California Integrated Renewable Energy Systems Report

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California Renewable Energy Center: Vision and Development Metrics

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Abstract:

In April of 2009, an agreement was executed to fund the first two years of California Renewable Energy Collaborative (CREC) operations. Enough experience is in hand now to identify development metrics consistent with the original vision and to determine if the vision is achievable or needs to be updated or revisited.

CREC's current mission emphasizes research, modeling and assessment support for California's renewable energy deployment programs and PIER's renewable energy development and demonstration programs. Progress serving the mission has been sufficient to encourage an update involving a more ambitious and robust role for the CREC team.

Specifically, California has an important unmet need that could only be met by expanding CREC's capacity and further stabilizing its operation.

California's market-based renewable energy deployment programs need direct and comprehensive support that is grounded in science, technology, economics, finance and environmental assessment.[1] There is also a need for coordinated and active engagement by CREC across the full spectrum of renewable energy RD&D efforts underway in California.

Accordingly CREC should develop scoping and strategic implementation options for a permanent California state level research center or with capacity to address technical, economic and policy issues unique to California or of special importance to California.[2]

There are many issues and needs that are unique or especially important to California that NREL either cannot address or would not be asked by the USDOE to address.[3] These include technical integration issues that will be encountered at unprecedented levels of renewable energy deployment across all cost-effective future applications. Such levels are likely to be encountered first in California and later in the remainder of the US.

Elements of guidance for consideration and execution of an updated CREC role and vision are available in existing successful models for coordination between public renewable energy R&D programs and affiliated organizations or contractors. Some are briefly discussed in the report along with some particularly productive historical models. An appendix provides a menu of development metrics that may apply to the recommended vision, depending on its stage of implementation.[4]

[1] While state agencies can provide such support on certain perennial and over-arching topics and have related modeling and assessment capacity, gaps nevertheless exist, and there is a continuing need for database development and management that is difficult to meet with agency resources.

[2] A separate report is available that analyzes the major renewable energy options in order to differentiate between topics and questions where California faces similar, different, or unique issues. See http://cal-ires.ucdavis.edu/

[3] The present report does not provide detailed analysis to assess the scope of the unmet needs. A separate report is available that does so. See http://cal-ires.ucdavis.edu/

[4] The original baseline vision and other alternative visions that were considered are summarized and evaluated in unpublished documents and not covered here because they do not appear to meet state needs.

Acknowledgements:

This report is an account of work by Cal-IRES, a program of the California Renewable Energy Collaborative. The work scope was specified by the California Energy Commission in Agreement # 500-08-017 which provides funding for CREC research over the period 05/28/09 to 04/26/12. Specifically, this report is the primary deliverable under Task 2.6 of the agreement. It reflects an extended process of thoughtful discussion and multiple recent rounds of suggestions from the CREC leadership team and staff as well as earlier rounds of constructive discussions and dialog with PIER colleagues including Prab Sethi, Sandra Fromm, Ken Koyama, and Martha Krebs. Their interest and support motivated an effort to supplement the wide angle vision for a future California Renewable Energy Center with a closer view of how capacity could be increased while stabilizing and strengthening on-going efforts. Special thanks are due Ronnie Holland for many conversations and discussions that clarified issues and affirmed the value of the present effort.

Introduction:

The California Energy Commission, through its Public Interest Energy Research Program, (PIER) has for some years been the primary sponsor of three renewable energy collaboratives. PIER's investment continues to pay significant dividends in terms of fundamental assessments, coordination among technology area stakeholders, and events convened for purposes of information dissemination and public review and dialog.

Looking to build on this success, in 2007 PIER program managers and CREC directors undertook to create the California Renewable Energy Collaborative (CREC). Their goals were to: 1) stabilize core funding, 2) align the CREC research agenda with emerging PIER program priorities, 3) provide a framework for expanded interaction, coordination and shared services among individual collaboratives, 4) make CREC coverage of renewable topics consistent with PIER's existing renewable research portfolio by adding a fourth collaborative addressing solar energy, and 5) expand effort in cross-cutting or integrated activities among the renewable energy collaborative and sectors.

During the contract development period PIER continued to develop a vision for CREC's role as: 1) a technical partner in planning and executing PIER research programs, and 2) a living repository for deep technical expertise and insight across major renewable technology groupings. In the latter stage of contract development, collaborative leaders developed a strategic plan for CREC's further development consistent with the vision.

