ The resulting increase in traffic congestion has finally made the public aware that something needs to be done.

The transportation sector also has been concentrating on meeting short-term needs rather than sustainability. Two-thirds of our oil consumption is for transportation.¹⁵ But our domestic oil reserves are not growing, so we increasingly depend on foreign oil to meet our needs. In 1970, we imported only about 20% of our oil; now we import about 55%.¹⁶ We spend billions of dollars to defend our interests in good relations with oil-exporting countries, but very little in developing new technologies that would allow us to meet our transportation needs without such heavy reliance on oil.¹⁷

Primary education is widely recognized as one of the most serious deficiencies in Florida and in many other states.¹⁸ There are widely varying theories about how to remedy the problem, but they all recognize that your generation and mine need to make sacrifices so that the future generations will have the advantages that we obtained. In an era of increasingly complex science and technology, and of growing concern about moral standards, how can we not insist that the students of today and tomorrow need an even better education than we received? But, the amount we are spending on education in real dollars has barely increased.¹⁹ In a state where

11. MARK H. ROSE, *INTERSTATE: EXPRESS HIGHWAY POLITICS, 1939-1989*, at 113 (Univ. of Tenn. Press, rev. ed., 1990).

12. ANTHONY DOWNS, *STUCK IN TRAFFIC: COPING WITH PEAK-HOUR TRAFFIC CONGESTION* 11 (Brookings Inst., 1992).

13. UNIVERSITY OF FLORIDA, BUREAU OF BUSINESS AND ECONOMIC RESEARCH, *FLORIDA STATISTICAL ABSTRACT* 9 (2000).

14. *Id.* at 409.

15. Fred P. Bosselman, *Can Technology Reduce the Energy Cost of Sprawl?*, 30 ENVTL. L. RPTR. 10829 (2000).

16. FRED BOSSELMAN ET AL., *ENERGY, ECONOMICS, AND THE ENVIRONMENT* 1109 (2000).

17. Increasing amounts of venture capital and industry resources have very recently been devoted to the development of fuel cell vehicles that would run on hydrogen. HENRY R. LINDEN, *ALTERNATIVE PATHWAYS TO A CARBON-EMISSION-FREE ENERGY SYSTEM, THE BRIDGE* 17 (Rice Univ., 1999).

18. In 1998, only 77% of public school students in Florida passed the High School Competency Test in mathematics. *FLORIDA STATISTICAL ABSTRACT*, *supra* note 13, at 140.

19. Between 1983-84 and 1997-98 the assessed valuation of property in Florida rose from \$243 billion to \$593 billion, an increase of 144%, while the amount spent on public elementary

one-fifth of the people are sixty-five or older, how can you make us aware of how badly we are short-changing our successors?

Another widely discussed symptom of our disregard of future generations is climate change. The overwhelming majority of serious scientists believe that the increase in emission of greenhouse gases has contributed to the warming of the climate. This climate warming will continue at increasing rates throughout most regions of the United States.²⁰ Each year in the 1990s ranked among the warmest fifteen years of the twentieth century; yet we are expending very little on the reduction of greenhouse gas emissions.²¹

Why are we investing so little in solving long-range problems? Some people argue that our growing reliance on the stock market as the barometer of value is a major factor. The market encourages us to concentrate on quarterly results rather than long-term prospects. Any corporate manager who proposes to sacrifice immediate gains for long-term investment runs the risk of being replaced or taken over. Consequently, managers "sometimes engage in activities counter-productive to the long-term interests of the company in order to 'meet the numbers.'"²² Entrepreneurs, such as Ed Ball, Walt Disney and John MacArthur, who focused on long-term gains, are few and far between today.

Other people blame economists. They suggest that we need to revise the older ideas of the classical economics in order to encourage people to think in long-range terms. For example, let us consider discount rates. Economists use discount rates to reduce the value of any benefit that will not be realized until some time in the future.²³ This is logical if the benefit

and secondary schools went from \$4.95 billion to \$12.85 billion, an increase of 159%. FLORIDA STATISTICAL ABSTRACT, *supra* note 13, at 122. Given the increased technical complexity of today's education, this minimal increase is completely inadequate, in my opinion.

20. Preliminary report of national regional assessment team, available on the web at <http://www.atcsec.faa.gov>.

21. The United States government's limited interest in such expenditures can be seen in REPORT OF THE NATIONAL ENERGY POLICY GROUP, NATIONAL ENERGY POLICY, pp. 3-11 to 3-13 (2001).

22. IRA C. MAGAZINER & ROBERT B. REICH, MINDING AMERICA'S BUSINESS: THE RISE AND DECLINE OF THE AMERICAN ECONOMY 193 (1982). Day trading and brokerage hype have added to this problem, as the long-term investors who used to dominate the market have been gradually outweighed by investors concerned primarily with short-term swings in stock prices. Traditional pension plans that sought long-term securities are being replaced by plans that give employees the option of playing the market.

23. The value of future financial benefits depends greatly on the assumptions one makes about the rate of income one can generate on investments while waiting for the future to arrive. Since any such prediction is largely guesswork, no one assumes that calculations such as these are anything but rough guides to financial strategy. But even with conservative interest rate

is an easily quantified financial gain. We would all agree that we would rather have the money today to invest, than to receive it some time in the future. But it makes less sense to apply discount rates to future environmental benefits, for example. Are we really willing to say that we are more interested in protecting the Everglades for our own enjoyment than for our grandchildren's?²⁴

Depletion of natural resources is another area in which economic concepts are being reexamined. Gross national product, the classical measure of an economy's output, has traditionally been defined to include the value of all natural resources produced, less the cost of production, without taking account of the fact that an asset has been depleted.²⁵ The fact that there would be fewer resources left to be produced was simply ignored.²⁶ Now there are attempts underway to develop a new economic methodology that will recognize the value of sustainability.²⁷

The traditional economist's answer to the problem of depleting resources was "substitution."²⁸ As the resource grew more scarce, the price would rise and we would invest in technological development of substitutes. For example, when the housing market in Silicon Valley became tight and prices went through the roof, many people bought cheaper homes in Modesto and endured the long commute. As wild salmon became scarce and expensive, people began to buy the cheaper but relatively tasteless farmed product called, euphemistically, "Atlantic Salmon." If Coca-Cola doubled its price, even confirmed Coke drinkers might switch to Pepsi.

