CTOFORUM
ENERGY COUNCIL

MODELING CALIFORNIA CARBON TRUST

Challenges and Opportunities

May 11, 2010 • Davis, CA

Acknowledgements

The CTO Forum thanks the following people, who generously gave the CTO Forum their time, insight, and leadership to help transform the California Carbon Trust. Their input forms the basis of this report.

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Summarized in chapters one through four

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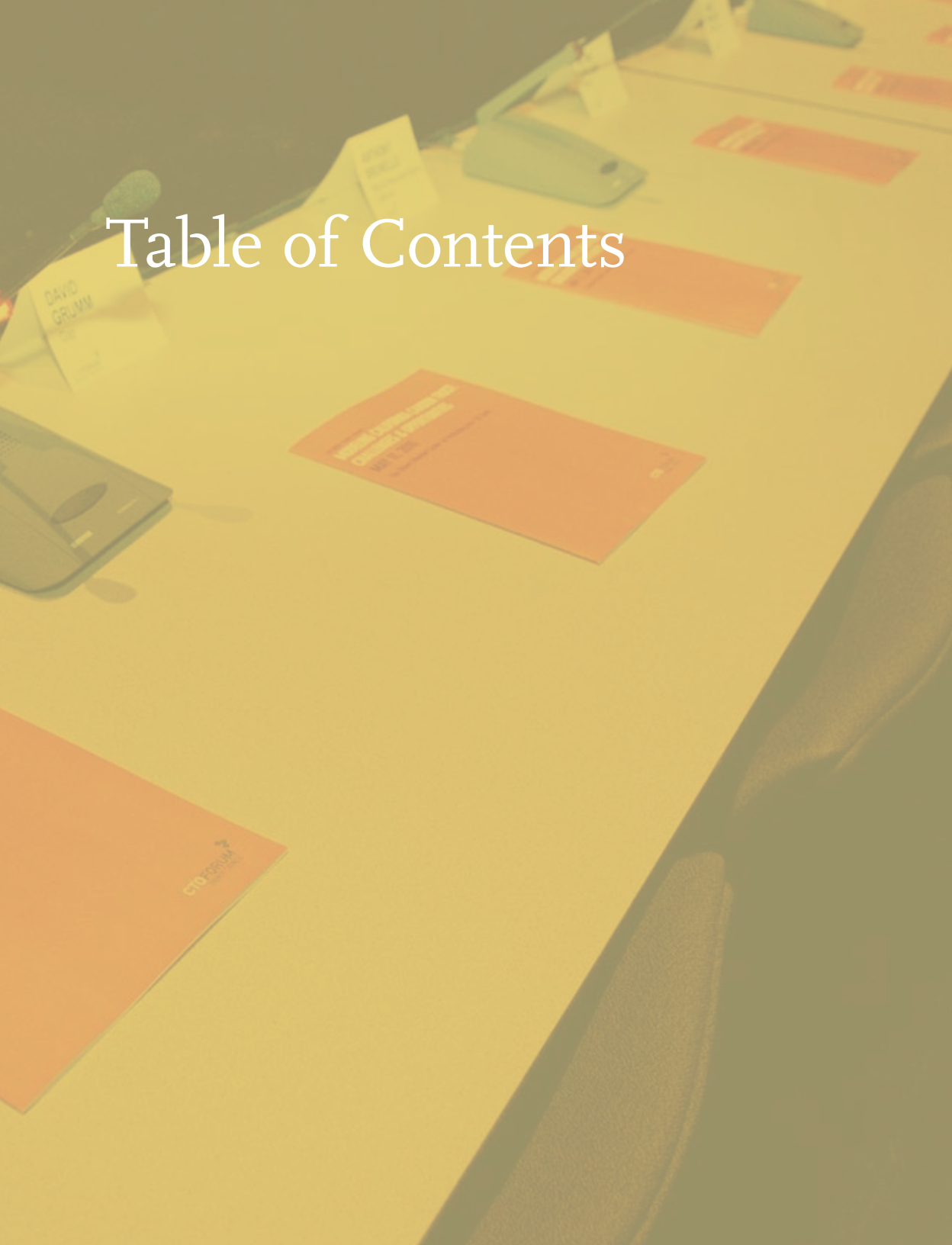


If ever an industry were in need of innovation, healthcare is it.

The U.S. alone spends $2.2 trillion annually on healthcare, or $8,000 per person, representing 16% of the U.S. gross domestic product. Healthcare consumes some of the world's most advanced technology for diagnosis and treatment, and yet uses the lowest level of information technology (IT) of any information-based business in the U.S. One effect is that unlike banks, for instance, healthcare providers currently cannot transfer information reliably from one stakeholder to another—even though healthcare information is arguably the most critical information we own.

In April 2010, leaders from healthcare provider organizations, payers, IT vendors, and academia came together through the CTO Forum to explore healthcare transformation through innovative business and financing models and advanced technology.

Regarding business models, speakers and panelists brainstormed ways to better align incentives for providers, payers, employers, and consumers. Moving from a fee-for-service to a pay-for-performance model could encourage providers to implement technologies and processes that shift healthcare model from treating acutely sick patients (as many as possible) to preventing sickness and promoting wellness. The need has become more urgent in the 21st century because today's global pandemics are diabetes, dementia, and depression. All are influenced by behavior, and none are suited for cost-effective treatment in capital-intensive "sick-care" systems staffed by expensive and scarce professionals.

Regarding the role of IT in healthcare reform, a theme that repeatedly surfaced during the forum is that the electronic medical record (EMR) is an essential building block for healthcare reform—but not the end goal. The real benefits arise from intelligent applications of the EMR, including:

- Aggregation, leading to better clinical pathways of care
- Enabling electronic payment, eliminating $500 billion in annual healthcare costs for manual payment processing
- Event-based EMRs, or recognizing telemetry data collected over the Internet (such as an out-of-range heart rate) and then automatically taking an associated action, such as notifying a designated person
- Maximizing the value of the EMR will require standards for semantics, and web-based tools for patients to give consent for their records to be shared.

Participants in the forum also discussed the cultural issues impeding healthcare reform. In particular, today's consumers are unable to vote with their wallet because the industry has not provided an easy way to identify the best providers and compare the cost of care. And even if consumers can compare the cost of care, they are insulated from the decision because the employer or payer bears the cost. IT cannot solve the cultural issues. However, IT can help to create expert systems to determine how to use resources effectively, matching the cost of the resource to the need.

The barriers to true healthcare reform—a shortage of people and increased demand—are the same barriers that technology has solved repeatedly in other industries

Therefore, IT can play a valuable role by helping to increase productivity, improve the quality of records and transactions, and provide systems to rapidly and accurately transfer critical information between stakeholders. Examples of IT innovations include telemedicine and cloud services for sharing medical images.