For discussion purposes, the original PIER vision will be referred to as the "baseline" vision. According to this vision as it evolved, CREC was to serve as the PIER Renewables program's primary science and technology partner while in parallel competing for funding available from other sources for related work. In its PIER-funded work CREC was to conduct pre-competitive research to inform the program's overall direction and also serve as an independent technical program integrator with collateral responsibilities to assist in technology transfer and stake-holder coordination.

In May of 2009, an agreement was executed to fund the first two years of CREC operations. Enough experience is in hand now to identify development metrics consistent with the baseline vision and to determine if it is achievable or needs to be updated or revisited. [5]

This report discusses and summarizes the results of efforts to do so.

Major sequential steps in these efforts included:

1. Review of the baseline CREC vision which emphasized close coordination between PIER and CREC.
2. Consideration of alternative visions that emphasize other existing or potential organizational development purposes.
3. Consideration of models for close coordination between public benefits RD&D programs and supporting organizations.
4. Consideration of state needs for pre-commercial renewable energy RD&D and analysis informing deployment policy.

The first two steps are not covered in this report. The original baseline vision and other alternative visions that were considered are summarized and evaluated in unpublished working documents and are not covered here because they do not appear to meet state needs.

Consideration of Successful Models:

There are multiple models for execution or support of government funded renewable energy RD&D. The following are worthy of note. Each appears relevant to CREC and PIER and is being implemented successfully in comparable contexts. They include:

CSI R&D model: A portion of California Solar Initiative funding was set aside for RD&D in support of deployment. Itron, a company having experience supporting the CPUC was selected to plan and implement the program, including providing staff for grant management and administration. The program has conducted two solicitations focused on solar electricity integration solutions, eliciting response from organizations directly involved in solar PV deployment.

Energy Commission policy makers have encouraged the PIER Renewables Program to focus on RD&D in support of deployment. The CSI R&D program seems to offer a workable model for accomplishing this purpose. It entails a process specifically and intentionally tailored for RD&D sourcing and contract management.[6] One way CREC could be involved in supporting a comparable model in technology areas would involve applying the contracting mechanisms used by the CSI R&D program, perhaps with CREC staff providing advice and review based on

[5] The agreement anticipated further work to refine the CREC vision and recommend development metrics. This report is an account of work by Cal-IRES, a program of the California Renewable Energy Collaborative. The work scope was specified by the California Energy Commission in Agreement # 500-08-017 which provides funding for CREC research over the period 05/28/09 - 04/26/12. Specifically, this report summarizes work under Task 2.6 of the agreement.

[6] The Energy Commission's process rigorously conforms to state contracting standards that did not envision the unique conditions of research sponsorship.

their specialized expertise, and with PIER contract managers managing the agreements as part of an overall PIER/CREC team.

NREL technical assistance model: DOE relies on its National Renewable Energy Laboratory and other national laboratories for assistance with its competitively sourced RD&D projects to a greater extent than PIER relies on CREC. For example, DOE is providing funding to communities across the country that responded successfully to a solicitation very similar to PIER's initial RESCO[7] solicitation.

In concert, NREL is funded by DOE to support program planning and outreach, including technical assistance to funded communities and outreach and coordination with communities whose proposals were unsuccessful but who are continuing to pursue DOE's program goals with other funding. NREL is developing a website for DOE's program which will serve the purpose of facilitating exchange of technical information and project status information among the communities and has offered to include information for PIER funded projects on the website. In addition, each DOE funded community received $50K worth of direct NREL technical and other assistance.

PG&E and other historical models: There are also successful models that served well in earlier stages of renewable energy industry development. In California, the state's investor owned utilities (IOUs) emphasized a close coupling of analytical and experimental "engineering research", which revolved around test facilities and pilot deployment venues.

For example, in the late-1980s and early-1990s, PG&E had a comprehensive program of collaborative research in solar and wind energy, advanced natural gas conversion and energy storage. The program developed the PVUSA solar electricity system research center in Davis, California for purposes of evaluating innovative system solutions. PVUSA also included a strategically sited 500kW commercial project feeding into its distribution system. It was used to evaluate advanced economic models developed by the PG&E research team. PG&E's Modular Generation Test Facility in San Ramon was configured to allow parallel and interconnected operation and simulation of multiple 100kW scale sources, including molten carbonate fuel cells, production diesel engines adapted for efficient, low NOx natural gas conversion, solar PV, battery and superconducting energy storage, and advanced dc-to-ac power conversion components.