No one doubts that "substitution" takes place. To classical economists, however, it is simply the natural operation of the market with no negative

assumptions, one thing is clear: if you carry the calculations out for the length of a generation or more the present value of future benefits is reduced to insignificance. Or as the famous British economist Lord Keynes observed, "in the long run we are all dead." ROBERT L. HEILBRONER, *THE WORLDLY PHILOSOPHERS: THE LIVES AND TIMES OF THE GREAT ECONOMIC THINKERS* 254 (4th ed. 1972).

24. Lisa Heinzerling has written an excellent critique of the use of discount rates in regard to future lives. Lisa Heinzerling, *Discounting Our Future*, 34 *LAND & WATER L. REV.* 39 (1999).

25. Joy Hecht, *Accounting for the Environment: New Directions for the United States*, 14 *NAT. RES. & ENV'T* 179, 180 (2000).

26. See Karl-Göran Mäler, *National Accounts and Environmental Resources*, 1 *ENVTL. & RES. ECON.* 1 (1991).

27. WILLIAM D. NORDHAUS & EDWARD C. KOKKELENBERG, *NATURE'S NUMBERS: EXPANDING THE NATIONAL ECONOMIC ACCOUNTS TO INCLUDE THE ENVIRONMENT* (Nat'l Acad. Press, 1999); ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, *TOWARD SUSTAINABLE DEVELOPMENT: ENVIRONMENTAL INDICATORS* (1998).

28. Daniel Levy & David Friedman, *The Revenge of the Redwoods: Reconsidering Property Rights and the Economic Allocation of Natural Resources*, 61 *U. CHI. L. REV.* 493, 499-502 (1994).

connotations. They simply assume away any problems by adopting the assumption that technological change can offset any limits to growth that might be associated with a finite supply of natural resources.²⁹ If you hanker for wild salmon or a house in Silicon Valley, your nostalgia is simply a personal "taste" and thus does not deserve to be considered in economic calculations. As Robert Ayres puts it, "economists have preferred not to examine the concept of technological substitution too closely."³⁰

Technology has truly given us some wonderful things, but are we really satisfied that substitutes can be found for everything? Can the wilderness ride at the theme park replace the wilderness? What if we upset important ecosystems past the point from which they can return to productivity?³¹

But, the most difficult principle of classical economics to challenge is "consumer sovereignty."³² Economists have traditionally tried to avoid making value judgments by adopting the assumption that people always make wise decisions about what is in their self interest. But today, most economists recognize that, at a time when we realize both the complexity of human motivations, and the differing access of people to information, this assumption is unrealistic.³³

Some classical economists still argue forcefully that democracy is threatened if outside experts superimpose their value judgments on those

29. See, e.g., Robert M. Solow, *Resources and Growth*, 68 AM. ECON. REV. 5 (1978).

30. ROBERT U. AYRES, *RESOURCES, ENVIRONMENT, AND ECONOMICS* 45 (John Wiley & Sons, 1978).

31. Kenneth Arrow et al., *Economic Growth, Carrying Capacity, and the Environment*, 268 SCI. 520 (1995).

32. Dapha Lewinsohn-Zamir, *Consumer Preferences, Citizen Preferences and the Provision of Public Goods*, 108 YALE L.J. 377 (1998).

33. Daniel A. Farber, *Paradise Lost/Pragmatism Regained: The Ironic History of the Coase Theorem*, 83 VA. L. REV. 397 (1997).

of individuals.³⁴ But, the ecologists ask, what if the collective individuals are like lemmings headed for a cliff?³⁵ Do we ignore the scientists' warnings of impending degradation or disaster?

This dilemma is perhaps the crux of the problem facing planners in democratic societies everywhere.³⁶ How can the public be persuaded to modify its desires to accommodate scientific views that degradation or disaster will impact future generations?³⁷

34. "This assumption underlies the theory of consumer behaviour and through it the bulk of economic analysis . . ." THE MIT DICTIONARY OF MODERN ECONOMICS 78 (David W. Pearce 4th ed., 1992).

35.

If a self-regulating economic system is to be ecologically sustainable, it should serve a set of consumption and production objectives that are themselves sustainable. But this runs up against a principle of consumer sovereignty that privileges the existing preferences and technologies. If existing preferences and technologies are not ecologically sustainable, then consumer sovereignty implies system instability. This leaves these options: regulate activity levels within the existing structure of preferences, or change that structure of preferences, or both. The appropriate instruments—whether price manipulation, education, changes to property rights, etc. — will vary depending on institutional and other characteristics

Mick Common & Charles Ferrings, *Towards an Ecological Economics of Sustainability*, 6 ECOLOGICAL ECON. 7, 31 (1992).

36. For a recent collection of newer thinking on this issue, see BEHAVIORAL LAW AND ECONOMICS (Cass R. Sunstein ed., Cambridge Univ. Press, 2000); see also Symposium, *Innovations in Environmental Policy: The Psychology of Global Climate Change*, 2000 U. ILL. L. REV. 299 (2000).

37. Harpers editor Michael Pollan uses urban sprawl as an example:

The free-market think tanks spewed forth studies arguing that sprawl doesn't really exist or that, if it does, . . . the free market has given Americans exactly what their spending decisions say they want. And yet many of us — or maybe I should say some part of most of us — are dismayed by the landscape and traffic that our own dollars and desires have wrought. That's why it is possible both to deplore the arrival of a new Home Depot in my area and also to shop there. [Classical economists] would have you believe that the real me, the only one that finally matters, is the shopping me — the consumer; the deploring me should be dismissed as a sentimentalist or elitist or hypocrite.

Until now, that's been the general view on sprawl, one I've bought into myself. But it overlooks a complicated truth about modern life that conservatives would have us forget. It is that although we are consumers, we are not only consumers, but parents and neighbors and citizens too. The sort of world we bring into being with our dollars does not necessarily match the world we would vote for with our hearts, and one of the things politics is good for is to help us bring those worlds into a more pleasing alignment. What a radical idea.

