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Developing a "*Comprehensive* Energy Strategy" with a Capital "C"

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Abstract

Alberta policy makers are developing a "comprehensive energy strategy" which is sorely needed to guide Alberta through the many energy crossroads that it now faces. This paper focuses on the strategy's "comprehensive" aspect, by analysing why the energy strategy needs to be "comprehensive", what factors must be considered in developing the strategy, and what components must be included in the strategy, to make it "comprehensive". Our analysis of "comprehensiveness" stems from an energy systems perspective, which attempts to account for all energy forms and all other physical and institutional energy system parameters, and the linkages among those energy forms and system parameters. After identifying these energy system characteristics, and several fundamental policy issues that need to be addressed, the paper cautions that, because of the inherent complexities, the development of a "comprehensive" energy strategy requires a continuous, iterative process and a special focus on cross-cutting tools.

1.0. Introduction

The strange thing about the energy system is that we almost never think about it as a system.[1]

This paper aims to help overcome this conceptual hurdle by using an energy system perspective in considering how Alberta can fulfill its commitment to develop a "*comprehensive* energy strategy".[2] The rationale for a provincial "energy strategy" *per se* is reflected in the following prediction:

> [D]uring the twentieth century we were largely on a comfortable, and a fairly predictable, energy path of a mature fossil-fueled civilization. Things are different now: the world's energy use is at the epochal crossroads. The new century cannot be an energetic replica of the old one and reshaping the old practices and putting in place new energy foundations is bound to redefine our connection to the universe.[3]

Professor Smil's conclusions followed an exhaustive analysis of energy trends and his often-skeptical reviews of various proposed energy futures. Many details of Smil's entire book are bound to have generated debate and disagreement, but there is likely widespread agreement with his basic conclusion that global energy use has come to a "crossroads", even that it is "epochal" in significance.

This conclusion is likely especially applicable to Alberta's high energy economy for a variety of reasons chief among which is the urgent need for meaningful, serious reductions in carbon emissions from the province's fossil fuel sector and high energy consumption driven in turn by the province's rapidly growing economy.[4] However, there are numerous other reasons why Alberta has reached an energy crossroads all of which would likely take an entire page or two to list.[5]

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[1]David Sanborn Scott, *Smelling Land — The Hydrogen Defense Against Climate Catastrophe* (Westmount, QC: Canadian Hydrogen Association, 2007) at 53.

[2]This commitment has been expressed in several contexts. See, *e.g.*, Alberta Government Plan — Managing Growth Pressures, online: <http://www2.gov.ab.ca/home/506.cfm#2>; Alberta Speech from the Throne (7 March 2007) at 10; and *Government of Alberta Strategic Business Plan 2007-10* (hereinafter "*Strategic Plan*") at 4, 11-12.

[3]Vaclav Smil, *Energy at the Crossroads* (Cambridge: MIT Press, 2005) at 373.

[4]For a recent overview of climate change risks and their link to fossil fuels, see, *e.g.*, Intergovernmental Panel on Climate Change, *Summary for Policymakers of the Synthesis Report of the IPCC Fourth Assessment Report*, Draft Copy (16 November 2007), online: <http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf>. The implications of this report's findings for Alberta's climate change policy will be discussed in detail in a forthcoming Occasional Paper by Jenette Poschwatta (Calgary: Canadian Institute of Resources Law, 2008).

[5]Among these reasons are: the province's changing production trends among conventional and non-conventional oil and gas sources; the growing labour and fuel constraints on its energy producers, particularly on the oil sands sector; widespread recognition of the need for planning and other frameworks

Given Alberta's arrival at this energy crossroads, the province's forthcoming "energy strategy" seems amply warranted to successfully steer the province through this transition. If there is anything surprising about the commitment, it is only in its implication that Alberta does not *already* have an "energy strategy" especially given the important role that energy has long played in fuelling the province's economy.

The strategy's aim to be "comprehensive" in nature is appropriate to ensure that the strategy reflects a systems approach, in other words, to ensure a consistent government approach with respect to Alberta's myriad energy producing sectors, as well as to address the numerous linkages: among these sectors; between upstream and downstream components of provincial energy systems; and between energy and non-energy systems. Besides needing to address these linkages, a "comprehensive"-type of strategy is needed to address fundamental questions about the appropriate mix of Alberta's energy sources that would best serve provincial interests through domestic consumption and export. Closely related questions needing to be addressed are the relative roles of markets and the provincial government in determining this mix and in limiting the costs of energy production and consumption.

While the province's aim for a "comprehensive" strategy is warranted, the fulfillment of this objective will be difficult because of the wide range and complexity of issues involved. This paper's aim is to facilitate that task by suggesting topics that need to be addressed in developing the strategy and the components that need to be included in the strategy, so that it can be truly "comprehensive". In Part 2, the paper starts by identifying the benchmarks of *any* good government policy or policy framework. (This part treats "strategy" as a kind of "policy" and defines the latter term at the beginning.) Part 3 then discusses topics that need to be considered in developing the strategy, and components that need to be included in the strategy, to make the strategy "comprehensive". As noted at the outset, the discussion reflects an energy *systems* perspective. In other words, the analysis equates "comprehensiveness" with a "whole systems" approach. Part 4 focuses

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to manage local and regional cumulative environmental and social impacts of energy developments; a small but bourgeoning renewable energy industry most of whose sectors are calling for enhanced government support so they can fairly compete with non-renewable sources; a looming shortage of both electricity transmission and production capacities to meet projected future demands; potential new supplies of natural gas imports from either northern sources or from overseas shipments (in a liquefied state); controversial proposals for nuclear power development in Alberta; and an exploding biofuels market for Alberta's grain production (with attendant, increasing impacts on the province's grain-based cattle producers).

For a discussion of these "crossroads"-making circumstances, see, *e.g.*, Dr. Robert L. Mansell & Ron C. Schlenker, *Energy and the Alberta Economy: Past and Future Impacts and Implications*, Paper No. 1 of the Energy Futures Project (Calgary: Institute for Sustainable Energy, Environment and Economy, 2006); Oil Sands Ministerial Strategy Committee, *Investing in our Future: Responding to the Rapid Growth of Oil Sands Development — Final Report* (Edmonton: Government of Alberta, 2006); and Charles Frank, "Alarm Bells Ring in Oilsands Country" *Calgary Herald* (17 November 2007) C1.

on two particularly critical but often neglected topics — the relative roles of government and markets, and sustainability.

Finally, Part 5 turns the entire paper on its head by suggesting that the province's development of a truly "comprehensive" energy strategy is ultimately unattainable because of the complexities involved and the limits of humans' abilities to capture those complexities, and predict design outcomes. Drawing from experiences with "ecosystem management", the paper nevertheless concludes that these limitations should not preclude efforts to develop energy strategies that are as "comprehensive" *as possible* (or, in other words, that are iteratively more comprehensive than previous strategies) but that also include adaptive learning processes that make up for the modeling constraints.

2.0. Benchmarks of a Good Policy

What are the characteristics of a good "policy"? What makes some policy documents consistently referenced in decision-making contexts but others seldom used, or long forgotten statements of government intent? This part offers several answers to these questions. While the discussion concentrates on generic characteristics of good policy, some attention is paid to characteristics of energy policy in particular. Before listing these characteristics, this part clarifies what the paper means by "policy" and provides the common rationales for developing and using it in government decision-making.

2.1. What is Policy and Who Makes It?

The term "policy" has been used in numerous ways and contexts. For purposes of this paper, "policy" simply means *generic* grounds for decision-making. The term "generic" is used here to refer to rules or guides that are or can be abstracted from specific facts. In other words, their logic is not tied to a specific set of facts. This definition of "policy" is broad in the sense that it covers a spectrum marked at one end by rigid rules that leave decision-makers with no case-by-case discretion, and at the other end by flexible guidelines that provide general direction but still leave decision-makers with considerable discretion in making decisions in particular factual contexts.

The "policy" definition used here also includes decision-making guides often referred to as "goals", "objectives", and "strategies". The definition also includes legally binding sources, most notably, legislation and regulations. However, where relevant, this paper assumes that the province's forthcoming "comprehensive energy strategy" will be embodied in a non-legislative written policy-type document, although the document may call for new laws or changes to existing ones.

Who among government officials makes policy? In all likelihood, all government decision-makers do. Some officials have clear or express high level policy-making functions. But even regulatory tribunals and licensing officials, some of whose officials adamantly insist that they are policy takers rather than policy makers, develop and use lower level policies for analysing complex, factual issues and for making *ad hoc* decisions with respect to those issues. In Alberta, many of those energy-related decisions involve "public interest"-type determinations which are policy-laden because the decision-makers have broad discretion (in other words — little legislative guidance) in deciding what factors to consider and how to balance those factors.[6] This means, in effect, that they have broad discretion to define the "public interest". In short, different kinds of policies are typically made at all or most levels of hierarchical government decision-making structures.

2.2. Why Bother Developing Policy?

In order to identify the benchmarks of good policy, one must first be clear on why policy should be developed at all or, in other words, what functions policy serves in government decision-making. Perhaps the most obvious answer is that policy provides a means for the highest level of government officials that are responsible for any given subject to provide direction to lower-level decision-makers in the exercise of the latters' discretion in making decisions. This vertical delegation of decision-making power is typically needed for sets of decisions — *e.g.*, issuing regulatory approvals for individual development projects — that are too numerous or cumbersome for higher level officials to make themselves. Of course, the key assumption behind this policy role is that there *should* be a "top down" filtering of direction for front line or *ad hoc* decisions. The reason for this normative assumption is a democratic one, namely, that government direction should generally be determined or at least substantially influenced by electoral processes, and elected officials are generally located in the higher levels of government.[7] This said, open or transparent policy making processes are themselves useful contexts for engaging the public with respect to issues that are not adequately debated and fleshed out in elections of high level government officials. Thus, top-down policy making serves not only to effectuate electoral choices but to provide additional democratic processes outside of the electoral context.

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[6] As the province's former Energy and Utilities Board (EUB) recently stated, in discussing its "public interest" decision-making function, "[b]alancing those [public] interests is a policy laden function …", EUB Decision 2007-075: *AltaLink Management Ltd. and Epcor Transmission Inc.* (30 September 2007) at 5.

[7] For example, one author describes a "policy agenda" as a governmental response to a "widespread concern" among the electorate "embodying a perceived need for change": Randal Baker, "Energy Policy: The Problem of Public Perception" in Robert Bent, Lloyd Orr & Randall Baker, eds., *Energy — Science, Policy, and the Pursuit of Sustainability* (Washington, DC: Island Press, 2002) at 132.

Another purpose of top down generic direction setting is to facilitate governments' consideration of various and complex linkages among issues and subjects. Because of their issue- or subject-focused jurisdiction, "front line" decision-makers may not be aware of these linkages or at least may not be able to decide how those linkages should work. They may also be working at cross-purposes with other front line decision-makers with respect to issues or subjects that lie on opposite ends of those linkages.

Putting aside the advantages of direction setting from a top down standpoint, a generic direction setting process ensures consistency among *ad hoc* decisions and provides a forum for contemplation and resolution of fundamental issues that "front line" decision-makers may not be capable of adequately considering and addressing in the rush and pressure, and faced with the complexities, of deciding whether to issue approvals for individual projects and otherwise regulating individual activities. Addressing these fundamental issues may involve identifying assumptions that front line decision-makers are making or "facts" that they are taking for granted — whether consciously or sub-consciously — and considering where and when those assumptions originated and whether they are still well founded.[8]

The implication of these policy justifications is that, where possible, policy should be made outside of *ad hoc* decision-making contexts like regulatory approval proceedings for energy developments, rather than in the course of those proceedings. Thus, the broad "public interest"-type decisions that Alberta energy regulators are required to make may leave too much room for policy-making in *ad hoc* decision-making contexts.[9] On the

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[8]In these *ad hoc* contexts, "policy" might be more appropriately viewed as simply an abstraction of generic rules or principles from *ad hoc* decisions (*e.g.*, rules of fairness or reasonableness) than as having certain "functions" with respect to decision-making. References to "policy making" in the remainder of this paper refer to abstract policy-making contexts rather than to *ad hoc* decision-making contexts, because the province's development of a "comprehensive energy strategy" will presumably occur in the former context.