Wind research emphasized performance assessment of commercial wind farms in the Altamont Pass as well as collaborative R&D targeting the variable speed turbine technology that has become a standard element of modern wind turbine design. PG&E's effort featured programmatic integration of laboratory and field testing, collaborative commercial product development, and cutting edge assessment and modeling by PG&E R&D staff, and active information exchange with comparable utility R&D centers in Japan and Europe. The program's credibility was enhanced by its capacity for capture and analysis of unique and relevant technical and economic data.

[7] Renewable Energy Secure Communities

Other similar but more focused efforts paralleling and succeeding PG&E's also led to major progress against renewable energy technology goals. For example, sustained and progressive phases of testing at the concentrating solar power (CSP) research and demonstration sites at Almeria (Spain), Daggett (California) and Albuquerque (New Mexico) advanced and validated the technology solutions that are now being applied in several large solar thermal power projects under development in California. The first of these was recently licensed by the California Energy Commission for construction. In each case, there was a close marriage of system, component and materials development with related testing and experimentation. R&D conducted at these test and demonstration sites enabled significant technology progress at modest annual cost.

Consideration of Unmet State Needs:

Over time all major economies will be moving from dependence on 20th Century energy supply to 21st Century energy supply. There are compelling reasons to do so which have been aired in a number of reports and venues. State policy makers are aware that California has all the attributes necessary to be the proving ground for the technologies and market mechanisms necessary to this transformation. A California Renewable Energy Center combining core analytical and testing capacity in support of California market applications plus programs addressing currently unmet needs would likely return its costs ten or a hundred fold in terms of more rapid and cost-effective renewable energy deployment serving California. The current CREC could prepare the way for the new entity by tapping the full spectrum of existing university based renewable research capacity across the state while supporting initiatives to fill gaps and hosting programs complementing those of state agencies.[8]

CREC as envisioned here would be better able than the current CREC to accomplish a particular strategic purpose, i.e. to review and adapt the work of the National Renewable Energy Laboratory for applicability to California needs. For reference in this regard, NREL has a large permanent technical staff with the ability to address the most fundamental aspects of generic technology and market applications of interest across the US. However, while NREL results are broadly instructive and useful, they often fail to address market requirements and/or resource constraints specific to California.[9] By actively collaborating with NREL programs, a more focused and practical deployment-oriented California counterpart could materially enhance the value to California of the multi-billion dollar annual Federal investment in renewable energy. Not only would current efforts in support of California agencies and policy makers be greatly enhanced, but California's interest in capturing competitive awards in renewable energy technology would be served as well.

[8] A separate report is available that analyzes the major renewable energy options to differentiate between topics and questions where California faces similar, different, or unique issues. The report also outlines an organization model that could efficiently engage and develop California's renewable research capacity and fill programmatic gaps. See http://cal-ires.ucdavis.edu/

[9] A separate report is available that analyzes the major renewable energy options in order to differentiate between topics and questions where California faces similar, different, or unique issues. See http://cal-ires.ucdavis.edu/.

There is a fundamentally important reason to consider significantly strengthening CREC. California intends to lead the nation into technically and economically uncharted territory as it increases its renewable electricity production to 33% of state demand and beyond. The prudent, smart investment of hundreds of billions of dollars on behalf of California ratepayers and taxpayers is at stake. The difference between deployment policy that has reference to independent world class assessment, analysis and facilities, and deployment policy that does not, will be measured in billions and tens of billions of dollars of benefit to the California economy.

Current CREC Strategic Planning Outlook:

The strategic plan for a California Renewable Energy Center should account for the long term direction of California's public benefits from renewable energy R&D and the experience and vision of CREC's current leadership. The current strategic plan does so but does not reflect consideration of unmet needs or the experience of the first year of CREC operations. An updated strategic planning outlook should account for following contextual factors:

PIER Renewables Direction: The current direction for the PIER Renewables program has been summarized in recent planning documents[10] as follows:

Focus on three market scales[11]:

- Utility
- Community
- Building

1. Build market connectedness of renewable technologies with grid integration, storage, efficiency, lower costs

2. Research and development to maximize resources, infrastructure, coordination, and collaboration, and advance renewable science and technology

In its planning documents, PIER identifies the following tasks for a "Renewable Energy Research Center":

- Research the technical and economic integration of utility-scale renewable energy technologies to maximize the utilization of transmission lines, for example, assessing the potential for integrating wind with solar and storage technologies.