If we are going to meet the needs of future generations, then we need to be making long-range plans. But, today many people despair of the possibility of meaningful long-term planning. Many people believe that either environmental change, or technological change, or both, are so unpredictable that our technical ability to forecast these changes makes it useless to try to make long-range policy. It is this recognition of the likelihood of change that has led to a growing interest in a more resilient form of planning known as adaptive management.

III. ADAPTIVE MANAGEMENT

Adaptive management is a planning process in which the objectives and strategies of the plan are under continuous review, so that the plan itself, and the strategies to implement it, are constantly subject to revision.

The growing support for adaptive management as a planning system is a reaction to our increasing recognition that we are living in an unstable environment. Two elements of such instability are worth emphasizing, though others are also important. The first is the widely recognized expectation of continuing rapid advancement in many important areas of technology. The second is the less well known, but equally important, scientific recognition that the natural environment is itself in a state of constant change. It is my hope that these advances in ecology and management theory can lead toward a more sustainable planning system that can be embedded in our legal structure.

A. *Technological Change*

In current management theory, the need for adaptive management is accentuated by the expectation that technological change will continue at the rapid pace we are currently witnessing. Advances in genetics may bring about major changes in medical science which may have huge demographic implications.³⁸ Information technology is already having an effect on many peoples' lifestyle choices, including the choices of where to live and where to work.³⁹ New advances in electricity generation may remove our dependence on big generating plants and transmission networks.⁴⁰ And if

Michael Pollan, *The Way We Live Now: Land of the Free Market*, N.Y. TIMES MAG., July 11, 1999.

38. See generally LORI ANDREWS, *THE CLONE AGE* (1999).

39. THOMAS MICHAEL POWER, *LOST LANDSCAPES AND FAILED ECONOMIES* (1996).

40. See, e.g., G. Scott Samuelson & Jacob Brouwer, *The Power Park Initiative, A Model for the Future of Distributed Generation*, OIL & GAS J., *Special Supplement: The New Energy Economy* 59 (Fall 2000); BOSSELMAN, *supra* note 16, at 699-702.

you believe that the venture capitalists know what they are doing, the internal combustion engine, with its dependence on imported petroleum, may be obsolete within a generation.⁴¹

In the business schools, management theorists are increasingly embracing adaptive planning methodologies in response to these expectations of continuing change.⁴² Earlier management theories, emphasizing formulation of a strategic plan, dominated management theory in the 1980s.⁴³ However, planners would only focus on new information if it was packaged in a way to plug into the theoretical formula. If it was ambiguous, excessively complex, or challenged the paradigm on the basic plan, it was not focused on.⁴⁴ The plan blinded the planners to events taking place outside their narrow field of vision.

Such strategic planning theories are being abandoned in the face of empirical studies that are demonstrating their ineffectiveness.⁴⁵ In the most current management theory,⁴⁶ the emphasis has shifted from the plan as a

41. HENRY R. LINDEN, *ALTERNATIVE PATHWAYS TO A CARBON-EMISSION-FREE ENERGY SYSTEM*, THE BRIDGE 17 (Rice Univ., 1999).

42. SHONA L. BROWN & KATHLEEN M. EISENHARDT, *COMPETING ON THE EDGE* (Harv. Bus. Sch. Press, 1998); STAN DAVIS & CHRISTOPHER MEYER, *BLUR: THE SPEED OF CHANGE IN THE CONNECTED ECONOMY* (Addison-Wesley, 1998).

43. RICHARD P. RUMELT ET AL., *Fundamental Issues in Strategy*, in *FUNDAMENTAL ISSUES IN STRATEGY: A RESEARCH AGENDA* 9, 20 (Richard P. Rumelt et al. eds., Harv. Bus. Sch. Press, 1994).

44. Firms that use such planning methods to “create intensive focus and unified cultures . . . do so at the expense of responsiveness. The singlemindedness that initially gives them an edge over competition and results in success, over time reduces internal diversity.” Frances Westley, *Governing Design: The Management of Social Systems and Ecosystem Management*, in *BARRIERS AND BRIDGES TO THE RENEWAL OF ECOSYSTEMS AND INSTITUTIONS* 391, 396-97, (Lance H. Gunderson et al. eds., Colum. Univ. Press, 1995). Routines become rigid, non-core functions are cut, and “disconfirming information is neither sought nor fully entertained.” *Id.* Over time, the firm “ceases to pick up stimuli signaling fundamental changes in the environment and gradually reduces internal diversity until it is insufficient to respond to new demands from the environment.” *Id.*

45. Faith in long-range and strategic planning failed to survive the economic turmoil that began with the oil embargo of 1973 and the floating exchange rates, high inflation and increasing international competition that followed; “organizations learned from practical experience that simple extrapolations of history and cadres of professional planners failed to lead to innovation, adaptation to change, or even survival.” RICHARD P. RUMELT ET AL., *Fundamental Issues in Strategy*, in *FUNDAMENTAL ISSUES IN STRATEGY: A RESEARCH AGENDA* 9, 20 (Richard P. Rumelt et al. eds., Harv. Bus. Sch. Press, 1994).

46. “The economist’s neoclassical model of the firm, still enshrined in the textbooks — a smoothly running machine in a world without secrets, without frictions or uncertainty, and without a temporal dimension,” has in practice succumbed to “uncertainty, information asymmetry, bounded rationality, opportunism, and asset specificity.” *Id.* That the classical theory is still taught in some business schools is “a truly amazing victory of doctrine over reality.” *Id.* at 26.

document, to the plan as a process for analyzing new information that can confidently be expected but not predicted. One business executive has characterized it as the need to plan like a fire department. It cannot predict where the next fire will be, so a fire department has to shape a team that is capable of responding to the unanticipated,⁴⁷ which often may require reversing earlier decisions.⁴⁸

Adaptive management also requires that information be communicated within the organization to enable decisions to be made promptly as the need arises⁴⁹ through a "layered advice process" in which much information and many alternatives are discussed and analyzed⁵⁰ throughout the organization.⁵¹

In addition, management theory is increasingly looking to biology for management models. Scientists are applying complex adaptive theory, and drawing on the ideas of complexity theory, to try to simulate the way nature adapts to changing conditions. They advocate the use of adaptive planning methods that: (1) accept that solutions will not be optimal, (2) reject predictability as a criterion of effective management, and (3) understand that variability of performance is a reflection of the environment and not just a management flaw.⁵² This growing recognition that nature's models of adaptation can provide useful lessons for managers has led managers to a greater appreciation of the science of ecology.⁵³

47. WILLIAM E. FULMER, SHAPING THE ADAPTIVE ORGANIZATION: LANDSCAPES, LEARNING, AND LEADERSHIP IN VOLATILE TIMES 139 (Am. Mgmt. Ass'n, 2000) (quoting Andy Grove).