[9]For example, it has been left to Alberta's new Energy Resources Conservation Board (ERCB — formerly the Energy and Utilities Board) to make the basic policy decision — under its "public interest" decision-making mandate — as to whether incremental oil sands expansion should be allowed during the continued "absence of sustainable long-term solutions" to the "critical challenges" posed by the cumulative environmental and social effects of oil sands operations: EUB Decision 2006-128: *Albian Sands Energy Inc., Application to Expand the Oil Sands Mining and Processing Plant Facilities at the Muskeg River Mine, Joint Panel Report* (17 December 2006) at vi. The EUB cautioned that, "[w]ith each oil sands project", this problem "must weigh more heavily" in the Board's "determination of the public interest", *ibid*. However, this caution hardly suggests a clear policy basis for applying the broad "public interest" test. The Board itself has recognized that the "public interest" test is "difficult to define concretely" and to apply on an *ad hoc* basis. EUB Decision 2005-060: *Compton Petroleum Corporation Applications for Licences to Drill Six Critical Sour Natural Gas Wells, Reduced Emergency Planning Zone, Special Well Spacing, and Production Facilities Okotoks Field (Southeast Calgary Area)* (22 June 2005) at 12 (cited in Nickie Vlavianos, *The Legislative and Regulatory Framework for Oil Sands Development in Alberta: A Detailed Review and Analysis*, Occasional Paper #21 (Calgary: Canadian Institute of Resources Law, 2007) at 39). For a general discussion of the Board's "public interest" decision-making roles, see, *e.g.*, Michael M. Wenig, ed., *Canada Energy Law Service — Alberta* (Toronto: Carswell, 2007), §§17a, b and c (hereinafter

other hand, it is likely impossible, and may well be inadvisable, to eliminate all policy-making from all *ad hoc* government decision-making.

Finally, government policy-making often seems to be intended to serve yet another function: to give the public the perception that government is really tackling a tough topic and resolving difficult issues by setting a new, courageous course, even when policy makers have no such true intent. This function may be very successful (at least in the short term) in achieving its aim of quelling public concern or boosting government popularity, but it is arguably a negative rather than positive aspect of policy making from a broad democratic, public interest standpoint. Thus, this "window dressing" function of policy making will be ignored for purposes of this paper.

2.3. The Key Components

The above discussion of policy functions leads logically to a list of important policy features. For simplicity, the features are presented as if only one hierarchical abstract policy-making level exists. However, in reality, there are myriad policy making levels and contexts and some of these features may need to be more prominent in some policy contexts than in others. In other words, the policy features listed below may not all need to exist in any given policy. This said, any policy must itself exist within a broader, hierarchical policy *framework*. Thus, while the following components are phrased as prescriptions for a good "policy", they do not need to occur within a single policy as long as they occur within this broad policy *framework*.

- *Identification of the Problem or Reason for Policy Development* — Policy makers should be clear why they are developing any given policy — *i.e.*, what is the problem that needs to be addressed or other reason for setting generic directions for *ad hoc* decision-makers.[10] Logically, the exercise of providing this rationale will help policy makers understand their own policy-making task, as well as help the public understand a policy's intent and help lower level government officials interpret, apply and implement the policy.

- *Hierarchical Basis for Decision-Making and Implementation* — To facilitate their interpretation and implementation, policies should include a multi-step, hierarchical decision-making structure. These steps generally start with a broad target (often expressed as a "vision"), then proceed to more detailed "goals" or

"*CELS*"). For a critique of the Board's "public interest" decision-making, see, *e.g.*, Vlavianos, *supra* at 39-40.

[10] As one author has stated, there is an "old saying that if you don't know where you are going, you are unlikely to get there. The policy analogue is that if you don't know what problem you are trying to solve, you are unlikely to come up with the solution." Steven A. Kennett, "A checklist for evaluating Alberta's new land-use initiatives" (Summer 2006) 95 Resources 1 at 2.

"objectives", and end with specific tasks or decision-making criteria. This hierarchy ensures that policy makers will address, and explain to the public, what they want the policy to ultimately achieve and what steps they envision as being needed to achieve it. Alberta's natural resource management policies have come under fire for lacking this characteristic. As Kennett observed, "there is a track record of promising initiatives and thoughtful recommendations that have had disappointingly little impact on land and resource management."[11] In a prior paper, Kennett explained further that one of these policies "fail[ed] to penetrate to the structural level of legislation, institutional arrangements and decision-making processes. [The policy] … was pursued within a pre-existing legislative and policy framework that was never systematically reviewed and amended in order to achieve structural integration."[12] Referring to another Alberta natural resource policy, Schneider noted the absence of an implementation plan or substantive implementation actions five years after the policy's adoption.[13] A logical, hierarchical framework of decision-making standards and implementation steps is needed to ensure that policies are "structurally integrated".

- *Clarity and Precision* — Naturally, the detail and precision of each rung on a hierarchical policy ladder should increase the further down the ladder. By definition, vision statements cannot provide detailed blueprints for action. This said, the detail and precision of each policy rung should at least be sufficient to provide a logical basis for understanding how the content of the next lower rung was derived and ultimately to provide meaningful guidance for officials in carrying out their decision-making functions. Thus, vague vision statements that essentially call for the promotion of public welfare or of the "public interest" are arguably not particularly helpful except to clarify the obvious — that policy-makers have a public objective rather than a private one.

  Likewise, high level policies calling for "balanced" approaches or decision-making provide similarly unhelpful guides, because the identification of the *centre* or balance point in any balancing inquiry depends entirely on how the balancing test is set up.[14] Kitchen sink-type statements of objectives — for example, ones that call for economic growth and development as well as

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[11]Ibid.

[12]Steven A. Kennett, "Reinventing Integrated Resource Management in Alberta: Bold New Initiative or 'Déjà Vu All Over Again'?" (Winter 2002) 77 Resources 1 at 3.

[13]Richard R. Schneider, *Alternative Futures: Alberta's Boreal Forest at the Crossroads* (Edmonton: Federation of Alberta Naturalists and Alberta Centre for Boreal Research, 2002) at 3, 29-31.

[14]The classic example of the mis-use of "balance"-based policies are those calling for "balanced" approaches to development or intensive land use in landscapes that have high natural or ecological values, but without explaining how this approach should account for the amount of landscape already covered by such developments or uses.

environmental protection — are similarly unhelpful unless at least accompanied or followed by more concrete decision-making criteria and clear reasons for those criteria. Even a vision focused on "sustainable development" or "sustainability" is problematic without clear, detailed explanation of what those concepts are intended to mean and how they are supposed to be achieved.[15] At the very least, these kinds of broad statements must be followed by more detailed, precise statements of what policy makers are intending to accomplish and by measurable targets for those accomplishments.

- *Acknowledgement of Risks and Uncertainties* — The above call for "clarity and precision" in policy documents is not intended to suggest that all "cause and effect" relationships, and other facts that a policy relies on can be expressed unequivocally or with full certainty. Some events — like how an industry will react to a given environmental regulatory standard, and whether the standard is stringent enough to achieve specified environmental protection objectives — may not be provable with certainty and thus are more appropriately viewed as probabilities (as expressed either in rough narrative terms or sometimes in precise statistical terms) than as "hard facts". However, where key factual bases for policies are unknown or uncertain, policies should recognize these gaps up front or, in other words, be honest about factual uncertainties and how the policies have addressed those uncertainties. Thus, the call for "clarity and precision" includes clearly and precisely identifying facts whose nature or existence are themselves unclear or imprecise.

[15]Thus, Canada's Commissioner of the Environment and Sustainable Development recently took the federal government to task for failing to provide clear enough guidance for departments' preparation of their legislatively-required "sustainable development strategies". "Sustainable Development Strategies", Chapter 1 in *2007 Report of the Commissioner of the Environment and Sustainable Development to the House of Commons* (Ottawa: Office of the Auditor General of Canada) at 22 and 30-32. Similarly, the National Energy Board noted recently that "[c]learly expressed policies and programs are a critical element of establishing plausible future energy paths and providing more definite analysis." NEB, *Canada's Energy Future — Reference Case and Scenarios to 2030* (Calgary: 2007) at 109. Alberta's most recent climate change policy deserves mixed scores under these tests. On the one hand, the policy provides clear, numeric objectives and time-frames for greenhouse gas emissions reductions for each of its three sets of actions. *Alberta's 2008 Climate Change Strategy — Responsibility/Leadership/Action* (2008) at 20. On the other hand, the policy provides virtually no guidance on when the actions themselves must be taken and the contributions expected of most of the actions toward achieving the three emission reduction objectives. In addition, the policy's explanations of many of the committed actions are vague. For example, the policy commits the province to establish an "incentive program" to residential energy efficiency but provides virtually no clues as to the appropriate scope or nature of the requisite "incentives". *Ibid.* at 16. Likewise, the policy commits the province to "[i]mplement strategies to enable" greenhouse gas emission reductions. *Ibid.* This is essentially a "strategy to develop a strategy" and, as such, provides no direction as to what steps should actually be taken in this context.

- *Exposure and Critical Assessment of Underlying Assumptions* — As discussed above, one of the functions of policy-making is to prompt governments to identify and critically evaluate the merits of all assumptions that are reflected — often silently — in government decisions. It follows logically from this function that policies themselves (or background materials accompanying actual policies) should include a written identification of these assumptions and a discussion of their merits. Common assumptions relate not only to key facts whose existence may be uncertain or disputed, but also to moral norms or notions of social acceptability that should be acknowledged up front so they can be fully debated and publicly considered. As one scholar has explained, "much of what we take to be inevitable and self-evident is, to a great extent, a social[ly] conditioned perception which contains a variety of unexamined assumptions."[16] These assumptions should be examined, not only for policy makers' better understanding, but to enable the public to scrutinize and understand policy-makers' fundamental views. This said, it is questionable whether we can ever fully objectify and critique these assumptions.[17] Yet, a considerable de-layering or un-ravelling of deep-seated assumptions is likely possible and the effort is essential for evaluating policy options and providing the public with a reasonable basis for understanding and critiquing policy decisions.[18]

- *Identification of Incidental Effects and Strategy for Dealing with Them* — In today's complex world, the implementation of likely most if not all government policies has some effects that are either unwanted or at least unrelated to the policies' objectives. To ensure that the magnitude of any adverse incidental effects do not outweigh a policy's expected benefits, and that appropriate strategies can be designed if needed to minimize any adverse incidental effects, policy-makers should make every effort to identify these effects and explain how new policies will deal with them.

- *Equivalent Methods for Considering Cumulative Costs and Benefits* — The identification of the full or cumulative effects of policy implementation — whether those effects are intended or are incidental — is likely an impossible task. This is because one effect causes another which in turn causes another and

[16] F. David Peat, "Blackfoot Physics and European Minds", online: <http://www.fdavidpeat.com/bibliography/essays/black.htm>.

[17] As Peat suggests, "we are participators and not spectators in the universe. Within the act of observation, at the quantum level at least, observer and observed become one and analysis reaches its limit." F. David Peat, "Nature Morte: Inscape, Perception and Thought", online: <http://www.fdavidpeat.com/bibliography/essays/dutch.htm>.

[18] For examples of this de-layering exercise in two different disciplines — literature and history — see, *e.g.*, Daniel Quinn, *Ishmael: An Adventure of the Mind and Spirit* (New York: Bantam Books, 1992); and Ronald Wright, *A Short History of Progress* (Toronto: House of Anansi Press, 2004).

another, in a potentially infinite set of ripples emanating from a given source.[19] There are reasonably reliable methodologies for estimating some ripple effects (*e.g.*, economic models for calculating the overall economic effects of subsidizing a specific factory or industry), but other ripple effects may remain highly speculative. At some point policy-makers must decide what range of ripple effects are so remote that they cannot reasonably be included in policy considerations. However, in deciding where to draw this cut-off line, policy makers must at least be sure to account for an equal scope of ripple effects that are considered publicly beneficial as those considered adverse to the public interest. Likewise, policy-makers must apply equally rigorous methodologies for considering the chosen scope of positive and negative effects. For example, if policy makers use a "back of the envelope"-type analysis in concluding that subsidies intended to boost an industry will in turn economically benefit numerous "downstream" sectors, those officials should not refuse to assess the adverse environmental effects of those downstream activities on the ground that they are too speculative.[20] These rules of thumb help ensure that any cost-benefit analyses underlying policy decisions are not skewed or biased toward certain costs or benefits.[21]

- *Linkages to Other Policies* — Most if not all public policies are related to myriad other policies through vertical and horizontal linkages within a jurisdiction's broad or overall policy framework. Because of the number, variety, and complexity of policy issues governments typically face, it is likely impossible for any one government to clearly identify its entire framework of policies in all subject areas and to chart the precise linkages among them. (On top of this daunting task is the challenge of charting the linkages between a single jurisdiction's policies and those of other jurisdictions.) Nevertheless, there should be some semblance of an overall pyramid-like policy framework and policy-

[19]Part of the problem posed by this rippling scenario is that the relationship between causes and effects is likely non-linear and small changes in causes may have substantially different changes in effects. See generally James Gleick, *Chaos: Making a New Science* (New York: Penguin Books, 1987). Because of these factors, the greater the number of "ripples" the more difficult it is to predict effects at the last ripple.

[20]The U.S. Ninth Circuit Court of Appeals provided a recent example of judicial disapproval of this imbalanced consideration of costs and effects, in the context of its review of numerous challenges to new federal fuel automobile efficiency standards. According to the court, the government "cannot put a thumb on the scale by undervaluing the benefits and overvaluing the costs of more stringent standards." Hence, the court found "arbitrary and capricious" the government's approach of failing to conduct either a quantitative or qualitative analysis of the benefits of carbon reduction from more stringent fuel economy standards, when the government did evaluate various costs those standards would impose on auto manufacturers. *Center for Biological Diversity et al. v. NHTSA*, 508 F.3d 508 at 531-35 (9th Cir. 2007).