This white paper summarizes the discussion and recommendations of the speakers, panelists, and forum participants. It is hoped that this report can serve as the springboard for innovation to improve healthcare access, quality, and costs.

Sincerely,

Basheer Janjua
Founding Chair and President,
CTO Forum

Low Carbon Energy Technology and the Innovation Process

Innovation, as used in this discussion, is the process of bringing identified new technology into commercial practice. That process is recognized to involve a number of "stages" each of which is characterized by specific activities, risks, and costs4.). Innovation in many familiar sectors, such as personal computers, appliances, and even vehicles, is generally understood to be market driven and characterized by new functionality visible to the consumer. Low carbon energy technology, using California as an example, is typically policy or societal driven and, in general, the benefits will be transparent to the consumer. Without a strong market pull, suppliers of low carbon energy technology face heightened risk of market failure

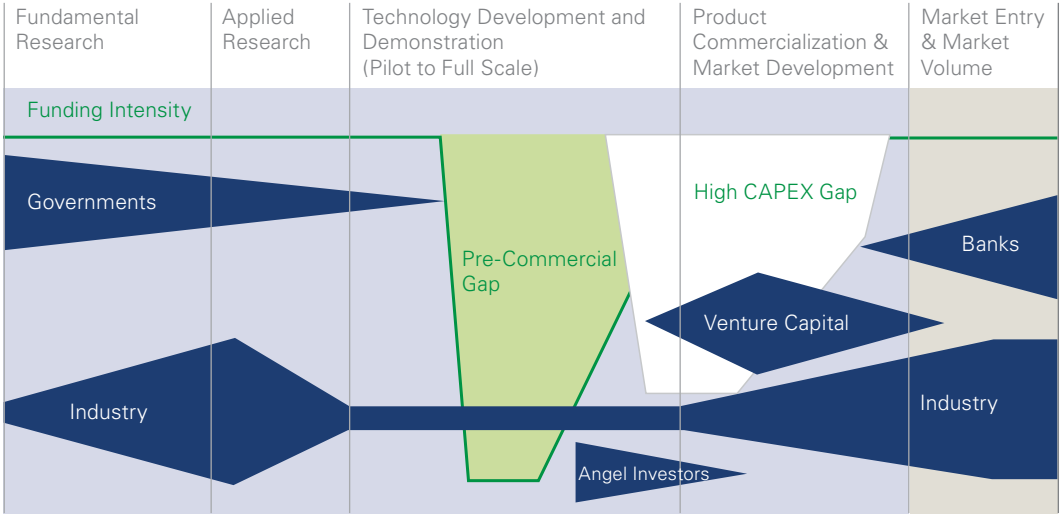


Figure 1. Modified from Sustainable Technology Development Canada presentation: Kolada, D.H., "A California Carbon Trust: Models, Opportunities and Challenges", CTO Forum Technical Council Meeting

Low carbon energy technologies have been a focus of government supported R&D for several decades. This support has been essential since the dominant business models in the energy industry do not heavily support R&D directed at alternatives. In general, industry R&D focuses on approaches to increase the efficiency of generating and distributing in support of existing energy services . Moreover, there is little work done on consumer behavior, other than trying to understand current motivators. This leaves plenty of space for innovation targeted at changing consumer behavior.

Unfortunately innovation of low carbon energy technologies frequently entails a significant increase in cost and risk at the stage where government funding is not traditionally available because of a focus on basic and early applied research support, and industry funding is scarce because of high risk and costs (Figure 1).

Risks at this critical stage include technical and market uncertainties which in the case of low carbon innovations may be exacerbated by considerations such as cost effectiveness, infrastructure compatibility or replacement, consumer acceptance and regulatory and permitting barriers. These uncertainties result in a gap in funding identified above as the "Pre-Commercial Gap". Beyond this stage there may also be significant funding challenges that arise because of the size of capital expenditures (Capex) required to commercialize and develop markets for low carbon technologies, for example in the transportation and power generation sectors. This gap is illustrated as the "High Capex Gap". However, it may not be a critical consideration for all low carbon energy technologies.

Public – private funding initiatives such as the UK Carbon Trust (UKCT) and Sustainable Development Technology Canada (SDTC) are designed to mitigate risk at these critical points in the innovation process. This may involve leveraged funding that encourages private investment; expert advice, particularly with respect to "critical path" items; "incubator" support; and specific activities designed to facilitate accelerated testing of technologies and business models.

Innovation Timeframes

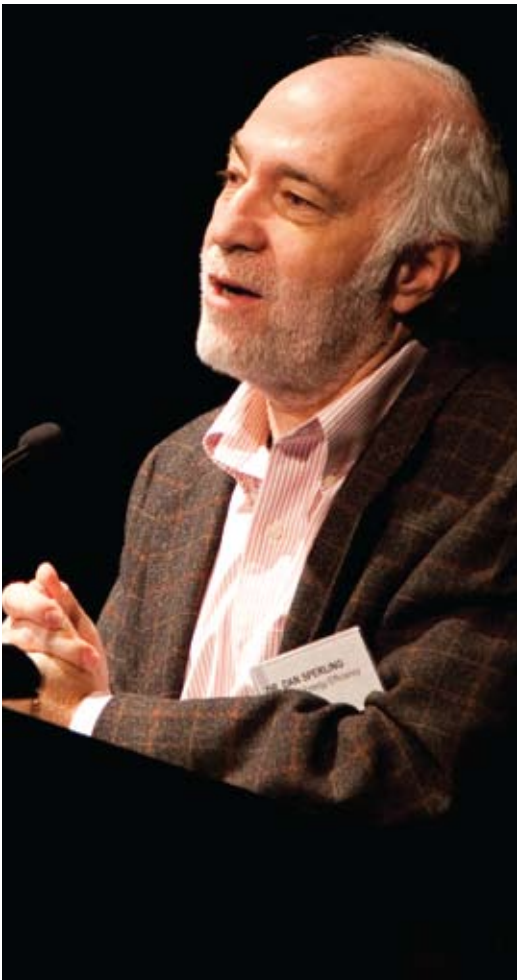
Depending on the characteristics of specific innovations, market penetration and movement through the process stages may involve a wide range of timeframes. Typically, innovations in the energy sector involving infrastructure development, modification, or substitution can involve very long times from applied research to significant market penetration, as much as 30 years. An example is the development and introduction of hybrid vehicle technology which began with applied research and engineering in the early 1990's, with market introductions in Japan in 1997, and has achieved about a 2.5% penetration of the total light duty vehicle market in the US in 2010. While generally considered successful, the impact of this technology on transport sector carbon emissions is still negligible because of low penetration and the slow rate of turnover of light duty vehicles.