48. James C. Scott, in his study of the failure of many international development programs, advocates a planning process that (1) takes small steps, (2) favors reversibility, (3) plans on surprises, and (4) assumes that future planners will be inventive. JAMES C. SCOTT, SEEING LIKE A STATE: HOW CERTAIN SCHEMES TO IMPROVE THE HUMAN CONDITION HAVE FAILED 345 (1998).

49. J.C. SPENDER, INDUSTRY RECIPES: AN ENQUIRY INTO THE NATURE AND SOURCES OF MANAGERIAL JUDGEMENT 66-67 (Basil Blackwell, 1989).

50. Kathleen M. Eisenhardt, *Making Fast Strategic Decisions in High-Velocity Environments*, 32 ACAD. OF MGMT. J. 543 (1989).

51. These ideas have been significantly influenced by Japanese management theorists, who have emphasized a management structure based on a matrix in which communication takes place among all levels of the structure, rather than a pyramidal structure in which information is passed down from above. See, e.g., NOBUO TAKAHASHI, DESIGN OF ADAPTIVE ORGANIZATIONS 65-74 (Springer-Verlag, 1987).

52. William G. Macready & Christopher Meyer, *Adaptive Operations: Creating Business Processes That Evolve*, in THE BIOLOGY OF BUSINESS: DECODING THE NATURAL LAWS OF ENTERPRISE 181, 183-86 (John Henry Klippinger, III, ed., Jossey-Bass Publishers, 1999)

53. CRAWFORD S. HOLLING & STEVEN SANDERSON, *Dynamics of (Dis)harmony in Ecological and Social Systems*, in RIGHTS TO NATURE: ECOLOGICAL, ECONOMIC, CULTURAL, AND POLITICAL PRINCIPLES OF INSTITUTIONS FOR THE ENVIRONMENT 57, 57-61 (Susan S. Hanna et al. eds., 1996). Holling's views were originally set forth in ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT (C.S. Holling ed., 1978).

B. Ecological Dynamics

Within ecological science, adaptive management also is seen increasingly as the most effective way to protect ecological functions. To ecologists, the key postulate of adaptive management is that environmental change is to be anticipated, not dreaded.⁵⁴ The contemporary ecological paradigm, as described by one of its earliest proponents, Steward Pickett, is that ecosystems are open, can be regulated by external processes, and are subject to natural disturbances.⁵⁵ “Thus, rather than viewing ecosystems as being ‘in balance’, systems are seen as in flux”⁵⁶

The University of Florida ecologist Crawford Holling, whose pioneering work in this area is widely cited and admired,⁵⁷ emphasizes that the environment is not constant, and that environmental change is not necessarily continuous and gradual, but may well be episodic.⁵⁸ Ecosystems do not have a single equilibrium; they have multiple equilibria that define functionally different states, and non-linear movement between these states is a natural part of maintaining structure and diversity.⁵⁹ In many

54. See DONALD WORSTER, *The Ecology of Order and Chaos*, in *OUT OF THE WOODS: ESSAYS IN ENVIRONMENTAL HISTORY* 3, 11-13 (Char Miller & Hal Rothman eds., 1997).

55. STEWARD T.A. PICKETT & KEVIN H. ROGERS, *Patch Dynamics: The Transformation of Landscape Structure and Function*, in *WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE* 101, 119 (John A. Bissonette ed., 1997).

56. V.T. Parker & S.T.A. Pickett, *Restoration as an Ecosystem Process: Implications of the Modern Ecological Paradigm*, in *RESTORATION ECOLOGY AND SUSTAINABLE DEVELOPMENT* 17, 22 (Krystyna M. Urbanska et al. eds., Cambridge Univ. Press, 1997).

57. Holling is the editor of the online journal *CONSERVATION ECOLOGY*, at www.consecol.org, and he led the MacArthur Foundation multi-year project on “Resilience of Ecosystems, Economic Systems, and Institutions.” Available at www.resalliance.org/reports/macarthur_report.pdf.

58. Holling argues that ecological systems do not have a single equilibrium; they have multiple equilibria that define functionally different states, and non-linear movement between these states is a natural part of maintaining structure and diversity. BRYAN G. NORTON, *A Scalar Approach to Ecological Constraints*, in *ENGINEERING WITHIN ECOLOGICAL CONSTRAINTS* 45, 50-51 (Peter C. Schulze ed., 1996) (Holling’s ideas “may usher in a new era in thinking about environmental management, an era that is more concerned with processes, functions, and thresholds, and less concerned with system behavior near equilibrium.”); see also JAMES H. BROWN, *MACROECOLOGY* 192-93 (1995) (periods of apparent stasis may reflect species shifting their geographic environment in response to gradual changes in climate or other environmental factors).