[21]For a discussion of problems in considering these ripple effects in the context of a regulatory approval for a single project, see Michael M. Wenig & Patricia Sutherland, "Considering the Upstream/Downstream Effects of the Mackenzie Pipeline: Rough Paddling for the National Energy Board" (Spring 2004) 86 Resources 1.

makers should make best efforts to vertically and horizontally "locate" any new policy within this overall framework. This exercise will clarify: what other policies are guides for interpreting any given policy; how that given policy will be implemented, including what sets of decision-makers and decisions are actually subject to the policy and whether those sets are actually *needed* to adequately implement the policy; what if any conflicts might arise among different policies and which of any such conflicting policies is intended to trump the others when conflicts arise.[22]

- *Linkages to Decision-Makers* — Besides needing to be linked to other policies, a given policy needs to be clearly linked to the set of government decision-makers that are expected to apply and implement it and to those other officials whose programs may be affected by its implementation. Making this linkage to specific government constituencies (or, where appropriate for higher level policies, to *all* government officials) will help ensure that policies can be implemented by prompting policy-makers to consider: which officials or departments are needed to "buy in" to a given policy; whether staff and other resources are realistically available to implement the policy; whether the officials expected to implement the policy actually have legal authority to do so;[23] and, when several agencies or departments are responsible for implementing a given policy, whether there are clear functional relationships among them.

In summary, to ensure that its "comprehensive energy strategy" is effective, provincial policy-makers should start by identifying and clarifying the functions it is supposed to serve and the problems or challenges it is intended to address. The above discussion listed several additional policy-making steps and policy features that both seem essential to ensure the success of any policy-making endeavour. The next part focuses more specifically on considerations and policy features that would seem necessary for an "energy strategy" to be truly "comprehensive".

[22]For example, given the international character of energy supplies and of the effects of energy use, one author concludes that it is "perhaps illusory" to even distinguish between "national and international" energy policies. Baker, *supra* note 7 at 153. Another author argues that climate change policies must be viewed within, and subject to, a broader strategy of promoting human welfare. Hadi Dowlatabadi, "On integration of policies for climate and global change" (2007) 12 Mitig. Adapt. Strat. Glob. Change 651-663.

[23]The latter problem appears to apply to Alberta's climate change policies. The current policy is virtually silent with respect to the government agencies responsible for its implementing its numerous "action" commitments. *Alberta's 2008 Climate Change Strategy*, *supra* note 15. The previous policy was assigned to Alberta Environment to implement but involved actions that seemed to fall more within the jurisdiction of Alberta Energy than Environment. Michael M. Wenig, Dr. William A. Ross, J.P. Jepp & Richard Panton, *Legal and Policy Frameworks for Renewable Energy in Alberta* (Calgary: ISEEE, 2007), online: <http://www.iseee.ca/whatsnew/reports/reports.shtml> at 69-70.

3.0. Comprehensive with a Big "C"

To date, the province has not explained its concept of "comprehensive", in the context of its forthcoming energy strategy. However, the province has impliedly defined the concept by noting that the strategy will address the development of *both* renewable and non-renewable energy resources as well as the "conservation of energy use". The province has also stated that these components will collectively be aimed at promoting "environmentally sustainable development and growth."[24]

If they are all addressed in the final strategy, these components will make the strategy more "comprehensive" than most energy policies which are typically focused on specific upstream or downstream sectors or on specific links between those sectors, or on specific impacts of energy developments.[25] However, the actual nature of the government's assessment and use of these components may have a huge bearing on the "comprehensiveness" of the final strategy and there are numerous additional, related details that could also be included. This part provides suggestions on how the province can expand its core components in order to make the final strategy truly "comprehensive".

Consistent with the policy development guide set out in the previous part, a useful starting point for this analysis is to consider why, if some form of energy strategy is needed to guide Alberta successfully through the "epochal energy crossroads", the strategy should be a "comprehensive" one. Unfortunately, the province's announcements of its plan to develop this strategy provide scant justification for its intended "comprehensive" scope. However, the likely justifications are not hard to discern. Alberta already has several policies or policy-like statements relating to various aspects of energy, but they are arguably not integrated with each other and do not cover all aspects of energy production and consumption in Alberta.[26] Thus, a single, "comprehensive"

[24]*Strategic Plan*, *supra* note 2 at 4, 8 and 12. The province noted that the energy strategy is one of several current initiatives that are all directed toward this objective, *ibid.* The 2007 Throne Speech adds that the energy strategy will pursue this sustainability objective in an "environmentally responsible manner, making full use of innovations such as near zero-emission coal", *supra* note 2 at 10. Alberta Energy's 2007-10 Business Plan describes the strategy's scope in similar terms but differs from the province-wide Strategic Plan by alternately referring to the development of a single "comprehensive energy strategy" and of multiple "comprehensive energy strateg*ies*". *Energy — Business Plan 2007-10* (Edmonton: Government of Alberta, 2007) at 130, 131, 132 and 136 (emphasis added).

[25]In the energy context, examples of these sector- or impact-specific policies are: Alberta's Electricity Policy Framework: Competitive-Reliable-Sustainable (Edmonton: Alberta Energy, 2005); Transmission Development — The Right Path for Alberta — A Policy Paper (Edmonton: Alberta Energy, 2005); Industrial Systems Policy Statement (Edmonton: Alberta Energy, 1997); and Albertans & Climate Change: Taking Action (Edmonton: Government of Alberta, 2002).

[26]See generally Wenig *et al.*, *supra* note 23 at 59-75.

energy policy is needed to tie existing policies together — *i.e.*, to make sure they are functionally consistent and have consistent objectives and are serving the same *ultimate* ends — and to fill in policy gaps.

From a broader perspective, the justification for a "comprehensive"-type of energy policy starts with a recognition that energy resources and energy-related activities generally occur, not in isolated or stand-alone contexts, but in complex physical and social *systems* with myriad, inter-related facets and connections to each other as well as to other, non-energy systems. A "comprehensive" type of energy policy is needed to account for how these connections operate and whether they need to be re-structured to further ultimate objectives. Besides removing inconsistencies, this re-structuring can maximize synergistic relationships among energy sources and activities.[27] These benefits are implicit in the integrated, systems-based themes expressed in the province's 2006 "Integrated Energy Vision", but that Vision arguably needs considerable refining to be satisfactorily understood and implemented.[28] Thus, this Vision was a useful predicate, but is not a substitute for, a "comprehensive energy strategy".[29]

With an understanding of the rationales for a "comprehensive"-type of energy strategy, the next step is to consider what *makes* a strategy "comprehensive". The answer lies in the rationale for this approach, namely, a "comprehensive" strategy is one that adopts an integrated, systems-based approach.[30] This paper does not purport to provide *all* the details or every design parameter that would need to be included to have a fully integrated, systems-based energy strategy. However, the following discussion arguably provides at least a core of parameters that would need to be factored into any energy strategy for it to be truly "comprehensive" in scope. These core parameters can be viewed as falling into three broad categories, relating to: the forms of energy; the physical aspects of human-created energy systems; and regulatory and policy structures for

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[27]Mansell & Schlenker, supra note 5 at 55; and Michael M. Wenig & Michal C. Moore, Is Conservation Worth Conserving? The Implications of Alberta's "Energy Resource Conservation" Mandate for Renewable Energy, Occasional Paper #20 (Calgary: Canadian Institute of Resources Law, 2007) at 33. See also, e.g., E.P. Dalziell & S.T. McManus, "Resilience, Vulnerability, and Adaptive Capacity: Implications for System Performance" in Consequence Modelling in Engineering Decision Making, Proceedings of the International Forum on Engineering Decision Making, First Forum, 5-9 December 2004, Stoos, Switzerland, online: <http://www.ifed.ethz.ch/events/firstforum.html> at 4 (unnumbered).

[28]Michael M. Wenig & Dr. William A. Ross, "Making Progress Toward a Truly *Integrated* Energy Policy" (March/April 2007) 31 LawNow 43-44.

[29]Not surprisingly, Alberta Energy's current Business Plan notes that Energy will develop "comprehensive energy strategies" to "implement" the Integrated Energy Vision. Alberta Energy, *supra* note 24 at 130. However, the Vision may be difficult to implement if it is not itself further refined.

[30]As Scott explained, we typically think about energy systems' "bits and pieces" rather than about the "overall system" notwithstanding that we "understand the importance of systemic thinking in so many other aspects of modern life." Scott, *supra* note 1 at 53.

managing those systems. These categories are not conceptually distinct, but are still useful for analytical purposes.

3.1. The Forms of Energy

To be truly "comprehensive", an energy strategy must account for and address all categories of "energy" and their corresponding sub-categories. This task is complicated, in the first instance, by ambiguities and complexities in the basic concept of "energy" and by the lack of a conceptually perfect, universal taxonomy of energy and energy system categories.[31] Thus, a physicist might start with the notion of "energy" as the "capacity to do work: that is, to move an object against a resisting force"[32] and then consider "potential" and "kinetic" energy as the two basic forms.[33] However, a more inter-disciplinary scientific view would list kinetic as among seven forms of "energy".[34]

Another common set of energy categories are: non-renewable and renewable energy sources. The former consist of fossil fuels and nuclear power (*i.e.*, fission of atoms from finite supplies of uranium). Renewable energy resources, in turn, consist of energy-bearing biological materials (*e.g.*, livestock manure, crops, and non-agricultural plant materials) and non-biological sources (*e.g.*, solar and wind energy, hydropower, and ground source heat).[35] However, the concept of "renewable" energy resources is hardly

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[31]Writing on the history of scientists' concepts of "energy", Smil notes that "despite this large, and highly complex, body of scientific knowledge, there is no easy way to grasp the fundamental concept [of energy], which is intellectually more elusive than is the understanding of mass or temperature." Vaclav Smil, *Energy: A Beginner's Guide* (Oxford: Oneworld Publications, 2006) at 6. At another point, Smil observes that "energy" is "not a single, easily definable entity, but rather an abstract collective concept, adopted by nineteenth century physicists to cover a variety of natural and anthropogenic … phenomena", *ibid.* at 8-9. In an attempt to capture all of the disparate concepts of "energy", Smil defines the term as "any process that produces a change (of location, speed, temperature, composition) in an affected system (an organism, a machine, a planet)", *ibid.* at 7.

As for categorizing energy *sources*, Jaccard states that "the closer you look … the more difficult it is to stick to simple classifications like fossil fuels, nuclear, and renewables. These sources of energy are more interrelated than many people assume." Mark Jaccard, *Sustainable Fossil Fuels: The Unusual Suspect in the Quest for Clean and Enduring Energy* (Cambridge, UK: Cambridge University Press, 2005).

[32]Godfrey Boyle, Bob Everett & Janet Ramage, *Energy Systems and Sustainability* (Oxford: Oxford University Press, 2003) at 6 (emphasis omitted).

[33]Carnegie Mellon University, *Environmental Decision Making, Science and Technology — Energy System* (2003) at (unnumbered) 12, online: <http://telstar.ote.cmu.edu/environ/ m3/s3/index.shtml>.

[34]The other forms are: electromagnetic, chemical, thermal, electrical, nuclear, and gravitational. Smil, *Beginner's Guide*, *supra* note 31 at 8.

[35]For a summary of the biological and non-biological sub-sets of "renewable energy" sources, see, *e.g.*, Ernie Jowsey, "A new basis for assessing the sustainability of natural resources" (2007) 32 Energy 906 at 907.

clear — all sources are finite on a geologic time-scale, and many if not all so-called renewable energy flows can change over human time scales — some may even cease altogether — due to human activities or natural climatic or geomorphologic events. And the generation of some renewable energy flows — *e.g.*, agricultural crops or crop residues — may occur with a set of practices which are themselves not ecologically sustainable.[36]

While these categories are commonly used, energy experts have classified energy forms or sources in still other ways. Several approaches start with the concept of "primary" energy but then differ on *post*-primary categories and also on the content of the "primary" energy category. For example, Bent *et al.* refer to "primary energy" sources as "includ[ing] fossil fuels, natural nuclear sources, and renewable forms of energy" but do not define the term in the abstract.[37] By contrast, Boyle *et al.* refer to "primary energy" as the "total energy 'content' of the original resource" and list fossil fuels and biofuels as the "main present" resources for "primary energy". The authors then use the two categories "delivered" and "useful" energy followed by energy "services" to complete their energy system model, while also referring to refined or processed fossil fuels as "secondary fuels".[38]

Jaccard provides still another variation by defining "primary" energy as gravitational forces and nuclear reactions (fusion and fission) because, either singly or in combination, these two forms of energy give rise to all other "secondary" energy sources.[39] In Jaccard's categorization, secondary energy sources are all those other sources that are derived from primary sources and that can be used in turn to provide "tertiary" energy sources, otherwise known as energy "services" or "end uses". These include heating, cooling, and ventilation, lighting, transport, mechanical power, and the power for electronic devices (*e.g.*, computers, fax machines, telephones).[40]

Scott offers an entirely different energy categorization through his five-part model of energy systems: energy sources; technologies for "harvesting" those sources; energy "currencies"; technologies for using those "currencies" to provide energy "services"; and the "services" themselves.[41] The first and third components of this model overlap with Jaccard's primary, secondary, and tertiary energy categories discussed above.