Long timeframes can mean substantial market risk, and this may be exacerbated by increased political risk associated with policy shifts within the government. The impact of such a shift in the transportation sector is exemplified by the Partnership for a New Generation of Vehicles, a Clinton administration initiative terminated early in the first years of the Bush administration, and the FreedomCar and Vehicle Technologies program, a Bush administration initiative, substantially modified in the early days of the Obama administration. Irrespective of the relative merits of these attempts at government intervention in the innovation process, a lack of policy continuity over the extended period needed for innovation in this complex area led to disruptions in a number of industry sectors and investment losses. This type of uncertainty discourages investor risk taking as well as entrepreneurial activity.

Innovation Ecology

Innovations occur within a defined market opportunity space. That space will be characterized by certain attributes accumulated over time: connectivity to other markets; distribution channels; price / value hierarchies; consumer assumptions, familiarity and preferences; standards and regulatory constraints; competitive suppliers and their associated supporting institutions (for example, manufacturing sub-contractors; distributors; installation, maintenance and repair services; training and educational resources).

Effective entry of new participants will depend on the complexity of the relationship between these elements in this "ecological" setting. High barriers to entry will develop where embedded patterns exist between suppliers, customers and regulators. For example the energy technology and utility incumbents hold most, but not all of the critical assets: intellectual property, "locked-in" infrastructure, regular revenue streams with relatively cheap, amortised capital assets. Disruption of these patterns can significantly reduce entry barriers and provide a basis for the creation of an entirely new ecological setting. In clean energy governments can "tilt the table" to encourage technology development and innovation.

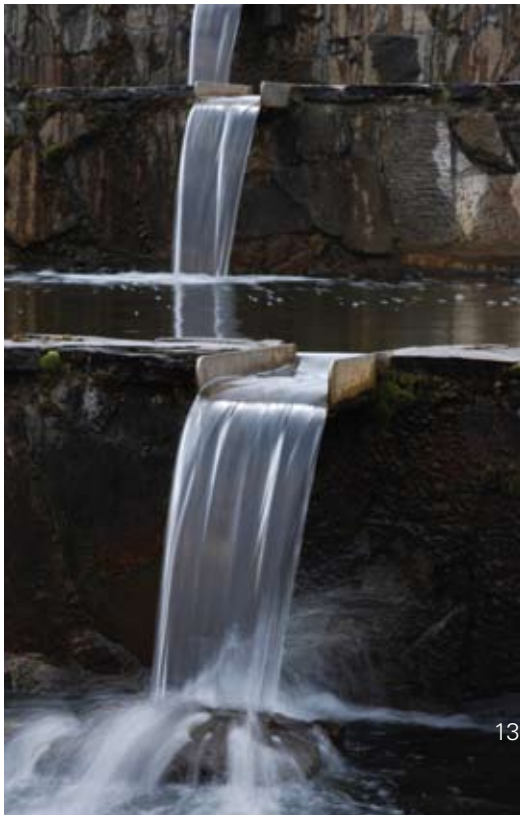


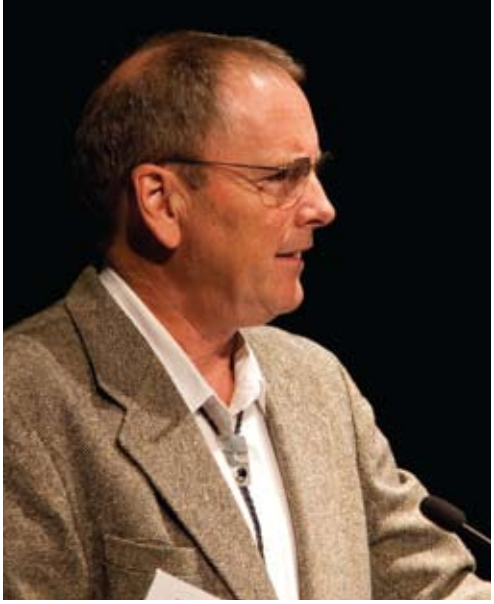
However, they may not be clear about the most effective mechanisms for impacting investment and the market, and may frequently underestimate the amount of time required to transform the innovation ecology.

Digital devices, handheld media, and the internet provide ready examples of "disruptive" technologies. While it may be the case that many of these disruptions were successful because they involved a relatively low initial investment of capital, their critical defining characteristic was the substantial change in functionality that they provided to the consumers of the goods or services. It is not necessarily the case that such disruptions are attended by lower costs, at least initially[6].

In cases where innovations provide only enhancements to expected functionality the barriers to entry may be much higher as the targeted consumers may not perceive a sufficiently compelling difference in "value to cost" to justify the assumption of the additional risk associated with innovation adoption. Marketers recognize this and it is the foundation of marketing tools such as "money back guarantees", extended warranties, free trials, and "introductory offers".

Energy services are all of those capabilities provided to consumers by energy providers, for example, industrial and residential heat and light, motor vehicle transportation, telecommunications, and so forth. They represent a family of "opportunity spaces"





The Energy Services Ecology

Energy services are all of those capabilities provided to consumers by energy providers, for example, industrial and residential heat and light, motor vehicle transportation, telecommunications, and so forth. They represent a family of "opportunity spaces" generally characterized by functionalities that are highly embedded in the behavior and decision making patterns of the service providers, consumers and regulators. The actions and decisions of these three groups are the major determinants of the Energy Services Ecology . In addition, energy service delivery mechanisms and infrastructure are typically highly evolved to provide high perceived "value to cost". In fact, it is the unappreciated value and cost components of energy services which result in pricing which ignores what are referred to as "externalities", including carbon emissions.

Changes in the perception of externalities by suppliers, consumers or regulators can provide a basis for redefining value / cost relationships and such a redefinition can lead to the creation of new innovation opportunities. In the early stages of such a redefinition however considerable risk accrues because of the large scale, slow pace, and global impact coupled with uncertainty about the detailed characteristics of the new ecological components.

For Example

What are the standards by which new functional capability will be measured?

What is the appropriate level of regulatory and policy intervention needed to encourage full valuing of what were previously externalities?

What is the appropriate level of regulatory and policy intervention to incentivize the development and deployment of required new technology? Can that intervention be relied upon for constancy?

What is the probability that a given technological innovation will, in fact, provide new functionality?

What is the likelihood that the technology can be deployed at a scale sufficient to address the externality? Over what period of time?

What changes in consumer behavior will be required for effective deployment of the new technology?

What "forcing functions" might be needed, if any?

What will be the response of existing market participants? What level of competition is expected in the new market space?

This list could certainly be extended, and it represents the sort of questions that need to be addressed by the key participants: government, industry, innovators and consumers. Investors in all of these groups require some answers to these questions in order to assess risk, opportunity, and required actions and decisions.

Specific Challenges for a California Carbon Trust Model

Specific challenges can be identified in California that arising from the factors governing the economic and political landscape in the state.