59. Holling refers to the phenomenon of “abrupt shifts among a multiplicity of very different stable domains” in such areas as lakes, marine fisheries, wetlands, forests and rangelands. C.S. Holling et al., *Final Report of the Project: Resilience of Ecosystems, Economic Systems and Institutions*, April 30, 2000, at p. 4; available at www.resalliance.org/reports/macarthur_report.pdf.

ecosystems, this leads to a four-stage cycle, consisting of the two classic stages of Clements' theory:

- (1) Colonization, in which rapidly reproducing species move in to take over vacant niches;
- (2) Conservation, in which the colonizing species are joined by and eventually dominated by the "climax community," to which Holling adds;
- (3) "Creative destruction," stemming from the fact that the climax community is so dependent on conditions remaining constant that it becomes "brittle," inviting sudden environmental changes, such as disease or exotic species invasion; this is followed by;
- (4) Reorganization, in which the ecosystem may either return to something approximating its earlier state, if it is resilient, or may "flip" into a new dimension.⁶⁰

The role of fire in forests and grasslands is an example of an episodic natural "creative destruction" of these ecosystems that has attracted much public attention.⁶¹

Holling and the University of Florida political scientist Steven Sanderson have pointed out that traditional planning policies for natural resources have ignored this dynamic element of ecology and have tried to promote an unnatural stability.⁶² Management policies that assume that existing conditions are the natural order of things "lead to systems that lack resilience and may break down from disturbances that were previously absorbed."⁶³

Planners need to expect the unexpected, and be prepared to assist the reorganization process through monitoring, experimentation, and feedback. Through continuous experimental probing of the changes in the external world, they need to recognize early signals of error, and build in incentives for corrective action. Such planning can turn an unexpected event, such as drought, price change, or market shift, into an opportunity rather than a crisis.⁶⁴

60. C.S. Holling et al., *Science, Sustainability and Resource Management*, in LINKING SOCIAL AND ECOLOGICAL SYSTEMS: MANAGEMENT PRACTICES AND SOCIAL MECHANISMS FOR BUILDING RESILIENCE 342, 350-52 (Fikret Berkes et al. eds., Cambridge Univ. Press, 1998).

61. The history of public attitudes toward fire in America is chronicled in STEPHEN J. PYNE, *FIRE IN AMERICA* (Univ. of Wash. Press 2d ed., 1997).

62. C.S. HOLLING & STEVEN SANDERSON, *Dynamics of (Dis)harmony in Ecological and Social Systems*, in RIGHTS TO NATURE: ECOLOGICAL, ECONOMIC, CULTURAL, AND POLITICAL PRINCIPLES OF INSTITUTIONS FOR THE ENVIRONMENT 57, 77-79 (Susan S. Hanna et al. eds., 1996).

63. *Id.*

64. Holling, *supra* note 60, at 355-56.

Ecologists such as Holling and Pickett advocate management policies that use a dynamic model which treats ecological systems as constantly open to outside processes,⁶⁵ and that will “simultaneously retain and encourage the adaptive capabilities of people, of business enterprises, and of nature.”⁶⁶ Holling says that sustainable development “requires flexible, diverse, and redundant regulation, early signals of error built into incentives for corrective action, and continuous experimental probing of the changes in the external world. Those are the features of adaptive environmental and resource management . . .”⁶⁷ that can turn an unexpected event, such as drought, price change or market shift, into an opportunity rather than a crisis.⁶⁸ As the above examples indicate, leading ecologists and management theorists are following similar paths.⁶⁹ Sustainable development “has embraced an adaptive management ethic”⁷⁰

The relatively new field of “ecological economics” is also devoted to efforts to understand the “coevolutionary development of human beings and the natural world.”⁷¹ One issue that ecological economists have addressed

65. PARKER, *supra* note 56, at 17, 24.

66. C.S. Holling, *New Science and New Investments for a Sustainable Biosphere*, in *INVESTING IN NATURAL CAPITAL: THE ECOLOGICAL ECONOMICS APPROACH TO SUSTAINABILITY* 57, 72, (AnnMari Jansson et al. eds., Island Press, 1994).

67. C.S. Holling, *Engineering Resilience versus Ecological Resilience*, in *ENGINEERING WITHIN ECOLOGICAL CONSTRAINTS* 31, 41 (Peter C. Schulze ed., Nat'l Acad. Press, 1996).

68. Holling, *supra* note 66, at 57, 72 (“Those adaptive capacities depend on those processes that permit renewal in societ[ies], economies, and ecosystems. For nature it is biosphere structure; for businesses and people it is usable knowledge; and for society as a whole it is trust.”).

69. Another perceptive assessment of ecosystem management from the viewpoint of management theory is by Canadian management professor Frances Westley. She says that adaptive management is a way of managing an ecosystem that is “responsive to the variations, rhythms, and cycles of change natural in [that ecosystem and] able to react quickly with appropriate management techniques.” This has “an appeal that transcends the management of ecosystems.” In the past decade — in response to radical shifts in world economies, resource bases, population dynamics, and competitive structures — private- and public-sector organizations in all domains have wrestled with similar challenges.” She describes adaptive management as a “learning-led” strategy. Learning introduces redundancies and inconsistencies into the organizational structure that “may modify the conclusive nature of existing ideologies.” In learning-led strategies, consensus emerges through much discussion. But she warns that learning-led networks may not have a “foundation of action routines” on which to draw; i.e., they may be “relatively resource poor.” Yet to the extent that mechanisms for sensing and responding to change “become rationalized and focused, the system may seem more efficient in the short run, but it may actually become more vulnerable.” Frances Westley, *Governing Design: The Management of Social Systems and Ecosystem Management*, in *BARRIERS AND BRIDGES TO THE RENEWAL OF ECOSYSTEMS AND INSTITUTIONS* 391, 394, 401, 413, 417 (Lance H. Gunderson et al. eds., Columbia Univ. Press, 1995).

70. Holling, *supra* note 66, at 57.

71. THOMAS PRUGH, *NATURAL CAPITAL AND HUMAN ECONOMIC SURVIVAL* 21 (Lewis Publishers 2d ed., 1999).

is the need to include information about the resilience of ecosystems in economic decision-making processes. A group of economists and ecologists, including Stanford economist Kenneth Arrow,⁷² summarized this position in a 1995 article in *Science*. They emphasized that continued economic growth will be threatened if the resilience of ecosystems is not maintained because the lack of resilience will cause many valuable ecosystems to flip to less productive states.⁷³

This growing recognition of the importance of resilience in ecological systems has led me inescapably to the conclusion that adaptive planning and

72. In addition to Kenneth Arrow, the article in *SCIENCE MAGAZINE* was authored by Bert Bolin, Robert Costanza, Partha Dasgupta, Carl Folke, C.S. Holling, Bengt-Owe Jansson, Simon Levin, Karl-Goran Maler, Charles Perrings and David Pimintel, *Economic Growth, Carrying Capacity and the Environment*, 268 *SCI.* 520 (1995).

