# Blueprint for California's Clean Energy Future

The Metrics of Energy Measurement

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## Introduction

The California Energy Commission (CEC) Integrated Energy Policy Report (IEPR) Committee organized a workshop on July 6, 2011 to present a proposed revision to the California Clean Energy Future (CCEF) planning process, a key element of state energy planning. Joining the CEC in the workshop and participating in the planning process were the "Collaborating Organizations", the Governor's Office, the California Air Resources Board, California Environmental Protection Agency (CalEPA), California Independent System Operator Corporation, and California Public Utilities Commission.

According to the Workshop notice, the agencies were looking for "… feedback on how to measure progress in meeting the policies identified in the California Clean Energy Future Overview document and on how to execute the policies and track progress in a transparent and effective way." Comments on this stage of the process were due to the CEC's Dockets Office on July 20, 2011 (Docket #11-IEP-1A). We submitted formal comments to the CEC docket, primarily to address the overall vision and organization of interagency measurement, and questioning the precepts that lead to the chosen metrics.

This article includes sufficient background and document detail to provide context for our formal comments, which have been posted to Teru Talk's "Reference" section. Our comments and article are intended to aid California in establishing a new conceptual framework for energy assessment, to help improve over-all monitoring of all aspects of energy supply and delivery, and hopefully to initiate a more realistic and flexible implementation of management programs to reach the State's very aggressive Clean Energy goals.

## Background

The original Overview for the California Clean Energy Future was developed upon the foundation of California's "Loading Order" policy adopted with the 2003 Energy Action Plan, which placed Energy Efficiency and Demand Response as the top priority. Renewable Energy held second rank, followed by Combined Heat and Power (CHP) and Distributed Generation (DG). Beyond these, the Loading Order specified use of the "cleanest and most efficient conventional generation".

The CEC adopted an Integrated Energy Policy Report (IEPR) in 2003 and fully revised the vision every two years pursuant to Public Resources Code § 25301[a]. On March 24, 2010, the CEC adopted an Order Instituting Informational Proceeding (IEPR Docket #11-IEP-1A) to develop the 2011 IEPR.

California's then Governor Schwarzenegger established difficult "clean energy" goals as outlined in the 2010 Clean Energy Future Overview, Implementation Plan and Roadmap. With the change in regime, our agencies now must revise these goals to reflect Governor Brown’s energy vision. Two crucial statements of his vision have been made public.

First, California was presented with a key campaign platform prior to Governor Brown's election. The prospective Governor's Clean Energy Jobs Plan details specific steps to dramatically improve the state economy by implementing Clean Energy. His Jobs Plan summarizes:

> "By 2020, California should produce 20,000 new megawatts (MW) of renewable electricity, and also accelerate the development of energy storage capacity. California can do this by aggressively developing renewables at all levels: small, onsite residential and business systems; intermediate-sized energy systems close to existing consumer loads and transmission lines; and large scale wind, solar and geothermal energy systems. At the same time, California should take bold steps to increase energy efficiency."

 

Second and as proposed in his Clean Energy Jobs Plan, the legislature passed and Governor Brown signed SB x1- 2, the California Renewable Energy Resources Act. The legislation now obligates all California electricity providers (both investor and publicly owned) to obtain at least 33% of their energy from renewable resources by the year 2020, the most aggressive renewable portfolio standard in the country.

Revisions to the CCEF under the current mandate of this year's Scoping Order must now incorporate original thought, quick action and aggressive pursuit. Three major areas of change to the prior IEPR planned for 2011 have now been ordered:

(1) Address Governor Brown's energy policy priorities regarding the Loading Order, following the outline in his Jobs Plan and the mandate of SB x1-2;
(2) Consider the safety and energy reliability implications of the PG&E gas pipeline explosions on September 9, 2010, considerations that must internalize the human and environmental costs of an aging infrastructure and of *all* energy transmission, and
(3) Review and evaluate use of public funds for energy, including renewable energy technologies and public interest energy research, under provision of the Public Goods Charge and related program funding.

The revised 2011 IEPR will be a set of inter-related topical documents, expected to be published from July through September 2011. Topics announced at this time include: (a) Energy Efficiency, (b) Renewable Generation Infrastructure in California, (c) Review of Public Goods Charge and Energy Research, Development and Demonstration Programs, (d) Bioenergy Development in California, (e) Transportation Fuel Supply, Demand and Infrastructure, and (f) Electric and Natural Gas Supply, Demand and Infrastructure.