Legislative Assembly Bill 32 (AB32)
Passage of AB32 and an Executive Order committed California to a reduction in greenhouse gas (GHG) emissions to 1990 levels by 2020 and to 80% below 1990 levels by 2050. These goals represent a significant incentive for innovation but also a significant challenge in assessing the impact of a given innovation.

Regulatory

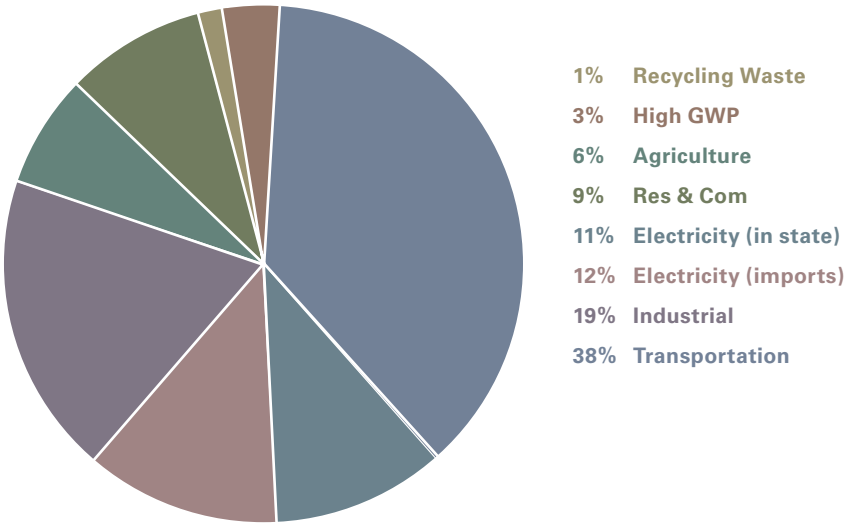
Much of the existing regulatory framework was not created with the complexities of the required transformation in energy supply and use in mind. For small and medium sized employers (SMEs) and entrepreneurs, this can lead to situations where it is practically impossible to execute the necessary demonstrations and market development in a timely and economic fashion. For example, permitting requirements for a demonstration system may involve monetary and time expenditures beyond the capacity of the entrepreneur or small business. There are initiatives underway to try and improve agency coordination, and regulatory reform and consolidation, as well as permitting reform are critical for the success of any attempt to improve innovation outcomes.

"...What you can safely say about the regulatory environment is the cautionary principle: make sure no project goes too fast and make sure there are no critical mistakes within it."

Bob Epstein, Vice-chair, Economic and Technology Advancement Advisory Committee

Sectoral Contributions to Emissions

CARB has identified the contributions to carbon emissions by sector, based on averages for 2000 - 2008 data[7]:

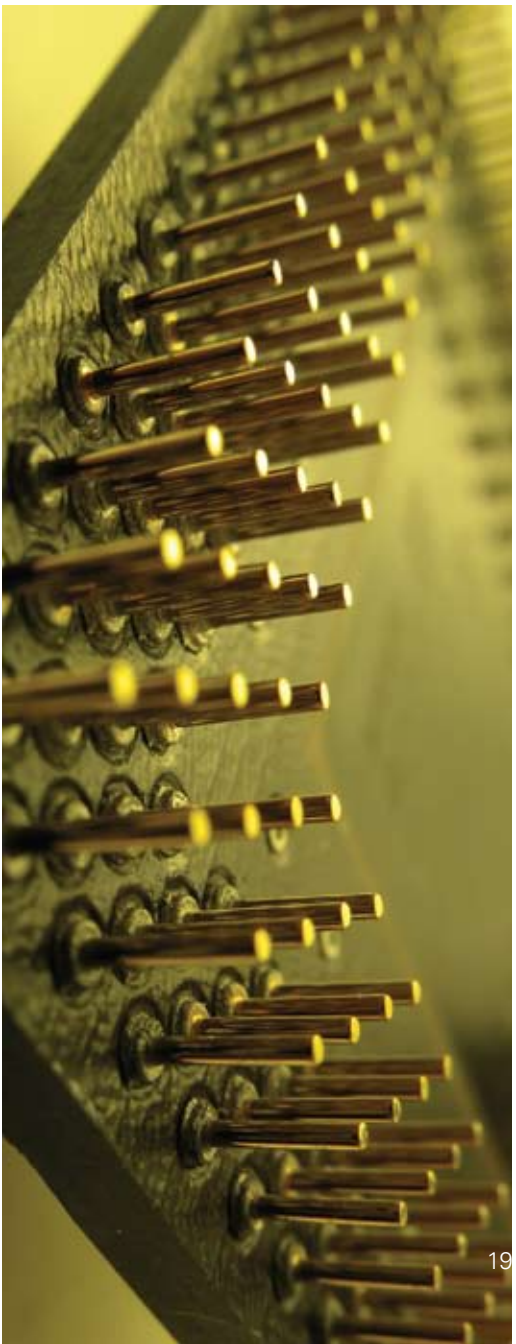


Because of the relatively small amount of coal fired electrical generation in the state[8],(and not because California is not more transport intensive—California ranks well below average for US in VMT/capita), the proportion of carbon emissions associated with transportation is significantly larger than if would be for the U.S. as a whole. For US, the emissions are 33% transportation, 41% electric generation, 26% all other[9].

This represents a major challenge as this sector is characterized by a high degree of distributed use, a variety of sub-sectors with substantially different use patterns (light duty personal vehicles; light, medium and heavy duty freight; rail; air; and marine), and a substantial embedded infrastructure, including roads, fuel supply and vehicle supply. It also directly or indirectly impacts a significant portion of California's economic activity. As a result it is

the target for intensive regulatory and policy activity: low carbon fuel standards, vehicle efficiency standards, land use reform, urban and suburban development planning, enhanced public transportation, and alternative fuel and vehicle infrastructure. Despite these initiatives, significant alteration of individual consumer choice and behavior will be required in order to reduce significantly carbon emissions in this sector. Aggressively pursuing the collection of opportunities related to behaviorally driven "demand" is critical because the rate of diffusion of new vehicle and fuel technology is relatively slow given the size of the vehicle fleet. California had almost 33 million light and heavy duty vehicles in 2007[10].