73.

The environmental resource base upon which all economic activity ultimately depends includes ecological systems that produce a wide variety of services. This resource base is finite. Furthermore, imprudent use of the environmental resource base may irreversibly reduce the capacity for generating material production in the future. All of this implies that there are limits to the carrying capacity of the planet. It is, of course, possible that improvements in the management of resource systems, accompanied by resource-conserving structural changes in the economy, would enable economic and population growth to take place despite the finiteness of the environmental resource base, at least for some period of time. However, for that to be even conceivable, signals that effectively reflect increasing scarcities of the resource base need to be generated within the economic system.

[One] useful index of environmental sustainability is ecosystem resilience, [which] is a measure of the magnitude of disturbances that can be absorbed before a system centered on one locally stable equilibrium flips to another. Economic activities are sustainable only if the life-support ecosystems on which they depend are resilient. . . . The loss of ecosystem resilience is potentially important for at least three reasons. First, the discontinuous change in ecosystem functions as the system flips from one equilibrium to another could be associated with a sudden loss of biological productivity, and so to a reduced capacity to support human life. Second, it may imply an irreversible change in the set of options open both to present and future generations (examples include soil erosion, depletion of groundwater reservoirs, desertification, and loss of biodiversity). Third, discontinuous and irreversible changes from familiar to unfamiliar states increase the uncertainties associated with the environmental effects of economic activities.

If human activities are to be sustainable, we need to ensure that the ecological systems on which our economies depend are resilient. The problem involved in devising environmental policies is to ensure that resilience is maintained, even though the limits on the nature and scale of economic activities thus required are necessarily uncertain.

Kenneth Arrow et al., *Economic Growth, Carrying Capacity, and the Environment*, 268 *SCI.* 520 (1995).

management systems are necessary if we are to avoid destroying the resilience of the ecosystems. But, this leads back to the dilemma I posed at the outset: Are intergenerational equity and adaptive management reconcilable? Does the fact that planning needs to be adaptive mean that it cannot be long-range? Does the prospect of unpredictable changes in technological and ecological conditions mean that long-range planning for the benefit of future generations is impossible?

No, long-term planning is not an option; it is a necessity. Decisions with long-range implications will continue to be made. For example, some types of natural resource management have always been tied to objectives that require a long-range view.⁷⁴ Growing wood or preventing aquifer pollution, for example, cannot be evaluated meaningfully on a quarterly basis.⁷⁵

The idea of a flexible planning process is by no means brand new,⁷⁶ but there is a definite trend in the professional and academic literature toward systems of planning and management that emphasize resilience and adaptability.⁷⁷ However, we are only beginning to recognize the need to build adaptive approaches into a system of statutes that assumed that both nature and society had more static characteristics.

74. Having a long-term view is an obvious pre-condition for adaptive management. As Carl Walters notes, "there is no point in learning more about something you intend to destroy shortly." CARL WALTERS, *ADAPTIVE MANAGEMENT OF RENEWABLE RESOURCES* 16 (Macmillan, 1986).

75. RICHARD T. FORMAN, *LAND MOSAICS: THE ECOLOGY OF LANDSCAPES AND REGIONS* 476-77 (Cambridge Univ. Press, 1995) ("Thinking long-term is the hardest part of management"). As J.B. Ruhl puts it, "Because there is no incentive to experiment, . . . learning that has not yet materialized into tangible performance results is stultified in a system that focuses on short-term quantitative results." J.B. Ruhl, *Thinking of Environmental Law as a Complex Adaptive System: How to Clean up the Environment by Making a Mess of Environmental Law*, 34 *HOUS. L. REV.* 933, 988 (1997).

76. It would be presumptuous to suggest that adaptive management was a new idea. Machiavelli, for one, advised his prince to be prepared to change with the times,

for if one governs himself with caution and patience, and the times and affairs turn in such a way that his government is good, he comes out prosperous: but if the times and affairs change, he is ruined because he does not change his mode of proceeding, . . . whether because he cannot deviate from what nature inclines him or also because, when one has always flourished by walking on one path, he cannot be persuaded to depart from it.

NICCOLÒ MACHIAVELLI, *THE PRINCE* 100 (Harvey C. Mansfield, Jr., trans., Univ. of Chi. Press, 1985).

77. A source that I have used as a basis for my recommendations is STEPHAN H. HAECKEL, *ADAPTIVE ENTERPRISE: CREATING AND LEADING SENSE-AND-RESPOND ORGANIZATIONS* 14 (Harv. Bus. Sch. Press, 1999). These theories are applicable to both the private and public sector.

IV. TOWARD ADAPTIVE PLANNING LAWS

How do these theories of management and ecology relate to the laws by which we plan and manage our land and natural resources? Many of our laws ignore the need for future adaptation. Our immediate stability and finality is deeply embedded in our system of laws.

For example, the National Environmental Policy Act assumes change is presumptively harmful and that our status quo is ideal.⁷⁸ Local comprehensive plans are seen by developers and environmentalists alike as vehicles for attributing finality to development decisions.⁷⁹ Agricultural programs promote stable yields of monocultural products.⁸⁰

Florida's "State Comprehensive Plan," embodied in the Florida Statutes since 1985,⁸¹ is a classic example of finality verging on mummification. As John DeGrove has pointed out, the Legislature rejected recommendations to provide a process for plan revision.⁸² For fifteen years, the plan has rested in its sarcophagus unexamined while the world has changed dramatically.