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[36]For a discussion of the scope of "renewable energy" sources, see, *e.g.*, Wenig *et al.*, *supra* note 23 at 2-3.

[37]Robert Bent, Andrew Bacher & Ian Thomas, "Rules of the Game" in Bent *et al.*, *supra* note 7, ch. 1 at 13.

[38]*Supra* note 32 at 57, 93-94 and 262, *et seq.*

[39]Jaccard, *supra* note 31 at 7-8.

[40]*Ibid.* at 11.

[41]Scott, *supra* note 1 at 55.

Unfortunately, Scott does not have a formal definition of energy "currencies", but he chose the term in order to analogize the concept to monetary currencies so that analogy provides several clues as to the concept's meaning, namely: energy currencies are convertible (*i.e.*, they allow energy to be transferred from one form to another) and can be used to allow energy sources to generate energy services over a broad geographic distance from the sources' locations.[42] Scott also notes that energy currencies are derived from energy sources and in fact bear "no similarity" to those sources. However, Scott views the increasingly widespread use of energy currencies (*e.g.*, gasoline, electricity, and hydrogen) as socially desirable because it has multiplied the kinds of energy services that can be provided, expanded the locations where these services can be provided, and increased the number of energy sources that can be used to ultimately generate the services.[43]

Each of these sets of energy categories is complex, and arguably ambiguous and imperfect. For example, Jaccard's identification of two "primary" energy sources is a useful reminder that there are basic energy building blocks but does not appear to be all that useful for energy planning or policy making or even to be conceptually ideal.[44] Jaccard's entire category of "secondary" energy sources is somewhat confusing because some "secondary" sources are derived from other secondary sources. For example, wind is a secondary source but is created by the heating of air from the earth's surface which in turn is warmed by solar energy, another secondary energy source. Likewise electricity, also classified as a secondary energy source, is itself derived from several other possible secondary energy sources (*e.g.*, solar, wind, hydro, and various fossil fuels). In fact, in many if not all electricity generating technologies, electricity is derived from the conversion of other secondary sources through one or another form of tertiary energy source or *service* (*e.g.*, the mechanical force of a shaft turned by wind blowing on blades attached to the shaft; the turning shaft creates the magnetic field that causes moving

[42]*Ibid.* at 37-39. In this latter sense, Scott further analogizes energy "currencies" to "gatekeepers" because currencies can also be used to prevent energy sources from powering certain services, *ibid.* at 41. Scott is careful to caution that these energy "transactions" are always less than 100% efficient due to the Second Law of Thermodynamics and that, like monetary currencies, particular energy currencies cannot be used for all types of energy transactions (*e.g.*, electricity is currently an impractical currency for flying an airplane and electricity is not convertible to gasoline), *ibid.* at 38-39.

[43]*Ibid.* at 37, 46.

[44]Jaccard's distinction between gravitational forces and nuclear reactions is conceptually problematic because, without those reactions, there would be no planets or other large masses that are needed for gravitational forces to operate. Conversely, gravitational forces tied to the Sun's large inner core apparently provide the energy that drives the Sun's nuclear fusion reactions. See Craig C. Freudenrich, *How the Sun Works*, online: <http://science.howstuffworks.com/sun2.htm>. In addition, some energy source was necessary to create the conditions that drive those sun-based nuclear reactions which suggests that there may be even more "primary" energy sources than the sources Jaccard identifies. Thus, to discover the "true" primary energy sources, one might need to look at the forces creating the universe, or beyond that event (if possible), rather than start with energy derived from our own sun.

electrons in a wire). The number and flexibility of linkages among energy sources makes Jaccard's three-tier classification system problematic, but those very characteristics also underscore the need for a "comprehensive" approach in developing energy policy. As Scott comments, "[c]onnections are the essence of how things work …."[45] So these "connections" must be accounted for in a "comprehensive" energy strategy.

Scott's schemata, particularly his focus on energy "currencies", avoids the over-simplification and confusion inherent in Jaccard's "secondary" energy category and highlights the importance of energy convertibility and energy "transactions". But even Scott's conceptual approach is imperfect because its labelling is context-specific. Something that is an energy source in one context might be a "currency" or "service" in another context.[46] Thus, Scott's model does not provide a universal categorization of energy sources or forms.

In sum, there are considerable conceptual problems in categorizing energy sources or forms. Each of the conceptual approaches summarized above is based on a particular disciplinary perspective or was designed to emphasize particular energy system aspects while glossing over others. Despite these conceptual problems, policy makers must adopt some conceptual framework of all energy sources, and account for all sources falling within that framework, in order to develop a truly "comprehensive" energy strategy. This approach sounds simple but it is arguably rarely if ever adopted. For example, although Alberta's renewable energy sources are considerable and diverse,[47] they tend to get less or no coverage in official reports of provincial energy "reserves" notwithstanding a legislative mandate that the province assess the reserves of all "energy resources".[48] The province's most recent energy reserves report lists total current and estimated future renewable energy *production*, but provides no estimates of actual reserves of renewable energy sources.[49] By contrast, the report provides extensive, detailed reserves estimates

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[45]Scott, *supra* note 1 at 54.

[46]Scott himself notes that the "roles things play depend on what part, or how much, of the system we are considering", *ibid.* at 51. As an example, he notes that from a planet-wide energy system perspective, sunlight is the primary energy source and coal is an energy currency whereas from a broader inter-planetary perspective, sunlight is a currency. Likewise, from the narrower perspective of an electricity-generating station, coal becomes the energy source under his model, *ibid.*

[47]See, *e.g.*, Mansell & Schlenker, *supra* note 5 at 48 (noting the "substantial potential for alternative and renewable energy" in Alberta).

[48]The first listed purpose of Alberta's *Energy Resources Conservation Act* (*ERCA*) is to "provide for the appraisal of the reserves and productive capacity of *energy resources* and energy in Alberta", R.S.A. 2000, c. E-10, s. 2(a) (emphasis added). The Act defines "energy resource" broadly as any "natural resource" in the province that "*can* be used as a source of *any* form of energy", *ERCA*, s. 1(c) (emphasis added). Viewed by either its plain meaning or its legislative definition, the term "energy resource" arguably subsumes both non-renewable and renewable energy sources.

[49]EUB ST98-2007: *Alberta's Energy Reserves 2006 and Supply/Demand Outlook 2007-2016* (June 2007). See also Mansell & Schlenker, *supra* note 5 at 48 (noting that, while "substantial", Alberta's

for fossil fuels.[50] Alberta's narrow approach toward assessing energy reserves is hardly unique. For example, the International Energy Agency's annual calculation of "world energy reserves" is focused on oil, natural gas and coal.[51]

3.2. Physical Parameters of Energy Systems

Given the complexities of classifying energy sources and forms, it is also useful to conceptualize and account for the components of energy systems from conventional energy system perspectives. However, as with the complexities of classifying forms of energy, even the conventional classification of energy system components is complex because it depends on what system perspective is being used. A common conventional perspective is of "upstream to downstream" ranges of energy activities — *i.e.*, from upstream energy production, to energy refining/processing, transmission and distribution, and finally downstream energy consumption. Of course, downstream consumers include energy producers, and manufacturers of technology or materials used to produce energy, so the upstream-downstream path has circular, rather than purely linear, characteristics. The path also has off-shoots in the sense that some energy resources are used as non-energy inputs for manufacturing or agriculture instead of being used to produce energy or, in some cases, products or derivatives of energy production are used for non-energy purposes.[52]

A closely related perspective of energy systems focuses on two *scales* of upstream-downstream linkages, namely, "decentralized" and "centralized" system scales. Generally speaking, in decentralized systems, energy production occurs at or close to the point of

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alternative and renewable energy reserves are "undetermined").

[50]EUB, *ibid.*, chs. 2-6, 8. After showing actual and estimated future production of both renewable and non-renewable energy sources, the report states that the "remainder of this report focuses on nonrenewable energy resources", *ibid*. at 2; see also *ibid*. at 9-5 (discussing contribution of renewable energy sources to the province's existing electricity generating capacity). See also Alberta Government, *Alberta's Energy Commodities Sector*, online: <http://www.alberta-canada.com/energyCommodities/ABEnergyResources> (government listing of "Alberta's energy resources" but limited to conventional oil, oil sands, natural gas, coalbed methane, and coal).

[51]Online: <http://www.eia.doe.gov/emeu/iea/res.html>. See also, *e.g.*, Boyle *et al.*, *supra* note 32 at 57 (noting that the "daily contribution of solar energy in warming and illuminating our buildings does not normally appear in national or international statistics").

[52]An obvious example of the former type of path is the use of corn for food rather than as an energy-bearing feedstock for biofuel production. Examples of the latter path include fertilizers and other commercial chemical processes based on sulphur derived from sour natural gas processing, crude oil refining, and bitumen upgrading. EUB, *supra* note 49 at 7-3 to 7-5. Likewise, the anaerobic digestion of livestock manure produces energy-bearing methane gas but also a solid "digestate" that is a useful fertilizer. *E.g.*, Alberta Agriculture, Food and Rural Development (AAFRD), *Agri-Facts: Anaerobic Digesters* (2006).

energy consumption, whereas that distance is farther in centralized systems. While this dichotomy is commonly used, it may be more useful to think about different energy system scales as a *spectrum* of distances between producers and consumers. A spectrum perspective takes better account of energy sources that serve two or more users in a local residential community or industrial park which range of systems do not fit neatly within the "centralized/decentralized" system dichotomy. In fact, this dichotomy is even less accurate given that many so-called "decentralized" sources are financially viable only because of their ability to sell excess power through connections to a "centralized" grid. Likewise, some energy users may use a local source for one kind of energy (*e.g.*, roof-based solar photovoltaic cells to produce electricity) but a non-local source for another kind of energy (*e.g.*, natural gas for space heating). Given these multiple sources, and accompanying variations in source/use distances, even the single spectrum perspective is somewhat misleading. Thus, a "comprehensive" energy strategy must provide a framework for considering energy systems from the standpoints of not only the distance between energy sources and energy users, but also the number of users of a given source, and the number of different sources used by a given user. In other words, a "comprehensive" energy strategy should account for a spectrum of energy system scales, and of potentially multiple scales for different energy sources or services, for purposes of providing a policy framework for designing or re-designing provincial energy systems.

To make matters more complex and confusing, the upstream/downstream spectrum does not fit neatly on a geographic spectrum defined by the location of Alberta's political boundaries. For example, Alberta-based bitumen may be processed and consumed within Alberta; processed within Alberta but exported for consumption outside of the province; processed outside of Alberta but imported for consumption within the province; or the extracted resource may be exported for both processing and consumption outside of the province. Likewise, Alberta-based coal might be used by an Alberta power plant for electricity consumption either within or outside of the province. Or provincial coal might be exported to a power plant outside of the province (some of whose electricity output might then be imported for consumption within Alberta).

Thus, additional energy system parameters arise from the import/export dichotomy — *i.e.*, the relationship between Alberta's political boundary and the location of energy consumption and of the extraction, refining, and processing of the natural resources used to produce energy (and of energy resources that are ultimately used for non-energy purposes, as noted above). It may be possible to depict these import/export parameters in a matrix but the matrix would be a complex one given the different types of energy resources and processes for generating energy from them combined with their jurisdictional location within and outside of Alberta. Given this complexity, it is unclear whether a single import/export matrix can be developed for all types of energy resources and all types of consumed energy.

Whether or not they can be depicted in a single matrix-like diagram, all of these inter/intra Alberta energy parameters must be accounted for and addressed in an energy strategy for it to be truly "comprehensive". Still other relevant parameters of energy systems are the: absolute quantities of energy used and energy system efficiency, *i.e.*, energy use per unit of output. (These might be considered energy system characteristics more than design parameters, although the appropriate labelling of these factors may hinge on whether they are being used to measure and describe systems or as targets for system design.)

Finally, all of the above energy system parameters relate to energy systems as stand-alone phenomena. In reality, however, energy systems exist within or are otherwise integrally tied to other physical, biological, and social systems.[53] As to energy system/ecosystem linkages, for example, energy policy-makers should consider the magnitude of raw materials needed as inputs for an energy system and of ecological services at risk from energy system outputs. In more general terms, policy-makers should design energy systems with an eye toward ensuring that habitat losses, pollution, and other adverse environmental "footprints" of overall energy systems are within socially acceptable limits.