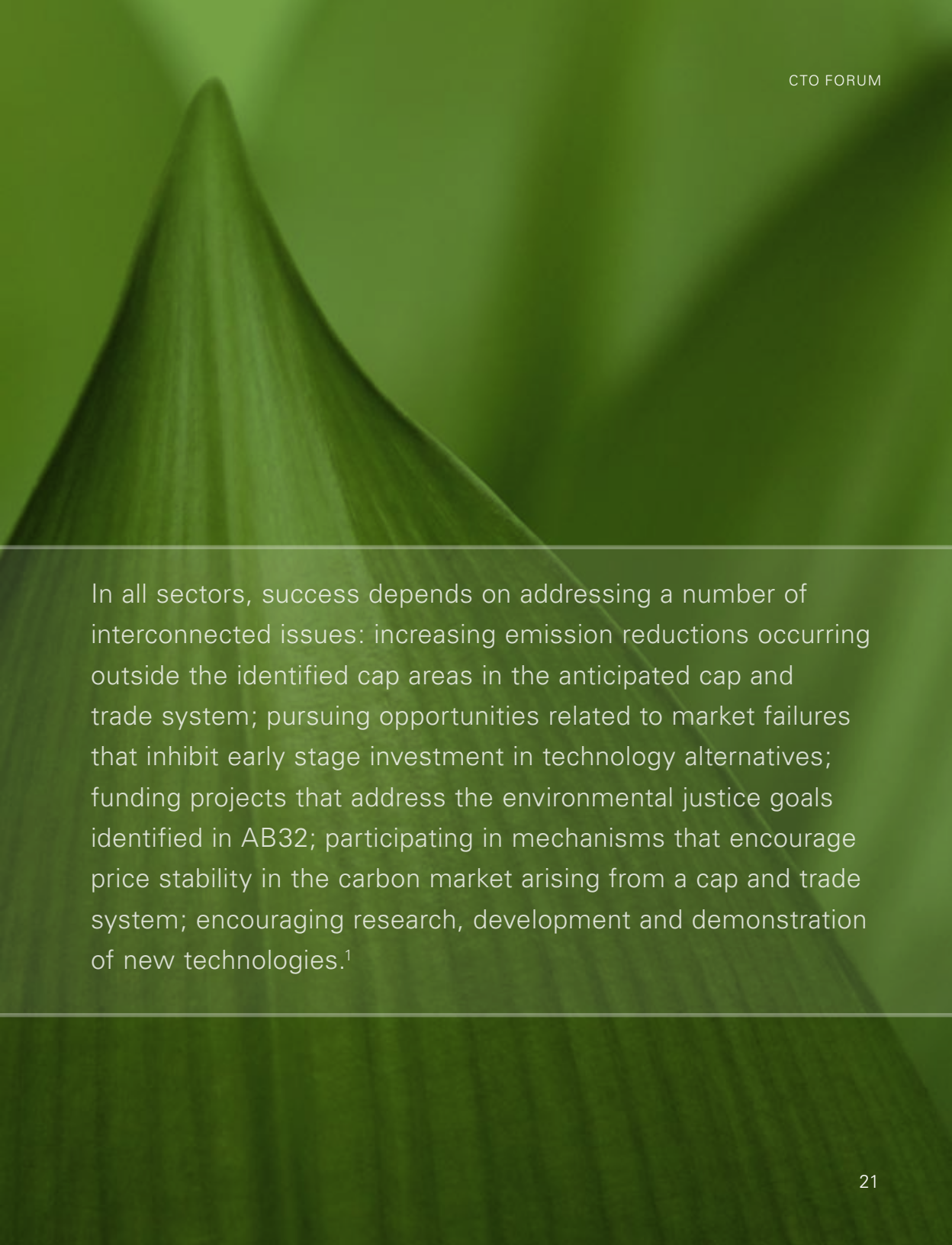
Turning over a significant part of this fleet will require decades at the current rates of replacement. Therefore, changing the use patterns of this fleet is a critical part of a transportation energy strategy. This concept is implicit in recent legislation, SB 375, which sets up a process by which local governments employ land use planning, pricing, and public transport to reduce driving and emissions. One of the motivations for this bill, and the policies emerging from it, is the recognition that communities can be better balance jobs and housing and reduce vehicle miles traveled (VMT).



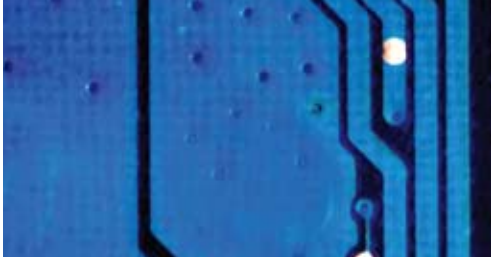
Technology innovations will also be critical to providing the impetus for these use changes, and many of these potential technologies are still in the front end of the innovation process pipeline. These might include:
Better land management and better public transportation. But the public transportation sector has seen almost no innovation on a systems level. Mass public transit only accounts for 2% of passenger miles traveled in the U.S. and it is about the same in California. Use of information technologies in the transportation sector to create more efficient mobility services, including demand responsive transit, smart car sharing, dynamic ride sharing (e.g. smart carpooling), and linkage of neighborhood cars with conventional transit and other mobility services.

As Dan Sperling pointed out in his opening remarks,

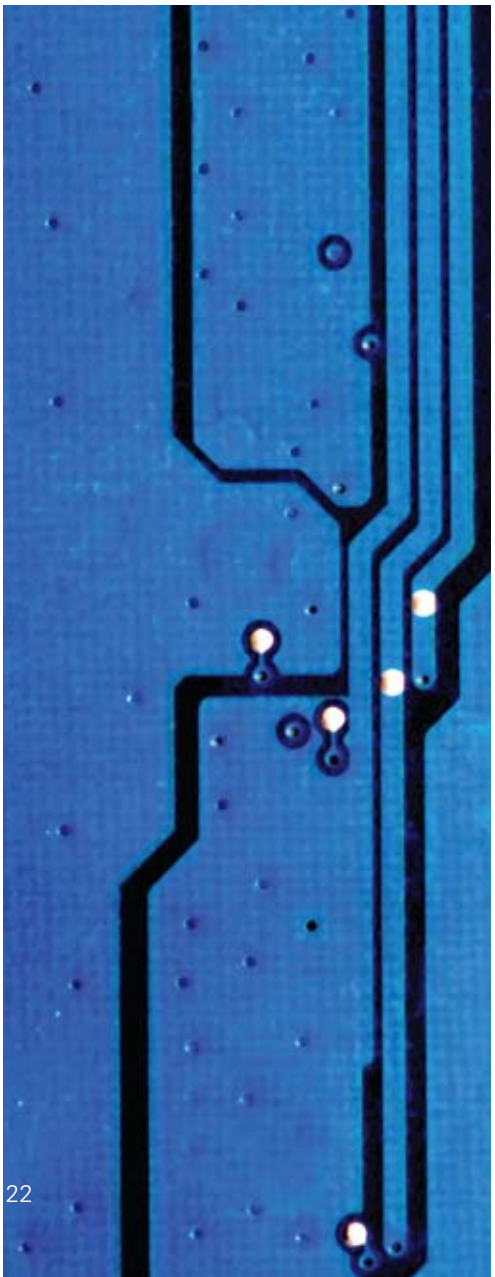
"...Almost none of this is happening and this is one of the more difficult challenges that we face because of all kinds of institutional and public finance barriers. All of which create a tough market for venture capital or new start-up companies to compete with."