Practicing lawyers are well aware that clients typically want final solutions to their problems. But we need to make them understand that we are living in a world that is changing so fast that finality is a dying legal concept. Bill Rodgers has pointed out that instead of relying so heavily on the post-feudal land law we inherited from England, we might better look at our legal concepts of property in wildlife, water, or oil as more appropriate analogies for dealing with modern ecological theories of environmental change. Because they are more fluid; they recognize the need to adapt to changes in the environment, while property rights in land have typically emphasized the value of finality.⁸³

Dan Tarlock emphasizes that "adaptive management is premised on the assumption that management strategies should change in response to new scientific information. All resource management is an ongoing

78. WILLIAM H. RODGERS, JR., *ENVIRONMENTAL LAW* 900-03 (West Publ'g 2d ed., 1994).

79. See generally JOSEPH DIMENTO, *THE CONSISTENCY DOCTRINE AND THE LIMITS OF PLANNING* (1990).

80. JOY TIVY, *AGRICULTURAL ECOLOGY* 224-26, 241-42 (1990).

81. FLA. STAT. ch. 187.

82. John M. DeGrove, *Florida Growth Management Legislation, 1969-2000*, (Oct. 2001) (unpublished manuscript, on file with the Journal of Law and Public Policy).

83. William H. Rodgers, Jr., *Adaptation of Environmental Law to the Ecologists' Discovery of Disequilibria*, 69 CHI.-KENT L. REV. 887 (1994) (discussing the need to broaden the variety of property rights needed for the protection of ecological values).

experiment.”⁸⁴ Other legal scholars have also suggested the need to abandon law’s traditional preference for finality in the making of environmental rules.⁸⁵ Daniel Farber says that although scientists are constantly improving our environmental knowledge base, there is still a high degree of uncertainty.⁸⁶ “Change has been a constant theme in

84. A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 LOY. L.A. L. REV. 1121 (1994).

The idea that all management is an ongoing experiment poses a profound challenge to our legal system because it undermines a core principle of procedural and substantive fairness: finality, . . . Once a decision is rendered, we expect parties to forever abide by the outcome. Finality takes many forms. Sometimes, it is represented by express doctrines and legislation, [and on] other occasions, finality is implicit. For example, the premise behind an environmental impact statement is that once environmental damage has been fully disclosed, a one-time decision can be made on the merits of the activity, and even if the activity will irrevocably alter the environment, the decision is legitimate and final.

A. Dan Tarlock, *Environmental Law: Ethics or Science*, 7 DUKE ENVTL. L. & POL’Y F. 193, 206 (1996).

85. Some highly respected legal scholars, such as the University of California’s Joseph Sax, would go even farther, taking the view that resource management laws cannot properly address ecological issues until we completely reorient our perspective of private property away from its penchant for hard and fast rules. He believes that modern property law facilitates transformation of resources without a full analysis of the resources’ ecological values. As environmental conditions change, law will need to adapt to recognition of those changes. He argues that we need to supplement our recognition of the transformative value of natural resources with an equivalent recognition of their ecological value:

Land is not a passive Organization waiting to be transformed by its landowner. Nor is the world comprised of distinct tracts of land, separate pieces independent of each other. Rather, an ecological perspective views land as consisting of systems defined by their function, not by man-made boundaries. Land is already at work, performing important services in its unaltered state. For example, forests regulate the global climate, marshes sustain marine fisheries, and prairie grass holds the soil in place. Transformation diminishes the functioning of this economy and, in fact, is at odds with it.

Joseph L. Sax, *Property Rights and the Economy of Nature: Understanding Lucas v. South Carolina Coastal Council*, 45 STAN. L. REV. 1433, 1442 (1993); see also Joseph L. Sax, *Nature and Habitat Conservation and Protection in the United States*, 20 ECOLOGY L.Q. 47, 50-51 (1993) (need to replace enclave system of conservation with approach based on ecosystems). Professor Eric Freyfogle has also emphasized the “promise of ecology.” ERIC FREYFOGLE, *JUSTICE AND THE EARTH* 128-32 (The Free Press, 1995).

86. DANIEL A. FARBER, *ECO-PRAGMATISM: MAKING SENSIBLE DECISIONS IN AN UNCERTAIN WORLD* 178-79 (1999).

environmental law," and he argues that we should treat that as an opportunity rather than a problem.⁸⁷ We still try to make too many permanent decisions about environmental policy even though we recognize that our old decisions are outmoded. We "need to be more experimental, trying a lot of different things and attempting to learn from the results."⁸⁸

So, how should we go about incorporating the idea of adaptive management into our existing system of statutes and regulations? There have been a number of interesting efforts by individual agencies to incorporate more adaptive concepts into existing statutory programs, discussion of which would be beyond the scope of this Article.⁸⁹ Eventually, however, the legislative bodies will need to address the need for adaptive management as part of the basic statutory structure.

How could these ideas be implemented through legislation? The government could create an APO with the responsibility for continually evaluating and recommending changes in long-range planning goals and objectives in light of environmental and technological change. I use the term organization because such an institution could be located at a variety of places within the governmental structure, including the executive branch, the legislative branch,⁹⁰ or the university system.⁹¹ Ideally, an APO should be able to maintain a reputation of being responsive to changing political trends without being dominated by partisan politics. An APO also must be willing to constantly reevaluate its structure.

An APO would operate a continuous four-stage "sense-and-respond"⁹² process. First, an APO would monitor changes taking place in technology, the environment, and society. Second, an APO would evaluate these changes in light of existing objectives and strategies. Third, an APO would propose amendments to laws and regulations that would revise objectives and strategies to take account of the changes. Fourth, as strategies are

87. Richard A. Epstein, *Too Pragmatic by Half*, 109 YALE L.J. 1639 (2000) (reviewing DANIEL A. FARBER, *ECO-PRACTICISM: MAKING SENSIBLE DECISIONS IN AN UNCERTAIN WORLD* (Univ. of Chi. Press, 1999)); Lisa Heinzerling, *Pragmatists and Environmentalists*, 113 HARV. L. REV. 1421 (2000) (reviewing DANIEL A. FARBER, *ECO-PRACTICISM: MAKING SENSIBLE DECISIONS IN AN UNCERTAIN WORLD* (Univ. of Chi. Press, 1999)). It may give one confidence in Farber's pragmatic approach to read reviews that are quite critical of his failure to follow a reductionist or an antireductionist philosophy, respectively.

88. FARBER, *supra* note 86, at 179; *see also* Ruhl, *supra* note 75, at 933, 966-1000.

89. *See, e.g.*, BOSSELMAN, *supra* note 16, at 228.

90. Perhaps one of the closest analogies to what I am suggesting was the Office of Technology Assessment, which functioned as an adjunct of Congress until it was eliminated after the 1994 election.