[10] The PIER Renewables team offers the following perspective on its current direction. "In the past the renewables research area used what we call a "classical" strategy when planning renewable energy research and development activities. We developed budgets and solicitations for specific renewable energy technologies such as solar and wind, with a strong emphasis on technology development. We favored demonstrations that provided operational experience, and an indication of how well the technology performed its reliability, environmental impacts, and costs. This strategy is similar to the way DOE funds projects." Source: Presentation entitled "PIER Renewable Energy and Advanced Generation Research", August 9, 2010, provided by Sandra Fromm, team supervisor.

[11] Scales are intended to apply to electric, fuel and thermal applications of renewable energy

- Technical expertise for solar, wind, biomass, and geothermal.
- Identify market applications.
- Identify research gaps, and research those issues for solar, wind, biomass, and geothermal
- Research related to biomass, solar, wind, and geothermal.

CREC Staff Perspective and Discussion:

CREC staff recently met to brainstorm a possible new mission that would support PIER's direction. Current thinking is summarized as follows:

Mission: Support policies targeting California leadership in high penetration renewable energy deployment.

Strategy: Balanced, flexible, stable and maturing capacity responsive to state agencies and emphasizing collaboration with California industry.[12]

Full transformation of California's energy markets to a renewable energy base will likely require decades. Therefore, CREC's best role will be to envision scenarios for high penetration deployment and use these scenarios to plan the work that forms a science and technology bridge to California's renewable energy future. Key concepts include:

- Balance (e.g. between experimental, theoretical and analytical work)
- Flexibility (e.g. test facilities and "living laboratories" that can evaluate incremental improvements of initial test objects and applications)
- Stability (e.g. commitment of long term institutional support enabling focus on the mission instead of fund raising)
- Maturation (e.g. expansion of capacity through staff development, strengthening of support functions, and expanding core technical teams by adding and selectively filling full time positions. Being responsive to state agencies and collaborating with California industry requires the ability to simplify complex subjects while doing good science.)

Key Success Factor #1: Focus on science and technology solutions for California

Some questions awaiting answers may serve to illustrate the ways in which California science and technology solutions may be differentiated from generic solutions applicable across the US or globally:

- What will be the optimum mix of renewable and storage resources at different penetration levels? How will California's mix differ?
- What will be the mix of utility, community and building scale energy supply at different penetration levels? How will California's mix differ?

[12] Many innovative and entrepreneurial renewable energy companies are getting their start in California but move elsewhere as they scale up commercial operations. It is possible that CREC could provide analysis and leadership toward development and implementation of strategies that effectively address this problem, which will need attention by all levels of government and cuts across all major renewable energy market segments. This is one of many unmet needs that are covered in a separate report.

- In the longer term, how will heating and cooling energy be delivered in a state with moderate heating and cooling requirements, and specifically will there be increasing application of hybrid renewable and natural gas systems to compete economically with electric only systems?
- What new information, solutions and policies will be required for geothermal resources to effectively complement wind and solar resources at high penetration levels?
- In the context of a state energy usage profile emphasizing transportation, will bioenergy resources primarily displace natural gas, electricity or transportation fuels?[13]
- What is the best approach to net zero energy and/or emissions goals[14], e.g. net zero buildings, net zero neighborhoods, net zero communities or virtual power plants comprising local and interconnected resources?
- How will smart grid and plug-in vehicle deployment affect application opportunities for energy storage? Will California energy storage capacity be primarily load-coupled (e.g. cold storage for commercial buildings), supply-coupled (e.g. high temperature thermal storage in CSP plants, delivery-coupled (e.g. pumped hydro or compressed air storage) or transportation-coupled (e.g. plug-in or electric vehicle dual use)?

The answers to these and many other questions will shape the California renewable energy market.[15] Technology and application diversity will continue to expand in the global market, and renewable energy will be integrated according to local and regional particulars rather than national plans.

Key Success Factor #2: Integrate vertically, horizontally and virtually

As noted earlier, historical success models emphasized what is often referred to as "engineering research" that tends to involve less emphasis on disciplinary research, and more emphasis on early stage product R&D or diagnostic and evaluative testing that cannot be justified in the private sector because it does not build corporate competitive advantage. CREC should aim to integrate vertically across these main levels of R&D, all of which will be important in the context of an active market and mature industries.