According to the 2011 Integrated Energy Policy Report web page and accompanying schedule, a Summary of major findings and policy recommendations from the subsidiary volumes will be presented by staff and proposed for adoption by the Energy Commission during the last two months of 2011.

## 2011 Revision of the CCEF – Metrics of Measurement

The July 6th workshop concentrated on the changes proposed to the CCEF as part of the broader 2011 IEPR process. As outlined in the Overview, the CCEF Implementation Plan and Inter-Agency Roadmap both rely on *metrics of measurement* by which the agencies of purview over state energy planning might properly judge relative progress toward the mandated 33% goal.

Eleven specific energy measurement metrics that had been previously posted to the IEPR web page were described and considered for their overall thoroughness, organization, efficacy in tracking, and as needed to adjust the course of implementation:
(1) Demand Response refers to a reduction in customers' electricity consumption over a given time.
(2) The Zero Emissions Vehicle program will play a critical role in meeting California's air quality and greenhouse gas reduction goals for 2020 and beyond.
(3) The 2020 forecast of greenhouse gas (GHG) emissions is important for tracking California's progress towards the goal of reducing statewide emissions to 1990 levels by 2020.
(4) The current energy efficiency goals are based on historical savings assumptions and state policies for achieving greenhouse reductions.
(5) On-line capacity metrics track available energy by technology and by year from 2001 to 2010.
(6) Phasing out once-through cooling (OTC) directs improvement in nuclear plant efficiency.
(7) Renewable Energy generation data measure progress toward statewide RPS targets.
(8) Reserve Margins evaluate short-term market developments and a range of potential system variations to determine if there are any significant risks of potential electricity supply shortfalls during the upcoming peak demand season.
(9) The system average rate is calculated by dividing the annual revenue requirement of the IOUs by their annual retail sales.

(10) Statewide Energy Demand represents historical statewide annual electricity consumption and end-use natural gas consumption data.
(11) Transmission expansion plays a vital role in enabling the interconnection and operation of renewable energy to meet Renewables Portfolio Standards.

Agencies measure data associated with actions that they have purview over and can in some way hope to manage. The presented Metrics are a result of selecting key data sets and measurement programs associated with each of the Collaborating Organizations noted in the Introduction to this article, the agencies and institutions most directly responsive to and responsible for "energy" that have been and continue to be taking direct roles in the CCEF revision.

## Holistic Energy Management

Kicking off the July 6th workshop, CalEPA Deputy Secretary Anthony Eggert offered the well-worn quote that "what you can't measure, you can't manage", as an introduction to the overview of the California Clean Energy Future, and to the topic of metrics assessment. Mr. Eggert asked that those attending consider if indeed the agencies were using the right metrics of energy supply and demand measurement.

The corollary is also just as true; the above conundrum can be restated: *what you don't manage, you don't measure*. To a large degree, what is not counted does not count in the tally.

Prior to asking agency staff to present on each of the proposed Metrics, workshop participants were also asked to consider if there might be another way to *organize* the process that accounts for progress toward stated energy goals in California.

We would offer that "Energy Supply and Demand" must be viewed in its entirety, that the on-going revision of the CCEF is hampered by a very non-holistic perspective. Clean Energy planning must include *all* controlling interests and if the State is to so dramatically increase Renewable Energy, it stands to reason that the agencies with purview over all aspects of renewable energy *sources* must be fully engaged. Not in evidence during the workshop were representatives from agencies with purview over Agriculture, Forestry, Water and Waste. Renewable energy is only one part, and the minor component, of California's energy past, present and desired future.

Realistically, measurement and management of "clean energy" requires that they be done in context of *all* energy, clean and "dirty". As one example, Chair Weisenmiller observed during the workshop that understanding and measuring California's use of coal for power is necessary if we wish to observe and encourage the *decline* of that usage. Measurement of *each* energy pathway from source to end-user is similarly important.

## The Value Chain Approach

Agency staff provided the workshop with the process of metrics selection and organization. Ms. Heather Raitt, Assistant Executive Director on Climate Change, presented four key organizational categories: (a) Demand, (b) Supply, (c) Transmission, and (d) a catch-all component, "additional supporting processes".