In all sectors, success depends on addressing a number of interconnected issues: increasing emission reductions occurring outside the identified cap areas in the anticipated cap and trade system; pursuing opportunities related to market failures that inhibit early stage investment in technology alternatives; funding projects that address the environmental justice goals identified in AB32; participating in mechanisms that encourage price stability in the carbon market arising from a cap and trade system; encouraging research, development and demonstration of new technologies.[1]



Operational Challenges



Funding

A California Carbon Trust (CCT) that can participate in addressing these barriers also faces the challenge of identifying the sources of the required funding. Public sector funds in the state arise from two principal sources: fees and taxes. The former may be implemented by various state agencies, while the latter are under the exclusive jurisdiction of the legislature. The current fiscal crisis in the state has added to the difficulty of identifying and providing funding to a Carbon Trust. ETAAC identified revenues based on the sale of allowances within the cap and trade system as basis for funding the CCT. There is considerable uncertainty associated with these funds as the details of the cap and trade system have not been finalized, including the distribution of any attendant revenues.

"...none of us believed that the existing financial structure and grants that the state had were likely to be sufficient to achieve the objectives."

Bob Epstein, Vice-chair, ETAAC

Several state agencies, such as California Air Resources Board (CARB), California Energy Commission (CEC) and the California Department of Transportation (CalTrans), have funding allocated to system improvements that would reduce carbon emissions:
CEC administers the $80 million per year Public Interest Energy Research program.
CEC and CARB administer implementation of AB 118, which is fund of >$150 million a year that is focused specifically on trying to fill the gaps or identify and fund the gaps from early stage to demonstration pilot activities for low-carbon fuel technologies and vehicle technologies that impact GHG emissions and energy.

In power generation there are a number of programs for emerging renewables and the California Solar Initiative. These are supported by an approximately $2 billion that is available as a declining subsidy where there is initially a fairly high per watt subsidy for solar PV declining over time as different volume triggers are hit.

The Public Utilities Commission recently approved three billion dollars in incentives for the utilities to use to achieve their energy efficiency goals. About $ 2.5 billion is targeted toward electricity, and the remaining $ 500 million is targeted toward natural gas efficiency.

One idea is to dedicate a portion of these funds to support a CCT. Another public funding option was that contained in Proposition 87 which proposed increasing taxes on oil and gas produced in California in order to fund research into alternative energy technologies. It was defeated on the ballot, and opponents suggested that the actual effect would be to reduce oil and gas production in California, thus reducing the available revenues, while not altering the energy production landscape. Increasing the revenue associated with oil and gas production in order to fund initiatives for reduced energy use and carbon emissions might prove more palatable to the energy industry if the increase was in the form of a fee and considered deductible as an R&D tax credit, since the target revenues would be specifically dedicated to the support of new technology innovation. Rather than being a punitive measure such an approach could encourage needed investment.

"... energy and climate policies... will create some of the greatest business opportunities of this coming century...the businesses that can figure out how to cost-effectively provide people with the things that they need and want at the lowest overall impact to the climate...will be the winners...this is not going to happen overnight, there are going to be a lot of bumps along the way, and government can play a supporting role."

Anthony Eggert, Commissioner, California Energy Commission

In addition to industry, consumers should be expected to bear some of the costs associated with a CCT. The mechanisms should be developed as part of initiatives to stimulate desired behavioral changes related to demand modification. While either taxes, fees or a combination of the two could be employed, fees based on consumption could be designed more flexibly and monitored to identify unintended regressive impacts. In any case, no such approach could be expected to succeed without comprehensive review and reform of existing regulations, fees and taxes related to energy use.

Also worth exploring might be the creation of a regional, multi-state entity that could rely upon the pooled technical, commercial, and financial resources of more than one state as a way of leveraging the identification and successful commercialization of these new technologies.

Finally, regardless of the source of the initial funding, revenues from investments made by the CCT should be reinvested in the activities of the Trust, including support of operations, new initiatives, and further investment.

The members of ETAAC arrived at a more specific recommendation as discussed by Bob Epstein:

"...Across the board, after we talked with everybody, the recommendation was that it needs to be a declining fund managed by an independent your objective is to make a return, you're going to end up doing the same investments as a venture capitalist, but with fewer entity. The reason is that if resources. You're going to have a huge urge to go out there and say, 'I need some sure things in order to make my returns'. So, the pressure to make the returns is going to lead you to do the investments that other people are already doing anyway...."

Governance

Several models are available for governance of a CCT. One possibility is the creation of an organization reporting directly to CARB or a joint group of agencies within the California government. The lessons from the UK Carbon Trust and SDT Canada, as well as the deliberations of the members of ETAAC suggest some critical design principles. These include[11, 12]:

- Independence to choose which projects to pursue;
- The funding organization

  "… needs to be an independent entity because it is an uncomfortable situation to try to be a business partner with someone who is regulating you. Another point is that you want some insulation from political interference; you do not want that to be the background pressure."

  Bob Epstein, Vice-chair of ETAAC

  "Independence to choose which project to support is absolutely important…. You have to arrive at (support conclusions) through objective analysis of the opportunities presented to you at that time."

  David Vincent, Director, Projects, UKCT

  "…We operate with an independent board and an independent investment committee, which is stocked with seasoned private sector investors."

  David Harris-Kolada, VP, Corporate & Market Development, SDTC

- The confidence of business in order to secure their backing, which, in part, derives from being impartial and business-like in the operation of the Trust;

  "…Any public entity working in this space will have to have the confidence of business in order to secure their backing."

  David Vincent, Director, Projects, UKCT

"…We play a critical role in bringing together diverse, and sometimes competing, interests to bring clean technologies to market. Being a public sector entity, allows us to be viewed as a neutral body, which would be more difficult if we were a private sector entity and had a specific agenda that we were driving."

David Harris-Kolada, VP, Corporate & Market Development, SDTC

- An explicit set of connections to all of the key stakeholders: government departments and agencies; academia and R&D institutes; entrepreneurs; the financial sector, NGOs and industry;
- A focus on creating measureable results in terms of jobs; GHG reductions; investment value added; sector specific solutions;

"… Jobs are something that we have been focusing … on … GHGs are the primary way that we measure… and… the value for money… We basically do a net present value of all the benefits that accrue to Canadians from our program and offsetting the costs."

David Harris-Kolada, VP, Corporate & Market Development, SDTC

- Governance and reporting practices that create the necessary trust by the public funder;

"…The money is coming from the taxpayer, in the UK. They need to be confident that we have good governance and reporting practices."