3.3. Regulatory, Fiscal and Policy Parameters of Energy Management Systems

The last of the three broad categories of energy system parameters relates to the structures used by governments to *manage* energy systems and their interactions with environmental and other systems. The upstream/downstream perspective provides a useful starting point for analysing these management structures. In Alberta, this analysis leads first to the regimes for granting tenure — *i.e.*, rights to extract and produce — for publicly- and privately-owned energy resources, then moves to regulatory regimes applicable to extraction and production activities, and then to energy resource processing and refining, transmission, distribution, and consumption. Obviously, the applicability of any of these stages varies from one energy resource to another and by how any given "raw" energy resource is transformed to its ultimate end use. In addition, Alberta may soon precede the tenure regime with a land use planning process that dictates the acceptable geographic locations of resource tenures.[54] Royalty and tax regimes should

[53]The positive aspects of these inter-system linkages inspire observers like Scott, who states that it is "fun to watch how systems sustain their neighboring systems, connecting and disconnecting, feeding and being fed — a symphony of synergies." Scott, *supra* note 1 at 54. However, some inter-system linkages may be socially undesirable and thus also need to be "watched" and appropriately managed.

[54]For an explanation of the need for land use planning to precede provincial tenure decisions, see, *e.g.*, Steven A. Kennett & Monique M. Ross, *In Search of Public Land Law in Alberta*, Occasional Paper #5 (Calgary: Canadian Institute of Resources Law, 1998); and Steven A. Kennett, *Integrated Resource Management in Alberta: Past, Present and Benchmarks for the Future*, Occasional Paper #11 (Calgary:

also be superimposed on one or more of these chronological energy system stages; and all other applicable fiscal measures — *e.g.*, fiscal or in-kind support for technology research and development and infrastructure — should also be included.

Calculations of energy reserves are important factors in various energy management decisions so those calculations — including the calculation methodologies and the uses of the reserve calculations — should also be addressed in a "comprehensive energy strategy". In Alberta this assessment should include revisiting the province's approach, discussed above, of calculating "reserves" of fossil fuels but not applying functionally similar techniques to assess renewable energy supplies.

The category of regulatory regimes can itself be broken down into sub-categories relating to environmental protection and public and private land management, as well as those relating directly to energy production and transmission, distribution, and consumption.[55] An assessment of these regimes should pay particular attention to the legislative objectives and legislatively mandated decision-making standards, as well as to policies decision-makers have themselves adopted in exercising their discretion in applying those legislative standards.

Chief among the relevant legislative objectives is that, in the *Energy Resources Conservation Act*, to "effect the conservation of, and prevent the waste of" Alberta's "energy resources".[56] The Act defines "energy resources" broadly as any "natural resource" in the province that "*can* be used as a source of *any* form of energy"[57] but, to date, the "conservation/waste prevention" objective has surfaced with respect to energy decisions primarily or solely in the context of upstream production of fossil fuels, particularly oil and gas.[58] In fact, the objective's meaning is uncertain even in this narrow context.[59]

And regulatory and other management tools can be divided by the jurisdiction imposing them, from local governments (*e.g.*, through planning and zoning

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Canadian Institute of Resources Law, 2002). For a discussion of this problem in the oil sands context, and for numerous additional references on the planning/tenure relationship, see Vlavianos, *supra* note 9 at 6-9 and 13-16.

[55]For overviews of the provincial regulatory regimes for various energy sectors in Alberta, see Vlavianos, *supra* note 9; Wenig *et al.*, *supra* note 23; and *CELS*, *supra* note 9.

[56]R.S.A. 2000, c. E-10, s. 2(c).

[57]*Ibid*., s. 1(c) (emphasis added).

[58]Wenig & Moore, *supra* note 27.

[59]Michael M. Wenig & Michal C. Moore, "Searching for Meaning in Energy Resource 'Conservation'" (2007) 99 Resources 1.

requirements),[60] to provincial and federal agencies. (International agreements may provide yet another relevant management parameter.) In developing its own energy strategy, Alberta may have to take some of these extra-provincial management structures as "givens" although the strategy could include steps for the province to advocate for changes to any external government constraints which Alberta disfavours. Or, as Gibbins and Roberts suggest in the climate change context, Alberta should take the lead in developing needed national strategies rather than simply resist externally developed ones.[61]

The last set of energy management parameters consists of significant or long-standing energy-related policies (*i.e.*, those policies expressed in non-legal documents in addition to those discussed above that are expressed in legislation) that have been used to guide management decisions or that have at least been held out as justifications for those decisions. Among these policies is the "shared vision" for energy that was recently announced by the inter-provincial Council of the Federation.[62] At the provincial level, Alberta's "integrated energy vision" provides a recent example; older examples are policies relating to electricity transmission and production.[63]

In summary, Alberta's overall energy system is complex and has numerous, diverse components and characteristics, including linkages to other jurisdictions' energy systems and to ecological systems within and outside of Alberta's political borders. The above discussion provides a conceptual framework for identifying and analyzing these system components and characteristics, by focusing on the different forms of energy and on physical attributes of energy systems and management structures. This conceptual framework is hardly perfect or complete and other frameworks may be better. The most

[60]See Nickie Vlavianos, "Municipal Regulation of Oil and Gas Development" (August/September 2005) LawNow, online: <http://www.cirl.ca/pdf/2005cAugSepVlavianos.pdf>; and Wenig *et al.*, *supra* note 23 at 44-52.

[61]Roger Gibbins & Kari Roberts, "Energy Production — West should lead debate" *Calgary Herald* (13 November 2007) A12. The National Energy Board (NEB) is among those calling for a "long-term energy vision and strategy for Canada" as a whole, while noting that this strategy must be "well integrated at the regional level". NEB, *supra* note 15 at 111; see also *ibid.* at 109 (noting the need for "[f]lexible [energy-related] policy frameworks that extend beyond provincial borders").

[62]In a nutshell, this document expresses a vision of a Canadian energy future that involves: a "secure, sustainable, reliable and competitively-priced" energy supply; a "high standard of environmental and social responsibility" in energy production, particularly with respect to emissions of greenhouse gases and other pollutants; and "continued economic growth and prosperity". The Council of the Federation, *A Shared Vision for Energy in Canada* (Ottawa: 2007), online: <http://www.councilofthefederation.ca>. The document identifies eight "challenges" in achieving this vision and then lists a "seven point action plan" for the provinces to meet these challenges in a wide range of areas relating to energy transmission, energy and regulatory efficiency and energy conservation, renewable energy, technology research and development, human resources, and provincial participation in international energy fora.

[63]For a discussion of these policies, see Wenig *et al.*, *supra* note 23 at 71-74.

important point is that provincial policy makers seeking to develop an energy strategy that they can honestly call "comprehensive" must conceive of energy systems in all their aspects, and address all those aspects, in developing the strategy.

4.0. Markets and Sustainability

The above discussion addressed how the province could develop a "comprehensive" energy strategy from a horizontal analytical perspective, by attempting to essentially catalogue the numerous components and characteristics of energy systems. This part takes a more vertical analytical perspective, by addressing two topics that arguably underlay policy-makers consideration of those energy system components and characteristics. One topic — the relative roles of energy markets and government action — is a key issue the province needs to face in deciding how to achieve any overarching objective, but is rarely addressed directly, clearly, and transparently in policies or policy development. The other topic — sustainability or sustainable development — is an overall, and possibly the overriding, social objective for energy system design. While frequently mentioned in policy contexts, these references are typically notable more for their obscurity than for their clarity and usefulness.

4.1. Articulating the Relative Roles of Government and Energy Markets

Policy makers are increasingly considering market-based instruments as alternatives to traditional "command and control" regulatory tools to achieve social objectives.[64] However, in likely all if not most public policy contexts, policy makers face the more fundamental issue of defining the roles that governments should play, in the first instance, relative to markets, both in identifying social objectives and in allocating resources to meet those objectives.[65] Not surprisingly, this issue is covered at length in numerous university courses taught in a wide range of disciplines, from economics,

[64]See, *e.g.*, Alberta Environment, *Market Based Instruments and Fiscal Mechanisms*, online: <http://environment.alberta.ca/1996.html>. For a discussion of the overlaps between these two types of policy instruments, see Michael M. Wenig, "Ideological Rhetoric Doesn't Help" (Jan./Feb. 2007) 31 LawNow 43-44.

[65]It might be more accurate to say that the fundamental policy issue involves the relative responsibilities and roles among governments, markets, *and citizens*, rather than simply between governments and markets. To some extent, citizens' roles are subsumed under or reflected in market outcomes (through citizens' decisions to enter into or to forego market transactions) and in government decisions (through citizens' participation in elections and in various non-electoral government decision-making processes). However, in some policy-making contexts, citizens' roles may need to be acknowledged as useful alternatives or supplements to government or market roles.

business, public policy, political science, history, and environmental science, to philosophy, engineering and law.

Although the topic is widely covered in academia, there is hardly a consensus among academics regarding the precise roles of governments and markets in various policy contexts. However, there is arguably general agreement on several broad rules of thumb:

- So-called "perfect" markets achieve *efficient* outcomes in the utilitarian sense of providing the greatest good for the greatest number. But they do not define and achieve other social objectives, particularly those relating to equity (within and among generations),[66] and they do not prescribe morally appropriate behaviours. Thus, government action (influenced in turn by electoral processes and other forms of democratic participation) is needed to define or at least articulate these other objectives and to develop tools to achieve them and to enforce society's moral norms.

- Markets often do not operate perfectly, for a variety of circumstances, including when: goods and services have social costs and benefits that are not reflected in their market prices (the "externalities" problem);[67] there is insufficient information or other lack of capacity for consumers to make "informed" choices in purchasing decisions; there are increasing returns to scale; there are non-competitive or monopolistic practices; there is common or public property; and there are significant transaction costs.[68] Thus, government action is often needed to identify and "correct" these market failures.

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[66]See, *e.g.*, Don Fullerton & Robert Stavins, "How economists see the environment" (October 1998) 395 Nature 433-434. For a discussion of how conventional, market-based "discounting" practices short-change future generations, see, *e.g.*, Daniel W. Bromley, "Environmental regulations and the problem of sustainability: Moving beyond 'market failure'" (2007) 63 Ecological Economics 676-683.

[67]In Alberta, a prominent example of "negative externalities" in the upstream petroleum sector is the loss of large quantities of fresh water that is licensed — at no charge according to the rate or quantity of water used — for use in "enhanced recovery" of conventional oil or for *in situ* oil sands production. See, *e.g.*, Mary Griffiths, Amy Taylor & Dan Woynillowicz, *Troubled Waters, Troubling Trends: Technology and Policy Options to Reduce Water Use in Oil and Oil Sands Development in Alberta*, 1st ed. (Drayton Valley: Pembina Institute for Appropriate Development, 2006) at 2. The upstream petroleum sector is also responsible for considerable greenhouse gas emissions which are another prominent source of negative externalities. Until recently, these emissions were completely unregulated in Alberta; in 2007, the province began regulating major emitters through a scheme that imposes an effective cost of $15/tonne of CO_2 equivalent but this cost is not considered to remotely reflect the full social cost of GHGs. Poschwatta, *supra* note 4 (forthcoming). There are numerous other negative externalities of petroleum production but, of course, those externalities are not limited to petroleum or fossil fuels more generally, although the magnitude and nature of externalities vary widely among energy resources and among different types of energy systems.

[68]See, *e.g.*, Fullerton & Stavins, *supra* note 66.

Besides academics' general agreement on these rules of thumb, there is arguably increasing recognition that the whole neo-classical economic paradigm underlying market-based policies falls short in two fundamental, related respects: it fails to view economic systems as subsets of ecological systems;[69] and it fails to account for the non-substitutability of certain natural resources or the services provided by them.[70] These shortcomings provide yet another reason for government action, particularly in the environmental/natural resources arena, although the magnitude and scope of action needed to address these flaws is hardly certain.[71]

Although these issues are covered extensively in academia and are clearly relevant in policy-making contexts, governments' written policies often fail to address them directly and in clear, transparent terms. This flaw, in turn, suggests that policy makers have failed to fully consider the topic in their own minds, in addition to not providing a sufficient record for the public to understand how they have treated the subject. Alberta exemplifies this policy shortcoming because it lacks a clear, over-arching statement of the relative roles of government and markets in achieving social objectives and in promoting social values. This said, government leaders periodically publicly address this broad topic but their statements typically raise more questions than they answer. A classic example of this problem is the statement former Alberta Premier Ralph Klein is reported to have made in response to two environmental groups' call for the province to place a moratorium on new oil sands projects pending its development of a long-range plan to manage the cumulative environmental effects of oilsands operations. In rejecting this proposal, former Premier Klein apparently said:

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[69]As expressed recently by one scholar, "[n]eoclassical economics assumes perpetual growth with no limits to resource inputs or outputs from production processes … Since the 1970s … there has been a perception that economic analysis has become divorced from its biophysical foundations." Jowsey, *supra* note 35 at 908.