91. Another analogy is the National Research Council, operated by the National Academy of Sciences and the National Academy of Engineering.

92. STEPHAN H. HAECKEL, *ADAPTIVE ENTERPRISE: CREATING AND LEADING SENSE-AND-RESPOND ORGANIZATIONS* 14 (Harv. Bus. Sch. Press, 1999).

revised, an APO would monitor further changes resulting from the revised strategies and begin the cycle over again.⁹³

The formulation of an APO's recommendations would require an open process with opportunity for extensive public participation.⁹⁴ Fortunately, modern advances in information technology have facilitated the efficient dissemination of even complex ideas and responses. An example of the way strategy revisions can receive broader based analysis⁹⁵ is the joint-planning process for the Everglades, where strategies were presented and commented on by Internet.

Conversion of the APO's recommendations into law would take place through the normal political processes. If an APO has top talent, and develops skills in consensus building, it should prove to be influential. I hope that the growing importance of technological and environmental change to peoples' lives, and the increasing complexity of the issues, is gradually elevating the role of scientific and technological expertise in the political process. But skillful communication by an APO of its proposals will be essential if that influence is to continue.

The existence of such an APO would stimulate similar adaptive planning efforts in the private and nonprofit sectors and in other governmental agencies. There would be useful interchanges and debates over what kinds of data to monitor and how to interpret the trends observed. I want to emphasize that I do not see an APO as some sort of authoritarian overseer, but as a technically advanced participant in the type of consensus building that characterizes modern planning practice.

An APO would need expertise in science, technology, planning, law, economics, negotiation, and communication. I believe that much of the public recognizes that the speed with which change is taking place requires that decisionmaking be based on the best available technical expertise, however the idea of enhancing the role of "technocrats" may encounter populist opposition.

Legislation would be needed to set out an APO's own processes and objectives. One of the most important of those objectives should be a direction to an APO to evaluate existing planning objectives and strategies to ensure that they take into account the needs of both present and future generations. The evolving concept of sustainable development could serve as a framework for statutory guidelines.

Within an APO, it would be appropriate to create a branch that serves as an ombudsman for future generations; a group that would try to evaluate all policies from the perspective of the next generation. Lawyers are familiar with an analogy — the guardian ad litem. In the probate of estates, when

93. *Id.*

94. A useful resource is ALAN MILLER, ENVIRONMENTAL PROBLEM SOLVING: PSYCHOSOCIAL BARRIERS TO ADAPTIVE CHANGE 209-13 (Springer, 1999).

95. DeGrove, *supra* note 82, at 15.

the interests of minors or unborn persons are affected, the probate court can appoint a guardian ad litem to represent the interests of minors or unborn persons. Particularly in regard to education issues, the young people and the children yet unborn need a strong advocate if the States' voters are to be made to recognize their moral obligation to future generations. A guardian ad litem within an APO could serve such a function.

Let me flesh out this very tentative description by imagining how an APO might deal with a few of the issues of State policy in Florida.

A. Coastal Oil Exploration

Florida, along with a number of other coastal states, has adopted a policy of strongly discouraging exploration for oil and gas in the offshore areas along most of its coastline.⁹⁶ This policy is based on concern about possible adverse impact on the tourist industry and natural resources.⁹⁷ Assume that an APO, when asked to reexamine this policy in light of changing conditions, took into consideration the following technological and environmental changes: (1) natural gas is widely seen as the leading source for environmentally sound and economically efficient generation of electricity; (2) most current exploration in this country is for gas rather than oil; (3) production of natural gas carries much less risk to the environment than production of oil; and (4) abundant gas supplies would avoid the need to experiment with heavy oil products such as orimulsion.

This list includes only a few of the items that should be considered, and you may well argue that it is skewed toward suggesting that the policy should be changed. But, I have done that to suggest that even strongly held policies might benefit from reexamination.

B. Citrus Industry

For generations, the State of Florida has promoted the citrus industry,⁹⁸ which produces a crop worth over \$1.1 billion⁹⁹ and is the State's number one export crop.¹⁰⁰ As the recreation industry has taken over many former citrus lands in frost-plagued northern Florida, the groves have moved south into low-lying parts of southern counties.¹⁰¹ The State takes the responsibility to protect these crops from tropical pests and diseases.¹⁰²

96. FLA. STAT. § 187.201(b)(9)8. This policy is implemented in various State and federal laws.

97. See BOSSELMAN, *supra* note 16, at 373-91.

98. See generally FLA. STAT. § 187.201(23).

99. FLORIDA STATISTICAL ABSTRACT, *supra* note 13, at 309.

100. HOWARD T. ODUM ET AL., ENVIRONMENT AND SOCIETY IN FLORIDA 244-45 (Lewis Publishers, 1998).

101. See *id.*

102. FLA. STAT. § 187.201(23)(b)10.

Assume that an APO, if asked to reexamine this policy, considered the following possible technological and environmental changes: (1) changing climate conditions suggest that warmer weather will make it increasingly difficult to protect southern Florida from tropical diseases and pests; (2) rising sea levels may make it difficult to maintain agricultural production on low-lying lands without endangering potable water supplies for Florida's major cities; (3) increasing awareness of the economic values created by maintenance of natural wetlands may call into question the value of highly-subsidized agriculture; and (4) genetic research may suggest new crops that are more suited to south Florida's future environment.

Again, this list is not meant to be complete or neutral, nor am I suggesting that I have pre-judged the conclusion. The intent is to show that even long-established State policies deserve to be reexamined from time to time in light of changing conditions.

V. CONCLUSION

The problems of trying to represent future generations are daunting. Intergenerational equity rolls nicely off the tongue, but when you look back to 1970 and think about the extent to which planners of that era were able to anticipate today's conditions, you recognize the need for the humility that is embodied in today's adaptive management theories. The toughest challenge is to persuade the public to forego immediate pleasures for long-term satisfaction. In a market-oriented democracy, only education can produce a more sophisticated consumer who values not only immediate pleasures, but also long-range benefits. No APO can accomplish that alone. An APO will require the influence of the entire education system, but I am optimistic that gradual progress has been and will continue to be made.