[13] Currently, biofuels will likely be required in order to satisfy the emissions reduction associated with California's Low Carbon Fuel Standard. This might change if the car fleet electrifies, but some biomass may be involved. Source: Steve Kaffka and Bryan Jenkins

[14] Net zero is a term used to characterize systems in which the external energy inputs to a system, e.g. a building or a community or emissions generated within a system are either zero or are exactly off-set by energy exported from the system or arrangements to off-set the systems emissions by avoiding emissions elsewhere.

[15] It is beyond the scope of this report to comment on the appropriate breadth or priorities of a future CREC long term plan or research agenda. A number of models are available, and in any event, a stakeholder advisory process that builds on the advisory processes of existing collaboratives will be essential. Incremental additions to the current research programs of the individual collaboratives are a desirable next step. It is likely that the main CREC research thrusts will be aligned with state policy objectives, with some allowance for initiatives that anticipate problems and solutions attending higher than currently targeted renewable energy penetration in California's energy markets. (Thanks to Henry Shiu, California Wind Energy Collaborative, for raising the question of how to scope a broader and still California-relevant research program than is currently feasible.)

Meanwhile, horizontal integration will also be necessary as systems emerge that integrate more diverse supply, smarter delivery and more interactive uses of energy. The introduction and expansion of intelligent infrastructure at building and community levels will require R&D attention to more diverse applications of both mature and emerging conversion technologies and enabling technologies.[16]

Unlike the US national renewable energy center, NREL, California's renewable energy center will necessarily be a virtual organization to the extent that staff expertise will be distributed according to locations where specialized facilities exist and can be economically supported on a long term basis. For example, at UC Davis the opportunity will exist for community scale integration research in the context of the West Village net zero community, but some research topics in this category will best be addressed at other campuses having infrastructure and leadership supporting long term RESCO programs, e.g. UC Merced, UC Santa Barbara, UC Irvine, UC San Diego and Sacramento State.

Likewise, UC Davis has wind tunnel facilities that support research on aerodynamic design and modeling issues, while UC San Diego and UC Merced have capacity for solar radiation measurements and related analysis. Early stage solar photovoltaics research is distributed among several campuses, with UC Davis, for example, specializing in devices involving organic solar cell materials. Similarly, UC Davis has a pilot plant supporting research in digester based biogas generation using anaerobic digestion, while UC San Diego and UC Davis are working together on a joint pilot plant project addressing thermochemical biogas generation.

An important step in scoping a California renewable energy center will be to assess the topics uniquely important to California that will justify the maintenance or development of permanent facilities. An inventory of existing capacities related to these topics will be necessary to determine the balance between efforts best conducted in a physical center and those that would be better located in satellite centers that co-located with R&D infrastructure and/or demonstration projects.

Key Success Factor #3: Leverage Federal programs and funding

Certain renewable energy topics will require attention in California before they emerge as major issues for the US as a whole. Nevertheless, it is likely that any results generated by CREC with California funding will be of value to the overall US renewable energy deployment program. A significant portion of overall PIER funding flows to NREL for work that California institutions currently lack capacity to undertake. As CREC capacity expands and fragmentary efforts are brought into an integrated planning and execution framework, it may be possible for CREC to address some of the needs now being addressed for California by NREL. In any event it seems

[16] Further, there are some important differences between the RE resources that currently are used mainly to produce electricity and heat (solar, wind, geothermal) and biomass, which also is increasingly being used to for fuel production. One difference is that the landscape footprint of biomass is much greater and usually much more diverse in its effects. Another is that the menu of bio-products is more diverse, e.g. it includes feedstock chemicals and an array of other co-products. These differences result in a need for integrated assessment and net benefit analysis not just including bioenergy but within bioenergy. Source: Steve Kaffka

a reasonable goal for CREC's Federal funding to be at least comparable to California's funding of NREL.

Discussion:

Baseline Vision: According to this vision as it evolved, CREC was to serve as the PIER Renewables program's primary science and technology partner while in parallel competing for funding available from other sources for related work. Based on first year experience, it appears that the CREC overhead structure does not suffice to support other than opportunistic participation on proposal teams led by other organizations. Such opportunistic participation can help stabilize operations through sponsor diversification, but it is not clear that it will strengthen and focus CREC's overall efforts on the highest priority unmet state needs.