[70]See, *e.g.*, Robert U. Ayres, "On the practical limits to substitution" (2007) 61 Ecological Economics 115-128; Stefan Baumgärtner *et al*., "Relative and absolute scarcity of nature — Assessing the roles of economics and ecology for biodiversity conservation" (2006) 59 Ecological Economics 487-498.

[71]In fact, some raise an additional flaw, that the present economic paradigm raises economic growth — as measured by growth in conventional national financial accounts like "gross domestic product" — to the level of an overriding policy objective, at the expense of many other indicators of social welfare. See, *e.g.*, Robert Costanza, "Stewardship for a 'Full' World" (2008) 107 Current History 30 at 32. Many provincial pronouncements — like that quoted previously about the forthcoming energy strategy's need to promote "environmentally sustainable development and growth" — are cited by these critics as examples of this "growth-first" economic paradigm. Whether or not one accepts this critique, it underscores the need for governments to clearly articulate social objectives and to ensure that government programs and markets are properly aligned to achieve them.

> To have a long-range plan would be an interventionist kind of policy which says you either allow them or you don't allow them [to proceed]. *The last thing we want to be is an interventionist government*.[72]

In a single breath, Klein's one-sentence statement arguably touches on numerous fundamental governance issues that could be analyzed and discussed from a wide range of social science perspectives, from political science, to economics, law, sociology, and philosophy, and also likely even psychology and several hard sciences. In short, one could build an entire inter-disciplinary university course aimed at "unpacking" or "de-layering" the intellectual underpinnings of this simply-worded policy statement.

While the statement provides considerable grist for the academic mill, it fails from a governance standpoint because of the questions it leaves unanswered for the numerous government officials who might feel compelled to honour it in their decision-making contexts. What are the full parameters of the kind of "interventionist" policy that Klein abhors? Why is a so-called interventionist policy, including planning, so bad, especially when considerable public resources are at stake, including the oil sands bitumen (roughly 97% of which is publicly owned) and the terrestrial, aquatic, and atmospheric resources that are diminished by oil sands development? What social objectives are served by a so-called "non-interventionist" approach? And, how is a non- or anti-interventionist approach consistent with the considerable regulatory frameworks that currently exist for oil sands projects[73] and for other energy projects, large industrial facilities, and numerous other activities that are highly regulated?

Klein's statement may deserve kudos for its unusual candor, but is too brief to provide meaningful policy guidance. This brevity is understandable given the apparently spontaneous context in which the statement was made, but the statement touches on fundamental policy issues that call for more detailed explanation.

In short, Alberta policy-makers must thoroughly consider the relative roles of government and energy markets in developing an energy strategy, and provide the public with a clear record of those considerations. Consistent with the above discussion, any such exercise should indicate Alberta policy makers' views with respect to:

- The social objectives that "perfect" markets are believed to serve and those objectives that are not well served by "perfect" markets;

- Factors that might render energy markets imperfect and government roles needed to either remove or reduce those imperfections or as substitutes for markets in achieving given social objectives.

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[72]"Klein rejects environmental concerns over oilsands boom" CBC News (4 August 2006), online: <http://www.cbc.ca/story/canada/national/2006/08/04/klein-pembina.html> (emphasis added).

[73]For an overview of these frameworks, see Vlavianos, *supra* note 9.

Notably, this policy analysis should apply to all energy resources, energy technologies and applications, and for that matter to all energy system components. The analytical outcomes may vary well among these different contexts — *i.e.*, government intervention that is justified in one context may not be needed at all or at the same scale in another context — but the same questions should be asked in all contexts, particularly, the questions of what externalities are raised by the production and consumption of different energy resources and of how government should address those externalities.

4.2. Defining Sustainability in Workable Terms

The concept of "sustainable development" hit the world stage through its adoption in *Our Common Future*, the 1987 report by the United Nations-sponsored World Commission on Environment and Development (commonly known as the "Bruntland Commission").[74] The Commission's definition of sustainable development — "development" that "meet[s] the needs and aspirations of the present without compromising the ability of future generations to meet their own needs"[75] — is vague and, not surprisingly, has given rise to considerable debate among scholars and other commentators as to how it should be further defined.[76] Issues covered by the debate include whether the term's focus on *development* is even appropriate as opposed to a focus on "sustainability" more generally,[77] and whether sustainability is a desired end-point or more of a process.[78] Yet, the considerable interest and effort spent in defining the concept have themselves demonstrated the concept's enduring popularity and acceptance, at least, at a general level.

In fact, the voluminous sustainability literature is only one of many indicia of the concept's popularity. Within Canada, sustainability terms are used commonly in public policy discourse[79] and in the names or mandates of government agencies[80] and non-

[74]World Commission on Environment and Development (WCED), *Our Common Future* (Oxford: Oxford University Press, 1987) at 40, 43.

[75]Ibid.

[76]For example, one energy economist recently referred to the sustainability concept as "elusive and contentious." Jaccard, *supra* note 31 at 11.

[77]The two terms will be used interchangeably in this paper unless specifically noted.

[78]See, *e.g.*, Lloyd Orr, "Energy and Sustainable Economic Growth" in Bent *et al.*, *supra* note 7, ch. 6 at 158 ("[S]ustainability is not a specific *goal* as much as it is a *process* of continuous change and adaptation" (emphases in original)).

[79]See, *e.g.*, G. Bruce Doern, ed., *Canadian Energy Policy and the Struggle for Sustainable Development* (Toronto: University of Toronto Press, 2005).

[80]For example, Alberta Environment lists its mandate as to "*sustain* a healthy environment, a prosperous economy and strong communities", online: <http://environment.gov.ab.ca/default.aspx>. Likewise, the concept is embedded in "Alberta Sustainable Resource Development", which is the name of the

governmental research organizations.[81] Sustainability terms are also increasingly embedded in Canadian law.[82] Not surprisingly, sustainability is also prevalent in non-legal policy documents. In Alberta, sustainability-type concepts are mentioned in the province's discussion of its over-arching policy "vision" and numerous other times in the province's overall strategic plan,[83] and is referenced in numerous of the province's other prominent policies. For example, Alberta's environmental and natural resource management policy starts with a "vision of Alberta's sustainable development future"[84] and this theme has been echoed in the specific context of managing oil sands operations.[85] Similarly, Alberta's water management policy prominently references sustainability in its title and its text uses sustainability in the context of describing goals for economic development, water supply, wetlands and aquifers, aquatic ecosystems and watersheds, and water infrastructure.[86] There are numerous other Alberta policy references to sustainability — in contexts involving climate change, rural development, economic development, agriculture growth, electricity, and mining, if not in many other contexts as well.[87]

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provincial department responsible for managing province's public lands, fish and wildlife, and forests, online: <http://www.srd.gov.ab.ca/>.

[81]These include the University of Calgary's Institute for Sustainable Energy, Environment and Economy (online: <http://www.iseee.ca>) and the Winnipeg-based International Institute for Sustainable Development (online: <http://www.iisd.org>).

[82]In Canada, the federal *Auditor General Act* provides for the Auditor General's appointment of a "Commissioner for the Environment and Sustainable Development" and requiring that Commissioner to monitor and report on the progress of various federal departments "towards sustainable development", R.S.C. 1985, c. A-17, ss. 15.1 and 21.1. In fact, an on-line Lexis-Nexis search of the term "sustainable development", indicates that the term is referenced eighty-nine times in twenty-three different Canadian statutes; three Alberta statutes reference the term eight times all together. See also Jerry V. DeMarco, "The Supreme Court of Canada's Recognition of Fundamental Environmental Values: What Could be Next in Canadian Environmental Law?"(2007) 17 J.E.L.P. 159 at 192 (noting that "most" of "[n]early" fifty Canadian statutes refer to sustainable development). The Supreme Court of Canada has referred to sustainability expressly in resolving a division of powers dispute and impliedly in several other decisions referring to the *Bruntland Report*. See *ibid*. at 193-194.

[83]E.g., Strategic Plan, supra note 2 at 4.

[84]Government of Alberta, Alberta's Commitment to Sustainable Resource and Environmental Management (March 1999) at 3.

[85]See Alberta Environment, Regional Sustainable Development Strategy for the Athabasca Oil Sands Area (July 1999).

[86]Government of Alberta, Water for life — Alberta's strategy for sustainability (November 2003).

[87]See Government of Alberta, *A Place to Grow — Alberta's Rural Development Strategy* (February 2005) (over twenty references); *Securing Tomorrow's Prosperity* (Summer 2005) (fourteen references in economic development strategy); *Alberta Mineral Development Strategy 2002* at 5 (listing "sustainable development" as an "over-arching principle" and as central to its "vision"); *Albertans & Climate Change — A Strategy for Managing Environmental and Economic Risks* (undated) at 1 (one reference to economic

In short, there is widespread consensus — both within and outside of Alberta — that sustainability is a primary social objective, and hence that it should play a critical role in government policy-making. As the Canadian Council of Chief Executives declared in the opening sentence of a recent "policy statement", "[a]chieving sustainable development is the most fundamental challenge facing the world today …."[88]

This consensus is also fully reflected in the energy policy literature, much of which is infused with discussions of the energy-sustainability linkage.[89] Consistent with this consensus, Alberta's forthcoming comprehensive energy strategy must be linked to broad sustainability objectives.

Of course, it is not enough for the energy strategy to simply state this linkage. Following the policy development guidelines summarized in part 2 above, the province needs to further develop its own notions of sustainability. (This refinement should occur directly within the forthcoming energy strategy but, given the over-arching or cross-cutting nature of the sustainability objective, there should be a concurrent refinement of a more generic, across-the-board sustainability policy.) In other words, policy makers need to be clear *what* they envision as needing to be sustained, and *how* that objective can be achieved and measured.

In answering the "what" question, provincial policy makers should start with a sustainability vision relating to "development" in general or to some other broad welfare notion (or simply blanket "sustainability"), and then break down that broad notion into visions for its component parts which are typically expressed as (inter-linked) social, environmental, and economic components. Energy supply might either be a separate component or a subset of two or all three of the others.[90] All too often the threshold or core sustainability vision is directed specifically at only one of these components,

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sustainability); *Alberta's Agricultural Growth Strategy* (July 2004) (referencing sustainability in strategy's subtitle and in text in context of environmental sustainability and growth in agricultural production.). See also Alberta Energy, *Alberta's Electricity Policy Framework: Competitive — Reliable — Sustainable* (June 2005) at 1, 8, 26, 33, 44 and 49 (referring to a sustainable electricity industry as one of three central industry characteristics in opening policy "vision"; also references to sustainability in context of electricity markets, generation, and investment).

[88]Canadian Council of Chief Executives, Task Force on Environmental Leadership, *Clean Growth — Building a Canadian Environmental Superpower* (1 October 2007), online: <http://www.ceocouncil.ca/publications>.

[89]See, *e.g.*, Doern, *supra* note 79; Jaccard, *supra* note 31; Bent *et al.*, *supra* note 7; Boyle *et al.*, *supra* note 32; and Edward S. Cassedy, *Prospects for Sustainable Energy — A Critical Assessment* (Cambridge, UK: Cambridge University Press, 2000).

[90]One author views "sustainable energy" as the "absolute core" of the general concept of "[s]ustainability". Lloyd Orr, "Energy and Sustainable Economic Growth" in Bent *et al.*, *supra* note 7, ch. 6 at 158.

begging the question whether the other welfare components are going to be sustainable as well.[91]

Even these more limited sustainability targets can be misleadingly broad. For example, is the benchmark of a "sustainable economy" a specific GDP or GNP growth *rate* over time, or a particular economic size per capita, or some other measure? Is the desired economic level at all costs or only *as long as* certain desired environmental and social conditions can also be sustained? Similarly, does "sustainable energy" refer to a sustained supply or maintaining prices below a certain level? In terms of supply, must individual types of energy resources be sustained or simply the total energy value of all available supplies?

These questions underscore the importance of expressing a clear vision of sustainability, including clear, multi-sector benchmarks or indicators.[92] Still other sustainability parameters that should be defined include: the length of time over which the relevant targets or objects are intended to be sustained;[93] and acceptable rates of resource depletion, levels of environmental harm, social inequity, and other benchmarks during the *transition* to a sustainable state.[94]

As noted at the outset of part 3 above, the province seems to agree that its forthcoming energy strategy needs to have a sustainability linkage and has refined that concept by noting that the strategy will be designed to promote "environmentally

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[91]For example, Alberta's threshold policy "vision" and twenty-year "strategic plan" refer alternately to "sustained economic growth", "environmentally sustainable development and growth", a "sustainable public health care system", a "sustainable approach to economic development and growth", "sustainable" social programs and services, and a "sustainable land use approach". *Strategic Plan*, *supra* note 2 at 4, 5, 6, and 8.

[92]There is a growing body of literature and practice on the development of multi-dimensional "indicators" of sustainability. In the energy context, see, *e.g.*, Ivan Vera & Lucille Langlois, "Energy indicators for sustainable development" (2007) 32 Energy 875-882.