David Vincent, Director, Projects, UKCT

- An experienced staff who know, and are respected in, the technology space, and have flair, enthusiasm and commercial empathy;
- A strong, sustained commitment to learn by doing;

- A government administration (legislative and executive branches) which takes a longer term view, sticks with the challenge and doesn't oscillate between jumping in and pulling out;

  You need "…an administration that takes a long term view and asks how long-term a view do you need to get things moving, and how much long-term commitment. It won't be done in a couple of years. "
  David Vincent, Director, Projects, UKCT

- An explicit focus on accelerating the pace requires public policy interventions to work with markets, entrepreneurs and researchers to share the risks and smooth the commercial pathway for clean energy technologies and businesses;

Experience strongly suggests that realizing these design principles requires a certain amount of autonomy from the ordinary political and funding processes familiar to most established government agencies. This type of autonomy requires significant attention to the establishment of explicit, transparent, and accountable governance practices.

Foremost among these are the policies and procedures that ensure transparency in key operational elements:

- Planning and execution including: project area identification; project selection; risk assessment; valuation methodologies; portfolio management;
- Personnel hiring, evaluation, compensation, and development;
- Financial processes, internal and independent auditing
- Contracts, consulting and intellectual property;

Scope

A point of comparison between the model adopted in the UK (UKCT) and that in Canada (SDTC) is related to the scope of their respective activities. The UK Carbon Trust is structured around a collection of supporting activities:

INSIGHTS

Explains the opportunities & challenges surrounding climate change

SOLUTIONS

Delivers carbon & money savings via energy efficiency

INNOVATIONS

Develops low carbon technologies for future carbon savings

ENTERPRISES

Creates low carbon businesses for a low carbon economy

INVESTMENTS

Finances clean energy businesses for a green growth economy

The UKCT's annual budget is determined by the UK government and is currently at about £100m. Since 2001when funding began, the Carbon Trust has funded 190 projects for £28m, which have attracted an additional £32m in private investment. In addition, they have invested about £5.4m in 90 "incubated" companies that have attracted £86m in private investment. Early Stage investments of £17m have been made, leveraging a further £139m of private investment. Also, the Technology Accelerators area has accounted for over £80m invested in on-going or completed activities. The scope of each of the activity areas varies depending on the type of projects, the form of the "leverage" needed, and the role of the Carbon Trust.

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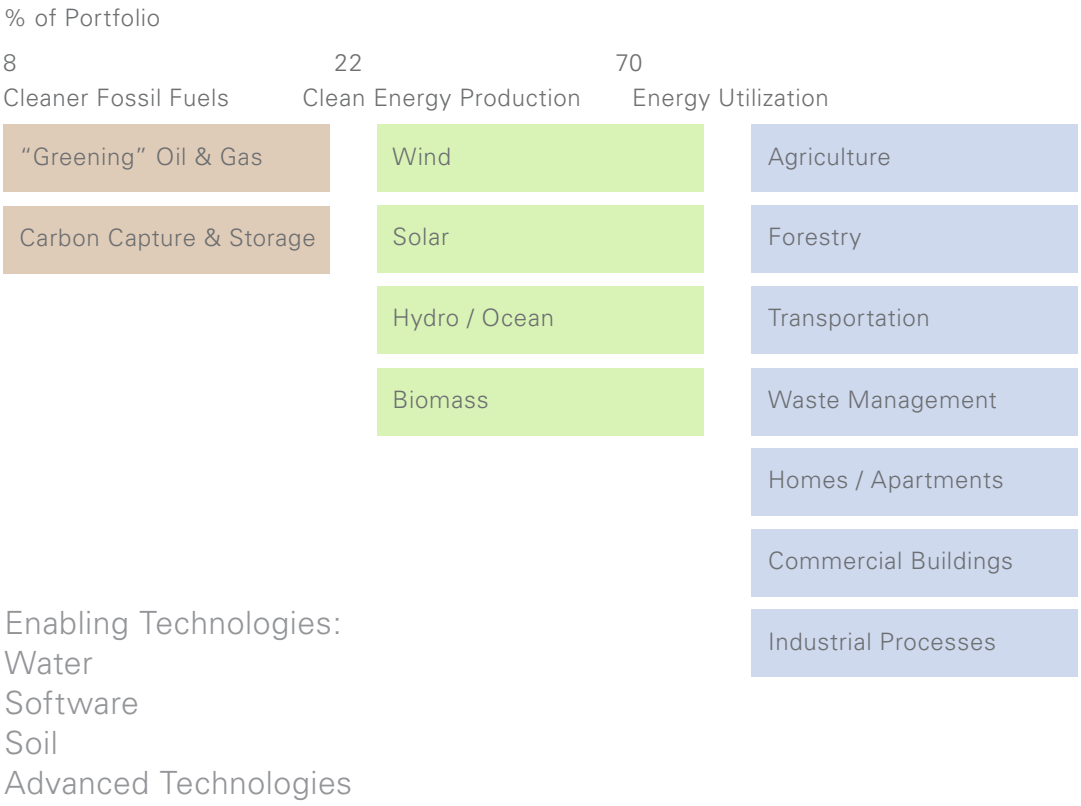
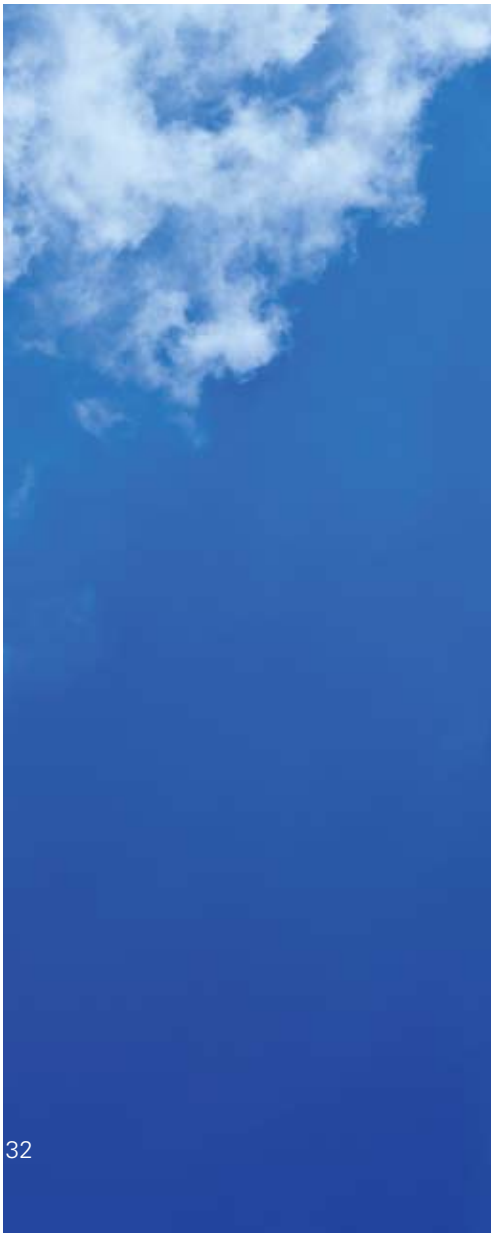
SDTC has taken a different approach because of a somewhat different mandate from the government sponsors: "SDTC is a policy instrument of the Government of Canada to deliver environmental and economic benefits to Canadians. We foster the development and demonstration of technological solutions that address: clean air, clean water, climate change and clean land."