We submit these concepts are inherent characteristics of the value chain of energy supply rather than a primary organizational structure. It is useful to revisit each of these concepts:

Demand is draw upon the end of a supply chain. Much of our governance over energy has been focused on modifying demand, through imposed restrictions and quotas to offering temporary incentives and policy preferences. Yet "demand" becomes less manageable for example, when we consider on-site generation and distributed combined heat and power. Who will measure and manage *this* element, using what combination of the metrics chosen? Demand is best understood as the result of all factors acting upon an Output. Without clearly accounting for the pathway leading to that output, it is probably unrealistic to expect effective management of Demand, as the controls occur all along that pathway, not simply at the end.

 

Supply as described in the IEPR program documents has been too narrowly defined. In context of an end-to-end value proposition, *supply* must encompass everything from the origination of resources which eventually are converted to energy, and not simply the last step of provision to the end-user. Here, we find total lack of representation of purview over those sources that contribute to so many "pathways". One obvious example would be the long-standing assessment of biomass as a renewable feedstock. Where is this accounting and management represented in the current Metrics consideration?

Transmission most aptly describes the paths of the products of the value chain from generation to end-user. Controls over transmission are naturally of high priority for agencies with specific purview over only the final pipe and wire infrastructure required for delivery of energy products. While there is obviously a need to insure that transmission has sufficient capacity for present and future conveyance needs, there is a hazard inherent in assigning too much weight to end-point controls. There is also a need to consider how implementation of "smart grids" and on-site generation will complicate understanding of transmission.

Additional Supporting Processes as outlined in the Overview constitute a mixed accumulation of physical systems and managerial methods. Rather, we might define a *Process* category as that combination of systems and methods present at any point along the value chain that effect conversion from one raw form of a resource into another more accessible and beneficial form. It appears that all other components currently assigned to this catch-all category might then be more appropriately considered as "modifiers" along the value chain.

Any commodity assessment must take into account the source, the process, and the output. Each step along a pathway from raw source to end-user inherently must accrue value (if no more than access) at each step. Step-wise value-added processing turns a resource into a commodity, and this perspective is certainly appropriate for all provision and use of Energy. A value-chain approach to energy monitoring and management logically takes into account the local, state and federal policy-driven regulatory framework that impacts this value-added process. Public or private, market or policy driven, each value-chain exhibits certain characteristics and is subject to certain controls.

Establishing metrics of measurement logically should extend to the existing and needed mechanisms necessary to identify the broadest cross-section of energy generation. The data necessary for tracking the flux of coal, natural gas, crude petroleum, biomass, water, geothermal resources, solar irradiation, microbial, and radioactive feedstock and any other potential resource from which *energy* might be generated for an end-user thus falls within scope of the metrics of energy measurement. Energy-provision benefits, barriers, challenges and inequities become apparent once in context; monitoring impact / response of policy and regulation upon this flux must be considered.

Plotting out the vision, implementation schedule, and "roadmap" of California's energy future assumes that management can be effectively informed by proper and thorough monitoring and that research, development, commercialization, and governance may be positively used to direct growth toward the desired outcome. That quantifiable outcome, whatever it might be, must be viewed as the result of the processes that add (or subtract) value along the path from resource to commodity, impacts upon value that signal to the market desired direction and rate of growth.

## Modeling the Energy Value Chain

A simple Input/Output (I/O) organizational model may best provide a foundation for truly identifying, monitoring and understanding the flux of California's overall energy value chain. I/O modeling organizes all components of and controls upon the progress from source to end-user. For energy, the CCEF I/O model starts with an agreed upon suite of mutually beneficial socio-economic outcomes, one goal of which is to adjust the energy generation and provision balance to attain a portfolio of 33% renewable energy by 2020.

An inclusive and responsive I/O model construction for Energy must pay close attention to the *process* by which the myriad resource Inputs become commodity Output. It is with the step-wise identification, characterization and management of *process* that the I/O model most provides access to critical "inflection points", places where the least management can result in the most optimal result. We can think of our model as an Input-Process-Output (IPO model) framework.

Accounting for all elements of an energy value chain must be a "live" program, always open to additions, deletions, revisions, and refinements as conditions change. Input, Processes and Outputs need attributes, the characteristics that differentiate it from other similar elements.

Modeling also requires an approach that consistently excludes any judgment of worth of the element added until the element may be adequately viewed in context of the whole. Any a priori value attributed to individual elements tends to defeat the goal of creating a model representative of the energy system's inherent diversity, resilience and rate of change. Determination of value is a <u>product</u> of the model, not an element-selection criterion.