[93]The Bruntland Commission's definition refers to "future generations" and sustainability scholars have stressed this multi-generational focus. See, *e.g.*, Bromley, *supra* note 66; and Bent *et al.*, *supra* note 7 at 8. For a discussion of the morality and nature of obligations toward future generations, see, *e.g.*, Richard B. Howarth, "Towards an operational sustainability criterion" (2007) 63 Ecological Economics 656-663, and of how and whether people can be *motivated* to fulfill a moral obligation to future generations, see Norman S. Care, "Protecting Future People: The Motivation Problem" in Bent *et al.*, *supra* note 7, ch. 7 at 197-221. Alberta's over-arching policy "vision" and "strategic business plan" extend only twenty years, to the year 2025, which is arguably too short a period to reflect a truly inter-generational perspective. *Strategic Plan*, *supra* note 2 at 6. See, *e.g.*, Godfrey Boyle, "Introductory Overview" in Boyle *et al.*, *supra* note 32, ch. 1 at 7 (stating that, "[i]deally … we should judge the sustainability of all energy systems on an indefinite time scale — far into the very distant future.").

[94]For example, Boyle suggests that a goal of developing energy systems that are sustainable over an indefinite time period "might be realistically interpreted as endeavouring to ensure that energy systems become sustainable … over the next century or so …", *ibid.* at 7.

sustainable development and growth."[95] However, this policy direction needs considerable amplification and reconsideration. Among other questions needing to be answered are: How will "environmental sustainability" be measured and ensured? Are there other benchmarks of social welfare that should also be sustained — including "development and growth" themselves (but presumably, only as indicators of other benchmarks of social welfare)? If yes, what are the desired levels of those benchmarks and how will their attainment be measured and promoted by the forthcoming energy strategy?

In summary, to be "comprehensive", Alberta's forthcoming energy strategy must not only encompass the wide range of energy forms and energy system components discussed in part 3 above, but also come to grips with two fundamental topics: the relative roles of governments and markets, and sustainability. "Coming to grips" with the former topic means exposing and critically analysing long-held assumptions, clearly identifying underlying social objectives, identifying the shortcomings of energy markets in achieving these objectives, and explaining what set of government tools are needed to address those shortcomings. This exercise should be consistent for all provincial energy sources, although the outcomes may well vary among them. Similarly, Alberta's energy policy-makers should not only adopt a sustainability-type objective, but clarify its meaning and how it will be measured and promoted by the energy strategy.

5.0. The Myth of Achieving a *Truly* "Comprehensive" Energy Strategy

Thus far, this paper has implied that Alberta can develop an energy strategy that is truly "comprehensive". However, this goal is likely never fully attainable. The more comprehensive — *i.e.*, the more holistic or inclusive — a strategy gets, the greater the complexity and magnitude of systems involved and of linkages among them leading, in turn, to more uncertainties about cause and effect. In all likelihood it is impossible to fully capture all of the design parameters and energy topics listed in the previous parts of this paper in a single, coherent, model that could be used to identify an "ideal" energy system and to identify the steps that would be necessary to enable a transition from the current system to any such "ideal" version.

Given the futility of ever being able to develop a truly "comprehensive" energy strategy, is the exercise worth attempting at all? Experience from the analogous field of ecosystem management is instructive in answering this question. Like the holistic perspective of a comprehensive energy strategy, ecosystem management involves a holistic account of complex environmental and social systems. Because of the

[95] *Strategic Plan*, *supra* note 2 at 4, 8, and 12.

complexities inherent in this holistic perspective — including those inherent in defining appropriate ecosystem scales for management purposes and ideal conditions for any chosen ecosystem scale — ecosystem management is often viewed as more of an "evolving set of constructs" than as a "perfect" environmental management approach.[96] Likewise, ecosystem management concepts are described as providing a direction on a spectrum of management reforms, rather than as an ideal approach that can ever be fully achieved. For example, one ecosystem management scholar has stated that "striving for some aspect of an ecosystem approach, as difficult as it might be, is better than what we are doing now" and that "movement toward the ecosystem management end of the spectrum is good, even if it fails to achieve management of whole ecosystems."[97] Like ecosystem management frameworks, a "comprehensive" energy strategy is still worth striving for and using as a benchmark in assessing existing policies and developing new ones, even if it may never be fully attained.

Besides striving for increasingly "comprehensive" strategies over time, in developing any particular iteration (including the first strategy), the province should also pay special consideration to government tools that have a "comprehensive" effect — *i.e.*, that are as cross-cutting, or have as broad a reach, as possible. Once again, energy systems have multiple, multi-dimensional parameters and there are many complex linkages among these parameters and among energy and non-energy systems. Given these complexities, rather than focus entirely or mostly on tools targeted at the development of particular energy resources or particular energy producers, it is worth considering financial incentives and other tools that send a unified "signal" throughout energy system components and to all system participants.[98] An obvious example of these cross-cutting tools is a carbon tax on all energy consumption (including energy consumption by upstream energy producers).[99] However, even this tool falls short of having a

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[96]Michael S. Quinn, "Ecosystem-Based Management" in Dixon Thompson, ed., *Tools for Environmental Management: A Practical Introduction and Guide* (Gabriola Island, BC: New Society Publishers, 2002), ch. 23 at 370 and 382.

[97]Steven L. Yaffee, "Three Faces of Ecosystem Management" (1999) 13 Conservation Biology 713 at 715 and 721.

[98]As Peat explains, "where any local oscillation [in a system] appears, its ultimate origin may lie within the dynamics of the whole system. So attempting to 'control' or prevent local deviations from prescribed behaviour may give rise to yet more problems. What would be required would be a very gentle steering of the whole system." F. David Peat, "Non-Linear Dynamics (Chaos Theory) and its Implications for Policy Planning", online <http://www.fdavidpeat.com/bibliography/essays/chaos.htm>.

[99]While still unpopular in Alberta, this tool is gaining increasing popularity both within and outside of Canada. For example, Canada's National Round Table on the Environment and the Economy (NRTEE) recently urged Canadian governments to consider this tool as one of several options for establishing an economy-wide GHG emission price. See NRTEE, *Getting to 2050: Canada's Transition to a Low-emission Future — Advice for Long-term Reductions of Greenhouse Gases and Air Pollutants* (Ottawa: 2007) at 22-23. Likewise, Jaccard prefers this tool but believes it is likely to play only a "consolidating role" in support of other tools because of its political infeasibility. Jaccard, *supra* note 31 at 274-277. For a discussion of the

"comprehensive" application due to its limited focus on carbon, although carbon reduction is perhaps of paramount concern given the immediate need to address climate change. At any rate, special consideration should be given to the design and use of tools that encourage energy systems *as a whole* to minimize their full, life cycle costs.[100]

Of course, the complex, integrated, and holistic character of a "comprehensive energy" approach also suggests that single or simple policy prescriptions will be unwarranted or mistaken. As physicist and scientific historian David Peat recently explained:

> If the [scientific] revolutions of the twentieth century have taught us anything, at least they should have indicated the inherent limits of reductionist and mechanistic ways of thinking. That is, of believing that situations can always be neatly categorized and divided up; or that problems can be clearly identified, isolated and solutions applied. Our complex world simply does not respond to such an analysis any more.[101]

One of the implications of this constraint is that "suites" of policy tools will likely work better than single tools, provided that the tools are well coordinated or integrated.[102] Another implication is that policy prescriptions should include strong "feedback loops" — *i.e.*, flexible, iterative processes based on constant monitoring and rigorous evaluation of monitored results.[103] Considerable ongoing work in developing comprehensive suites of sustainability "indicators" can provide useful benchmarks for this "adaptive management" approach.[104] However, policies that are too dynamic can be toothless or meaningless, so these feedback loops should not dwarf other policy components.

Finally, the field of "resilience thinking" likely provides additional useful insights for developing a "comprehensive" strategy for Alberta's multi-faceted, inherently complex energy system.[105] In a nutshell, this is a multi-disciplinary attempt to understand the key

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bases for these political constraints, see Lawson Hunter, "Tax Shifting — Even corporate executives are geared up for a green levy" (2008) 34 Alternatives Journal 11-13.

[100]Wenig & Ross, *supra* note 28; and Wenig *et al*., *supra* note 23 at 4, 77 and 91.

[101]F. David Peat, "From certainty to uncertainty: Thought, theory and action in a postmodern world" (2007) 39 Futures 920 at 927-928.

[102]For example, Jaccard suggests a multi-faceted "policy portfolio", rather than a single policy tool, to reduce GHGs. Jaccard, *supra* note 31 at 291. The NRTEE likewise recommends several concurrent GHG reduction policies. NRTEE, *supra* note 99 at iv. However, Jaccard cautions that the policy "portfolio" approach is "not always a good idea. Sometimes governments try to look busy by assembling a potpourri of uncoordinated policies that overlap and even work at cross-purposes." Jaccard, *supra* note 31 at 291.

[103]This is a commonly expressed component of good ecosystem-based management frameworks. See, *e.g.*, Quinn, *supra* note 96.

[104]See, *e.g.*, Vera & Langlois, *supra* note 92.

[105]See, e.g., Brian Walker & David Salt, Resilience thinking: Sustaining Ecosystems and People in a Changing World (Washington, DC: Island Press, 2006); Carl Folk et. al., Resilience and Sustainable

characteristics of social-ecological systems and to use this understanding to promote the systems' sustainability. The "resilience thinkers" make clear that they have not yet assembled a "tight body of theory" of system dynamics, and are unlikely to do so in the "near future".[106] However, their findings thus far may provide useful insights for policy makers. In brief, resilience scholars stress that social-ecological systems are inter-linked at multiple scales and are dynamic, with change often occurring in non-linear ways. In the scholars' view, numerous variables can affect the function of any given system, but typically only a few variables are the most significant. In addition, system variables generally have thresholds which, if exceeded even by only a small amount, can cause a system to cease functioning or to at least change dramatically. Resilience scholars urge policy makers to adopt approaches that account for these complex system characteristics and use measures like "resilience" — the capacity of a system to absorb inevitable disturbance and retain essentially the same structure and function — to assess system performance. These are likely useful lessons for managing large-scale energy systems. However, more research is needed to assess how the scholars' models of system dynamics fit with large-scale energy systems and the full implications of the scholars' findings for energy policy. A summary of resilience thinking principles is included in the Appendix.

In summary, an "energy strategy" is sorely needed to guide Alberta through the many energy crossroads that it now faces. Alberta's aim of developing a strategy that is "comprehensive" is appropriate given the many facets of energy systems and the linkages among them and the fundamental, underlying issues that need to be addressed up front. In order to be "comprehensive", the strategy should reflect an energy systems perspective that accounts for all energy forms and all other physical and institutional parameters, and the linkages among them. Because of the complexities, however, a "comprehensive" energy strategy cannot be developed in a single try; it requires a continuous, iterative process each step of which should reflect an assessment of the success and scope of previous steps.

Development: Building Adaptive Capacity in a World of Transformations, Scientific Background Paper on Resilience for the process of The World summit on Sustainable Development on behalf of The Environmental Advisory Council to the Swedish Government, 16 April 2002; Special Feature on Exploring Resilience in Social-Ecological Systems (2006) 11:1 Ecology and Society et seq., online: <http://www.ecologyandsociety.org/vol11/iss1/>; and the website of the "Resilience Alliance", <http://www.resalliance.org/1.php>.

[106]Brian H. Walker *et. al*., "Exploring Resilience in Social-Ecological Systems through Comparative Studies and Theory Development: Introduction to the Special Issue" (2006) 11:1 Ecology and society (online, unnumbered p. 3). As another resilience paper commented, "it does not seem appropriate to describe resilience-based inquiry as a theory. It is better described as a collection of ideas about how to interpret complex systems." John M. Anderies, Brian H. Walker & Ann P. Kinzig, "Fifteen Weddings and a Funeral: Case Studies and Resilience-based Management" (2006) 11:1 Ecology and Society (online, unnumbered p. 7).

Appendix: An Overview of Systems Theory in "Resilience Thinking"

Systems occur in many forms. An ecological system is a biological community consisting of all plants, animals and micro-organisms interacting with each other and the non-living physical factors of the environment. Ecological systems are influenced by dynamic ecological processes, such as fire or flooding. In contrast, social systems (as the term is used here) are human-made systems that are independent from ecological systems. There is often an assumption that ecological and social systems are separate and can be treated independently. The reality is that many systems involve the interaction of nature and humans. These systems, called "social-ecological" systems are often difficult to fully understand and manage.

The challenges inherent in managing these types of social-ecological systems have resulted in a different way of thinking about systems and systems management termed "resilience thinking".[107] This type of thinking arose from observation that solutions to individual problems may be successful in the short term but may cause unexpected long term responses or consequences. For example, farming practices designed to improve efficiencies can result in top soil degradation and eventual long-term loss of land productivity. Another observation is that seemingly small changes in a system can have major consequence. For example, in business, a small change in the price of a raw material can result in a major blow.