Success Models: The renewable energy R&D success models outlined above have features that could render CREC's efforts more effective in support of California's renewable energy deployment goals. The NREL technical assistance model is directly relevant and could be immediately applied in support of PIER's on-going RESCO agreements. The CSI R&D model bears examination to determine if it could somehow be adapted to the front end of PIER's competitive RD&D sourcing process. Historical models also provide some guidance, even though for the most part they were focused on creating options rather than supporting their active deployment. Specifically, co-locating analysis and testing capabilities worked well, and sustained efforts by dedicated teams over one or more decades were necessary to deliver significant technology improvement and adaptation.

Development Metrics: The baseline vision did fit the circumstances at the time CREC was proposed. However, circumstances continue to evolve. If the baseline vision is to be pursued successfully, adjustments will be required on both sides of the PIER/CREC relationship. Discussion of the development metrics identified in Appendix A would be the best place to start a bi-lateral discussion of needed adjustments and selection of metrics to match mutually agreed interim and final visions. An important consideration will be what level of program integration the institutional capacities on both sides can support. Without consistent metrics and capacity, accountability will be incomplete. Once development metrics are prioritized and agreed, quarterly reports and reviews can include assessments of progress against them.

Unmet State Needs: A compelling case exists for creating a California renewable energy center whose work complements and leverages that of the National Renewable Energy Laboratory. At this time CREC is a virtual organization that could be dismantled as readily as it was created. It has attracted outstanding staff and leadership but perceived instability in funding support hinders further development. As renewable penetration increases, California will need a permanent renewable science and technology organization that has full time staff and is able to support state agencies and utilities. California's aggregate annual investment in renewable energy R&D by venture capital funds, utilities, the USDOE, and private sector companies easily exceeds $1B. There is much that a more robust and stable organization could do to enhance this investment's benefit to the California economy. Just bringing California's renewable research communities together for discussion of research results and

common issues and problems would be a major contribution in itself. It is questionable whether PIER staff can play this role while also carrying a heavy contract management work load.

Preliminary Planning Guidance: In its competitive development and demonstration awards, the PIER Renewables program is emphasizing technical solutions enabling integrated deployment at three scales of market application (i.e. utility, community and building). PIER expects CREC to maintain technical expertise, identify market applications and conduct research related to biomass, solar, wind and geothermal, and also to "research technical and economic integration of utility-scale renewable energy technologies."[17] CREC's current PIER-funded work scope is for the most part consistent with this expectation. However, funding for technical and economic integration efforts is relatively limited, and proposed amendments do not address integration.

This report, along with companion documents mentioned in its footnotes, is intended to serve as an introduction to discussion between CREC and PIER regarding scenarios for CREC's further development and future role in support of California renewable energy deployment. There is an emerging consensus within CREC regarding the need for changes in CREC's mission, strategy and scope operations.

Conclusions and Recommendations:

1. CREC should develop scoping and strategic implementation options for a California state level research center or laboratory with a permanent California renewable energy mission. The effort to evaluate options should have visibility to and direction from an advisory board with senior level representation from state agencies, utilities, industry and academia as well as California-based federal laboratories and perhaps also NREL.

2. CREC's current and interim mission should be clarified so that future funding requests to PIER can be evaluated according to how well they support it. In general terms, the primary mission should continue to be research, modeling and assessment support for California's renewable energy deployment programs. A collateral and complementary mission should be to promote technology transfer and accomplish peer review of the diverse and inter-related elements of California's renewable energy research portfolio.

3. Appropriate application of the development metrics in the Appendix depends on development stage and resourcing. The metrics reflect desirable aspirations but also imply the feasibility of outcomes that may not be attainable under current or foreseeable circumstances. They should be applied with care, with due reference to the resources available to effect improvements.

[17] Source: Scope of Work, California Renewable Energy Collaborative, Contract 500-08-017, California Energy Commission, Sacramento, California, March, 2009

Appendix A: Development Metrics Menu

Introduction:

The essential attributes of a valid vision for CREC are that it be both feasible and sustainable. The list of candidate development metrics below includes strategic and tactical measures of feasibility. Only a few metrics on the menu below apply under current circumstances. Other metrics will be applicable at increased funding and staffing levels. Most if not all will be applicable when the vision of a fully capable and effective California Renewable Energy Center is fulfilled. Progress toward this vision will necessarily be achieved in stages. Funding required for full implementation of the vision is well beyond current levels and even beyond levels that PIER could support without major impacts on other programs, so it will be important to focus on metrics for the next stage. Once the next stage is defined it will be important for PIER and CREC to achieve consensus regarding near term metrics and their relative priority.