## Input-Process-Output Model

**Input** to the energy value chain includes a broad range of feedstock types, some inherently containing more contaminants or environmental toxins than others. Yet it is not the feedstock that solely determines whether energy generated will be clean or dirty, it is the entire chain of acquisition, transport, processing, delivery and even specific pattern of usage that determines socio-economic and environmental "friendliness".

A quick list of "energy inputs" might include but certainly would not be restricted to solar, water (hydropower), geothermal, biomass, waste (including waste heat recovery), fossil-based sources and nuclear reactivity. The category list must be left open; already, new science has been indicating that energy may be scavenged simply from the motion always present in our environment.

Input attributes would describe agencies of purview and the policies, rules, regulations and laws pertinent to a particular energy feedstock component. As an example, there are many different local, state and federal agencies that impact "biomass"; some impacts are feedstock type and source specific, others are more generic. Having diverse types of biomass slotted as Input provides a way to sort out the controls over each type, group of types, and category of groups. For biomass in particular, we needn't "start from scratch"; the meticulous work of the California Biomass Collaborative under direction of the "re-invigorated" Interagency Bioenergy Working Group has certainly provided an accounting of types, sources and quantities. The management of this data has not represented in the current Metrics under consideration.

Similar data sets define, with widely varying levels of accuracy and thoroughness, a broad array of Input types to the California Energy value chain. The task of placement within a matrix becomes one of linkages to existing data sources and purviews, and identification where such sources and purviews are absent or unsatisfactory for an identified type.

In one difficult example, California has recently had the misfortune to see that a system input of "clean" natural gas still can constitute a disastrous public hazard in a poorly maintained infrastructure. "Coal" as an input feedstock type may be clean or dirty depending not so much on the chemical characteristics of the feedstock, as on the characteristics of conversion Process; old coal-fired energy generation is far dirtier than our newest "clean coal" technologies. The feedstock type should be represented in the model whether one is pre-disposed to shun or support the inclusion of coal.

**Process** describes the stepwise progression from the raw Input to creation of the final commodity as an Output. Accounting for Process in the IPO model starts with acquisition and aggregation, proceeds through transport and certainly includes all forms of refining and reforming, whatever the feedstock. Barriers and controls that rely on methodical data collection mechanisms have been institutionalized upon Process along this entire pathway; each factor impinging for good or bad upon the Process exists as a "adjustable" variable that may be increased or decreased to effect a shift toward overall goals. To do so, however, these attributed must be identified and associated with the specific steps of value chains that they impact.

As an example, the prescriptive controls over percentages of "renewable" versus "fossil" input to a Process might be better observed and potentially modified in context of the inclusive IPO model. Transport, fuel refining, and chemical production are globally trending toward use of less fossil and more bio-sourced feedstock, yet this has less to do with any policy or regulatory dictum than the economics of availability. To paraphrase a colleague in the oil and gas industry: *'Hydrocarbons is where you find 'em'*. The recent and on-going Definition of Solid Waste rulemakings, for example, take this into account.

Presumptions of the degrees of "cleanliness" based on Input can only confuse an understanding of processing types. Using a matrix approach encourages assigning value after inclusion, rather than assuming attributes and therefore precluding the proper placement within the whole. There may well be processes that simply should not be allowed to be part of California's energy future, yet that determination should depend upon the context of "clean, compared to what?"

To monitor and manage a change in Process that can decrease or increase the effective value to be accrued along the value chain from an input to the output, we must account for and measure the types of Processes, and objectively assign attributes of operations maintenance, constraints, and limitations. Identification of Best Management Practices (BMPs) can be one result of such an incremental assessment. In truth, *any* system may be operated well, or operated poorly; an emphasis on Best Management Practices regardless of the type of conversion mechanism used for processing is probably more likely to provide the desired "clean energy" result.