The fundamental concept behind these observations is that systems inevitably change. Systems management then must take into account change (including unexpected, unplanned for change) and include management of the cycle itself. Consequently, management strategies need to be context dependent and need to change over time as the systems themselves change. The following is a brief discussion of the resilience approach including the definition of key terms.

[107] A key source on resilience in systems is Walker & Salt, *supra* note 105. Other sources are Folk *et al., supra* note 105; Brian Walker *et al.*, "A Handful of Heuristics and Some Propositions for Understanding Resilience in Social-Ecological Systems" (2006) 11:1 Ecology and Society, article 13 (online); and Brian Walker *et al*., "Resilience, Adaptability and Transformability in Social-ecological Systems" (2004) 9:2 Ecology and Society, article 5, online: <http://www.ecologyandsociety.org/vol9/iss2/art5>. For a discussion of these principles on organizations see E.P. Dalziell & S.T. McManus, "Resilience, Vulnerability, and Adaptive Capacity: Implications for Systems Performance", International Forum for Engineering Decision Making (IFED); Switzerland (2004), online: <http://www.ifed.ethz.ch/events/Forum04/Erica_paper.pdf>.

Characteristics of Resilience Thinking

In resilience thinking, systems can be simple, complicated or complex-adaptive. A simple system is one that involves few components and clear relationships between the components. An example of a simple system is the shifting mechanism for a bicycle. A complicated system is characterized by interconnected components whose size and behaviour don't change over time. The relationship between components is consistent and change in one component results in a predictable change in other components. An example of a complicated system is the mechanical equipment a factory uses to produce widgets. If the speed of a motor that moves a conveyor belt is changed, the speed of the conveyor belt also changes. There is a direct effect on the conveyor belt from the change of the motor but the change doesn't lead to secondary feedbacks. If there are many motors, belts, scales all used to produce the widgets, the system is complicated.

Resilience thinking is focused on complex-adaptive systems. A complex-adaptive system is not merely a complicated system. A complex-adaptive system is complex in that it is impossible to predict all the results that will occur when one system component is changed — in other words, the system has multiple secondary feedbacks. The system is adaptive in that different system components react differently, and adapt to change. Some components will perform better than others under similar conditions so that the entire system may change significantly over time. No single component is in full control of the system and consequently a complex-adaptive system can be described as self-organizing.

Consider, for example, the interactions in a vegetable garden. Although many of the interactions (such as those between soil conditions, water and sunlight) are understood and interlinked, the final results at harvest are neither linear nor predictable. No single part of the system is in control (including, or perhaps especially, the gardener). Unexpected pests and weeds enter the system with differing results on different vegetables. The effort to control one type of pest can open up a niche for another. Some seeds have unexpectedly poor germination rates and weeds quickly appear to take up the space. The garden plot system adapts as the world changes and there are secondary feedbacks to change. The plants and pests of the system are independent of each other but they are strongly interactive (although not all components interact with all others). A particular effort to produce a bumper crop of tomatoes will cause the other plants (whether weeds or vegetables) and pests to adapt to the intervention — possibly changing the performance of the entire system.

The three main requirements for a complex-adaptive system are as follows:[108]

- Some system components are independent and interacting. In our example, the different vegetables, pests, weeds and the gardener are all independent but interact with each other.

[108] Walker & Salt, *supra* note 105 at 34-35.

- There is some selection process at work on the various system components that impacts the results of the interactions between components. In the vegetable garden, the gardener imposes selection pressure in activities such as watering rates, weeding and pest control. Other selection pressures (such as the weather) are outside the control of the gardener.

- Variation and novelty are constantly being added to the system as components change over time and new ones enter the system. Weeds and pests will enter the system and all other parts of the system will adapt to the pressure.

Not all systems are complex-adaptive systems but many are such as: ecosystems, economies, organization and organisms. Under resilience thinking, management of these types of complex-adaptive systems requires an understanding of how these systems work. The key principles are summarized below.[109]

Adaptive Cycles

Systems that change in response to internal dynamics and external influences or disturbances typically exhibit four characteristic phases. The first is a phase of growth characterized by readily available resources and the accumulation of structure. As structure and connection between system components increases, more resources and energy are required to maintain them. This second phase (called the conservation phase) is one where net growth slows and the system becomes increasingly interconnected, less flexible and more vulnerable to external disturbances. These two phases (growth and conservation) are called the "fore loop" which corresponds to ecological succession in ecosystems and development periods in organizations and societies.

Inevitable disturbances lead to the next phase (the release phase) where the resources tied up in the system are released as the structure of the system collapses. This is followed by a reorganization phase where novelty can take hold and another growth phase begins. These two phases are referred to the "back loop". The new growth phase may be very similar to a previous growth phase or very different. The term "creative destruction" is used to describe the disturbances that periodically impact the adaptive cycle.[110] The disturbance changes the cycle which breaks down stability and predictability but releases resources for innovation and reorganization. A simplified adaptive cycle is illustrated in Figure 1.

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[109]Walker *et al.*, "A Handful of Heuristics", *supra* note 107 (unnumbered pp. 2-3).

[110]Walker & Salt, *supra* note 105 at 75.

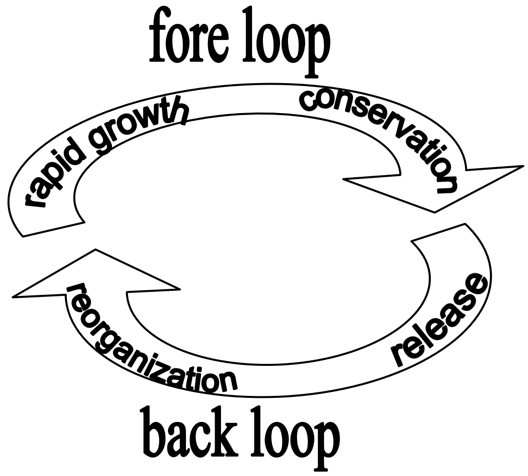

Figure 1 – A simple representation of the adaptive cycle.

A simplified example of an adaptive cycle is that of home lighting. Before the invention of the first practical incandescent light bulb by Thomas Edison, light was provided by candles and oil lamps. After the invention of the light bulb (which was an external disturbance), there was a period of rapid innovation and development in home lighting (the growth phase). The light bulb along, with a new system of electric lighting, resulted in a complete change in the method of home lighting — one that has become deeply entrenched in developed societies (the conservation phase). As concerns about energy costs and efficiency and climate change (all external disturbances) increased, the release phase was triggered. This was followed by reorganization where innovation occurs and home lighting appears to be moving into a new growth phase characterized by home lighting provided in the form of compact fluorescent bulbs (and possibly LED in the future). The first home lighting system back loop (from candles and lamps to light bulbs) resulted in a totally new way to provide light in homes (a change that no doubt caused some loss to candle manufactures) while the more recent back loop is resulting in a growth phase quite similar to the past as it continues to rely on electricity as a energy source and the use of replaceable bulbs.

Panarchy

Essentially any system is composed of a hierarchy of linked adaptive cycles operating at different scales of both time and space. Disturbances at both higher and lower scales will affect the system being observed. The term "panarchy" is used to describe the cross-scale dynamic on social-ecological systems. For example, a coniferous forest is composed of many systems that can be observed at the needle, crown, patch, stand, forest or landscape levels. Each of these systems exist in time from months (for needles), years (crown), centuries (patch, stand and forest) to thousands of years (landscape). Observing the system at the forest scale must take into account impacts from, and on, the systems both above and below it.

There are two key points when considering panarchy. First, the dynamics of a system at any given scale (the focal point) cannot be understood without taking into account the dynamics and cross-scale influences of the scales above and below it. Second, evaluation of system dynamics must clearly state what scale is the focal point to avoid mismatch between the management scale and the social-ecological system being managed.[111]

Resilience

Resilience is the capacity of a system to absorb disturbance or shocks and reorganize while undergoing change so that it still retains essentially the same basic function, structure, feedbacks and identity.[112] Social-ecological systems exhibit thresholds or crossing points that have the potential to alter the function and structure of a system. Shifts between alternate regimes[113] within a system occur when a threshold is crossed. While social-economic systems are affected by many variables, they are usually driven by only a handful of controlling (and often slow-moving) variables.[114] Each variable has a threshold and if a system moves past the threshold the system will begin to behave differently. Once a threshold is crossed it is usually difficult, or impossible, to cross back. Resilience is a measure of the distance a system is from these thresholds. The more resilient a system, the larger the disturbance it can absorb before shifting into an alternate regime. The closer a system is to the threshold, the less disturbance it takes to be pushed over.

There are two final points on resilience. First, resilience *per se* is not necessarily desirable. A social-ecological system in an undesirable state (*e.g.*, depleted fisheries or harsh dictatorship) may exhibit high resilience and resist all efforts to move the system out of the undesirable state. Different alternate regimes can have significantly different implications so that from a human point of view some will be more desirable than others. Of course, what is "desirable" also varies on the viewpoint and it can be measured in

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[111]For more information on scale mismatches in social-ecological systems see Graeme S. Cumming, David H.M. Cumming & Charles L Redman, "Scale Mismatches in Social-Ecological Systems: Causes, Consequences, and Solutions" (2006) 11:1 Ecology and Society, article 14 (online).

[112]The term "resilience" as used here is different from using the term to describe how quickly a system, often a mechanical system, can return to some point of equilibrium when disturbed. This is termed "engineering resilience". Walker & Salt, *supra* note 105 at 62. The term "resilience" here is a description of how much disturbance a system can take before it looses its ability to behave in the same way. In short it is the system's ability to resist crossing a threshold or tipping point. The difference is not of how fast a system can return to equilibrium but whether it can return at all.

[113]The possible states of a system can be described by all possible combinations of the variables that constitute the system. For example, if an electricity supply system in a region is defined by the amounts electricity available from natural gas, coal and wind energy, then possible system states are all possible combinations of the amounts of these three variables. The different combinations of the variables are the alternate regimes of the system.

[114]Walker & Salt, *supra* note 105 at 83.

various ways including economic terms, environmental terms and/or social terms. Second, resilience and adaptive cycles are both central components of resilience thinking but they describe different features. The adaptive cycle describes the behaviour of the system *over time* while resilience describes the system's state *at a point in time* compared to various thresholds. Where the dynamics of the adaptive cycle coincide with the dynamics of resilience, it usually occurs during the back loop and the new alternate regime usually represents a new adaptive cycle with different feedbacks and structure.

Adaptability

Adaptability is the capacity of the actors in the system to manage resilience. Because human activities dominate social-ecological systems, the adaptability of such a system is primarily a function of the ability of individuals and groups to manage the system. Human action influences resilience (either intentionally or not) and adaptability is the ability to manage the system so as to avoid crossing into an undesirable alternate regime or to succeed in crossing into a desirable one.

Transformability

Transformability is the ability to create a fundamentally different system when the current system in no longer tenable and adaptation is no longer an option. The decision to move into a new alternate regime may be in response to the failure of past policies or decisions, a resource crisis or driven by changes in social values. The ability to manage the transition into a new way is a measure of the systems transformability.

Resilience Thinking in Energy Systems

Energy systems include both ecological and social components and are able to be evaluated and managed through a resilience approach. Energy resources and activities do not exist in isolated or stand-alone contexts but as part of a system. Resilience thinking provides one method for energy system policy development that addresses the complexity of the systems approach.[115]

In developing a comprehensive energy strategy using resilience thinking, the province must clearly define the energy system that is the focal point of the strategy as well as the systems that exist above and below in scale. For example, if the energy system is managed at the provincial level, management of the system would necessarily include the

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[115]Walker & Salt, *supra* note 105 at 84 and 92. For a discussion of adaptive governance in resilience thinking see Per Olsson *et al.*, "Shooting the Rapids: Navigating Transitions to Adaptive Governance of Social-Ecological Systems" (2006) 11:1 Ecology and Society, article 18 (online). The Resilience Alliance, *supra* note 105, has developed two workbooks for assessing resilience in social-ecological systems: 1) *The Resilience Alliance 2007 — Assessing and managing resilience in social-ecological systems: A practitioners workbook*, vol. 1, Version 1.0, online: <http://www.resalliance.org/3871.php>, and 2) *The Resilience Alliance 2007 — Assessing resilience in social-ecological systems: A scientists workbook*, online: <http://www.resalliance.org/3871.php>.

impacts of the national, North American and world energy systems as well as the impacts from the systems involving conventional oil and gas, oil sands, electricity generation and the various forms of renewable and alternative energy. The province must also consider and define where the current energy system is at both in terms of critical thresholds and its phase in the adaptive cycle. Decisions can then be made to increase resilience, adaptability and/or transformability of the system depending on the future goals for the system.

Resilience thinking suggests that the cyclic nature of systems, including energy systems, is inevitable and that disturbance is certain at some point. Policy choices made today have a significant impact on the response of a system to future disturbances. A "comprehensive" energy strategy would acknowledge, accept and plan for change and disruption to the energy system.

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