Discussion:

The development metrics listed below should be viewed as reflecting aspirations having a wide range of plausibility and feasibility. In many cases they imply the feasibility of outcomes that may not be attainable under current or foreseeable circumstances. For example:

- Stable CREC operations are strongly dependent on stable staffing and leadership of programs on which CREC depends for funding support.
- If these programs continue to rely on private support contractors to meet analytical needs CREC aspires to address, then CREC's capacity to address such needs will not develop. Specifically, the capacity to conduct credible economic assessments would require capacity CREC does not currently bring into play, so opportunities for improvement on currently used methodologies will likely be limited.
- CREC centers currently have some capacity to respond to unplanned inquiries and requests. Responding to more requests in more depth would be feasible but would depend on capacity developed for other purposes.

List of Candidate Development Metrics:

- Stable Funding: Either through diversification of clients or negotiation with primary sponsor, there is a high probability of long term funding of core efforts

- Strategic Plan: There is a plan to realize the organizational vision to which CREC aspires. It is updated regularly based on progress against organizational development metrics

- Seed Funding: Start-up funding is available to launch new programs or initiatives.

- Budget Discretion: A portion of CREC's budget is available to support unforeseen needs or respond to unforeseen opportunities, e.g. development of proposals to expand or diversify the funding base

- Robust Research Agenda: Rapid development of a research agenda that provides a solid foundation in technical, market and economic analysis for major PIER Renewables development and demonstration programs

- Robust Analytical Capacity: Capacity and/or demonstrated access to capacity to address market, economic, environmental as well as technology and engineering issues related to accelerated RE deployment in California in the most efficient, timely and credible manner

- Leadership Attention Level: Rapid transition to full time direction of major research tasks, e.g. 2.0, 3.0, etc. and dedicated leadership of CREC.

- Collaborative Research Emphasis: Rapid transition to a "collaborative" research format or template, involving co-sponsorship, and co-funding of most or all research tasks by non-PIER public and private sector stakeholders

- Programmatic Alignment with PIER: Rapid transition to greater emphasis on RE integration in support of PIER RE's new programs, i.e. Utility Scale RE, RE Secure Communities, and RE Secure Buildings, and facilitation of integration research.

- Programmatic Partnership with PIER: Increased two way technical and advisory communications with PIER Renewables Team and PIER Leadership

- Visibility to External Decision-makers: CREC, through its advisory board, has the attention and support of decision-makers in sponsoring organizations or organizations having influence on sponsoring organizations

- Access to Research Capacity: Implementing UC institutions (currently UC Davis and UC San Diego), have specific and readily identifiable research capacity applicable to sponsor needs and interests.

- Visibility to Research Communities: All CREC units have an on campus presence and routinely and conveniently interact with UC faculty and students engaged in renewable energy research.

- Institutional Visibility and Support: Implementing institution senior leadership receives regular briefings on CREC and gives priority attention CREC's needs for work space and administrative, human resources and contracting support.

- CREC Coordinated Outreach: CREC enhances the outreach efforts of its units through its website and sponsored events.

- External Coordination: CREC is recognized widely and state-wide as a hub of renewable energy information, coordination and assistance.

- Internal Coordination: CREC leadership works as a team and meets regularly to ensure policy and strategy consistency.

- Dedicated Technical Resources: Each CREC unit has full time technical leadership and/or staff

- Competitive Awards: CREC has demonstrated experience and capacity to respond successfully to competitive solicitations in its areas of subject matter expertise.

- Cross-cutting Capacity: CREC has the capacity to administer and execute projects that cut across technical areas.

- Renewable Energy Integration: CREC renewable energy integration research addresses critical renewable energy deployment questions and issues.

- Collaboratives: Transition to sustained programs or centers of excellence in renewable energy technology and resources with continued exemplary contributions, including research, outreach and coordination.

- New Units: Expanding successful engagement with stakeholders and increasing contributions, including research, outreach and coordination.

- Adequate and Responsive Shared Services: Capacity for contract administration, budgeting, web-site development and maintenance, event and meeting planning and scheduling and other administrative functions.

- Administration: CREC provides administrative hub for coordination among CREC units and communications with PIER

- Management and Contracting: CREC has capacity to professionally manage programs and projects