**Output** elements of the energy model include all products of energy as a commodity, whether kinetic such as drive shaft power, thermal in terms of heating and cooling, electrical as direct and indirect current, or chemical as where that commodity is used for fuel. At present, most of the CCEF-listed Metrics involve measurement of attributes of commodities in this Output category, such as usage data and resulting controls over Demand Response constructs. Without question, the growth of zero-emissions vehicles (ZEVs) in the transport sector is important. Perhaps of more value however would be a better understanding of and accounting for each step in the value chain that results in user-access to Output energy commodities critical for those ZEVs to more rapidly penetrate the marketplace. Assessing ZEV numbers without reliable access to the rest of the associated value chain's data certainly must result in skewed analyses of the "manageable" characteristics of that value chain, with minimal utility for effecting the desired change.

Creating a "level playing field" among controls over energy Outputs is envisioned as a desired result of the CCEF revision. In absence of a matrix describing the life-cycle assessment characteristics of energy in context, it is difficult if not impossible to compare well-to-pump impacts of petroleum Inputs with other pathways. California's development of a Low Carbon Fuel Standard is attempting to construct just such a comparative matrix; extension of this model beyond transport fuels to include *all energy* would be worth serious consideration.

Output attributes are typically considered when selecting mechanisms to encourage or discourage specific patterns of energy usage. Energy agencies contributing their methods of monitoring clean energy governance efficacy will naturally feel more comfortable if not tasked with monitoring what they do not have the purview to manage. In such instances, the expertise of other governing and oversight parties not so directly charged with the end-user supply and demand flux must be engaged to fully grasp the controlling attributes of each energy output.

A matrix approach that reserves judgment and simply accounts for all outputs appears warranted. One need not *initially* know the activities, impacts, controls and benefits along a particular Process, to recognize an identified Output. The Output of all energy commodities should be identified and methodically assigned pertinent characteristics that in their turn can be measured and compared to the CCEF goals according to consistent and comparable criteria.

Energy output delivery is no different than any other commodity; the ability to safely and cost-effectively reach the Market determines and is determined by the entire value chain.

## Conclusion and Recommendations

*As presented in our formal comments to Docket*

Two closely related organizational concepts are offered to improve understanding of energy generation and delivery in California. First, we suggest that provision of *energy* constitutes an inter-related complex of value chains, of identifiable pathways from source to end-user. Second, we offer an Input-Process-Output model by which all forms of energy value chains may be identified, measured, and compared.

Agencies measure what they manage or intend to manage. For example, access to feedstock is critical to the energy value chain for nearly all sectors, but impacts to feedstock availability, whether positive or negative, tend not be considered because they are not strictly within the purview of "energy management." A cohesive state-wide energy policy must take into account access and availability from source to end-user.

Rather than consider efficacy against a set of performance standards of what constitutes "clean" versus "dirty," judgments are made in advance, and entire sectors of potential energy provision are disparaged. Coal is not inherently dirty; it is the industry-standard Process that converts coal to energy that has been the problem. Waste pollutes less when carefully controlled through an advanced conversion Process than when left to common management ending in landfill disposal. *Any* processing system can be run well or poorly, and it is the Process performance and specific use of Output rather than the Input feedstock source that should dictate considerations of environmental cleanliness.

We are recommending an inclusive method facilitating direct comparison of the energy value chain of the status quo vs. that of the proposed Process. The question, "Clean, compared to *what*?" needs to be answered. Using existing Process as the baseline for comparison establishes the basis for informed management leading to identification of Clean Energy.

We are *not* recommending that agency governance incorporate every aspect of each energy value chain. Indeed, in most cases, *less* governance would be preferred. We feel that more good will be accomplished by identifying and eliminating regulatory inequities than could be accomplished by more regulations, grants, loans or incentives.

We appreciate and do not underestimate the enormity of the task at hand to order all forms of energy provision to our state. Yet we also see that much of the data are already being managed, that the task is more about *inclusion* of these disparate management regimes than of wholly new constructs.

Data management for extremely complex and constantly changing conditions must be based on a holistic and inclusive initial identification of elements, followed by a rational placement of each in context of the other elements. This "database" approach is already a well-developed field of inquiry; its application to policy-laden purview decision-making may only recently have become possible. Society is no longer constrained by the sheer scale of the requisite data storage, organization, extraction, analysis and constant maintenance. The data can be gathered, but there are often far more subtle reasons for not doing so than simply data storage capacity.

If California is to implement the rapid increase in development of renewable energy as mandated, we must at a minimum *identify* every possible pathway. Once positioned in context of other pathways in the overall energy value chain, we can methodically enumerate attributes, among which will be that part of the spectrum of social, environmental and economic appropriateness we tend to collectively call "Clean Energy".