The first fund was launched in 2002. The SD Tech FundTM, allocated $550 M of which $ 464 M have been committed, providing funds for 183 companies and leveraging $ 1.1G from consortium members, 82% from industry. An additional fund, the NextGen Biofuels FundTM was started in 2007, with $ 500 M. It is targeted to large scale demonstration facility for next generation renewable fuels and co-products. Both funds are designed to act as venture capital funds, drawing in additional private investment.

STDC has created a portfolio based on “CleanTech Opportunities”



Common Elements of Successful Models



While there are differences in the scope of the activities and funding channels, there are some important similarities as well. Both organizations:

- Are focused on producing measureable impacts on GHG emissions, energy efficiency and employment;
- Practice a disciplined portfolio management approach including strategy, as well as risk and value assessment;
- Receive and review proposals and track supported applicants using a stage-gate process that builds in detail and sophistication as goals are accomplished;
- Provide innovation process guidance and experience to project partners to help increase the chances of success, and build a growing cadre of experienced entrepreneurs and companies;

- Place a significant emphasis on the relationships with partners that include: industry, government agencies, academia, private investors, and entrepreneurs;
- Have recruited experienced technical and financial personnel who understand the difficulties of innovation in general and innovation within the energy sector specifically.

When combined with transparent governance and relative independence from short term political and economic forces, both have succeeded in creating a powerful force within their economies supporting innovation in the renewable and clean energy sectors.

An Innovation System for Low Carbon Technologies

Recommendations from Deep-Dive Workshops

Challenges

Financing / Investment for capital intensive technology/projects

- Difficulty in accessing capital for both small (e.g. building retrofit) & large Scale
- Principle agent problem

Migrating Technology from Labs to the Field at Scale

- Transitioning Publicly Funded Tech to the Field Applications
- Price point needs to incentivize transfer
- Specialized "Value" or Delivery or Marketing for "green energy" that resonates

Scaling Up & Providing access to distribution Infrastructure

- Lack of agreed upon standard
- Lack of training for permit officials
- Consumer education

Potential Solutions

Public Funding:

- Clear, transparent milestones, Clear exit triggers and strategy
- Combine small Grant structures into larger pools of money that are coordinated
- "Entrepreneur in residence" to pair with early stage startups -> incubator at large scale
- Enable low cost paths to pilot / demo deployment in pilot test park(s)
- Copy working models for Biotech, Electronics, IT: but selling into commodity market
- Home surveys with Prioritized retrofit – results tied to MLS or other valuation
- Enable and encourage Backwards compatibility Path
- Facilitate access to Energy distribution for power generation and fuels
- Marketing: Consumer Information, Live Feedback and "Value"
- Streamlined permitting, harmonized codes and Trained officials & contractors for retrofit
- Credits for Green sources & ownership: migrate to exchange suggested, or that compare the results of the different interventions.

Favorite Ideas

- Pool public funding across categories (RD&D, Procurement, Mfg, education / training, etc.) to create new entity?
- Enable low cost paths to pilot / demo deployment
- Pilot test parks (plug-and-play) for small and large scale
- Funding for development
- Standardized Permitting Templates & Mitigation
- Common across state / localities
- Largest Market Possible to reduce risk, requiring harmonized standards

Providing adequate funding emerges as a top challenge and specifically in regard to the capital investments needed to provide for the "installation" of an innovation into the Energy Ecology. This is clearly an issue at large scale, where energy service providers will eventually have to pass the costs of capital onto the service consumers. It is also an issue at the smaller scale, for example, the landlord who would like to install smart meters or a solar array, or solar thermal heating in an investment property. How does the landlord recoup the costs of capital? Analogous problems exist within both the public and private transportation arena, including the subtleties of who finances the costs of land use constraints designed to improve community energy efficiency. Many of these challenges may ultimately be related to the cost of externalities, that is the existing alternative approaches have not had externalities fully included in their costs. Nonetheless, these will require specific strategies for dealing with the challenges in a way that encourages rather than retards innovation.

Equally important from the perspective of the energy services entrepreneur, or investor, is the difficulty of moving from the laboratory or pilot scale to the demonstration scale needed to ensure that technical and market risks have been adequately addressed in the innovation design. This is not just a question of finance, but is related to what types of facilities are made available that provide an adequate environment in which to conduct demonstrations. Of course, demonstrating a new control software, or device, such as a smart meter, may be significantly less scale

sensitive than demonstrating an off-shore wind system. Identifying what would be "fit for purpose" is as essential then as providing the facilities. An especially critical element at this stage is a clear, explicit set of "milestones", performance, cost, reliability markers that provide an indication of whether the innovation retains its important characteristics at scale. These milestones are essential to reducing the technical risk, but also to clarifying the financial and market risks as well.

Past the Demonstration Stage challenges remain in deployment, particularly where there is embedded infrastructure, in the form of permitting and regulatory practices, as well as consumer behavior, that intentionally or not favors the existing approach to providing energy services. Responses include driving permit and regulatory reform, creating permitting "templates", devising more flexible regulatory approaches, and providing meaningful consumer education. This latter could include the development of more detailed analysis of the environmental attributes and costs associated with choices.

The short list of "Favorite Ideas" identifies some of the core concepts that could be expanded to address these challenges. A key to leading such an effort is a central entity, a "one stop shop" whose role it is to try and pull together the disparate threads of this complex problem. This is precisely the role a California Carbon Trust might play.

Enhancing Public / Private Collaboration

Recommendations from Deep-Dive Workshops

Benefits of Collaboration

Shared Vision

- Alignment
- Understanding Driving to Measureable Results
- Identifying uncertainties & gaps
- Efficiency in evaluating & accelerating technologies
- Bridging the funding gap

Creating a Network

- Identifying and sustaining connections between stakeholders
- Champions and decision makers

Knowledge Base

- Honest broker – unbiased information
- Overview of all the options
- Means for educating stakeholders

Obstacles

"Lock-in"

- Existing technology / infrastructure / mindset

Timeframe Mismatch

- Innovation time frame
- Policy timeframe
- Political timeframe
- Consumer / cultural adaptation

Market entry

- Accessibility of SMEs / entrepreneurs to supply channels / market channels
- Regulatory and permitting barriers
- Lack of innovative business models

CTO Community Contributions

CTO Institute to bring stakeholders together

- Creating a shared vision
- Enhancing understanding of complexities

Independent entity that can characterize innovation pathways, penetrations, consumer behavioral changes, "critical path" policy and political issues

- Collaborations between SMEs and major corporations – analogous to SDTC's "Consortia"
- Regulatory and permitting process reform supported

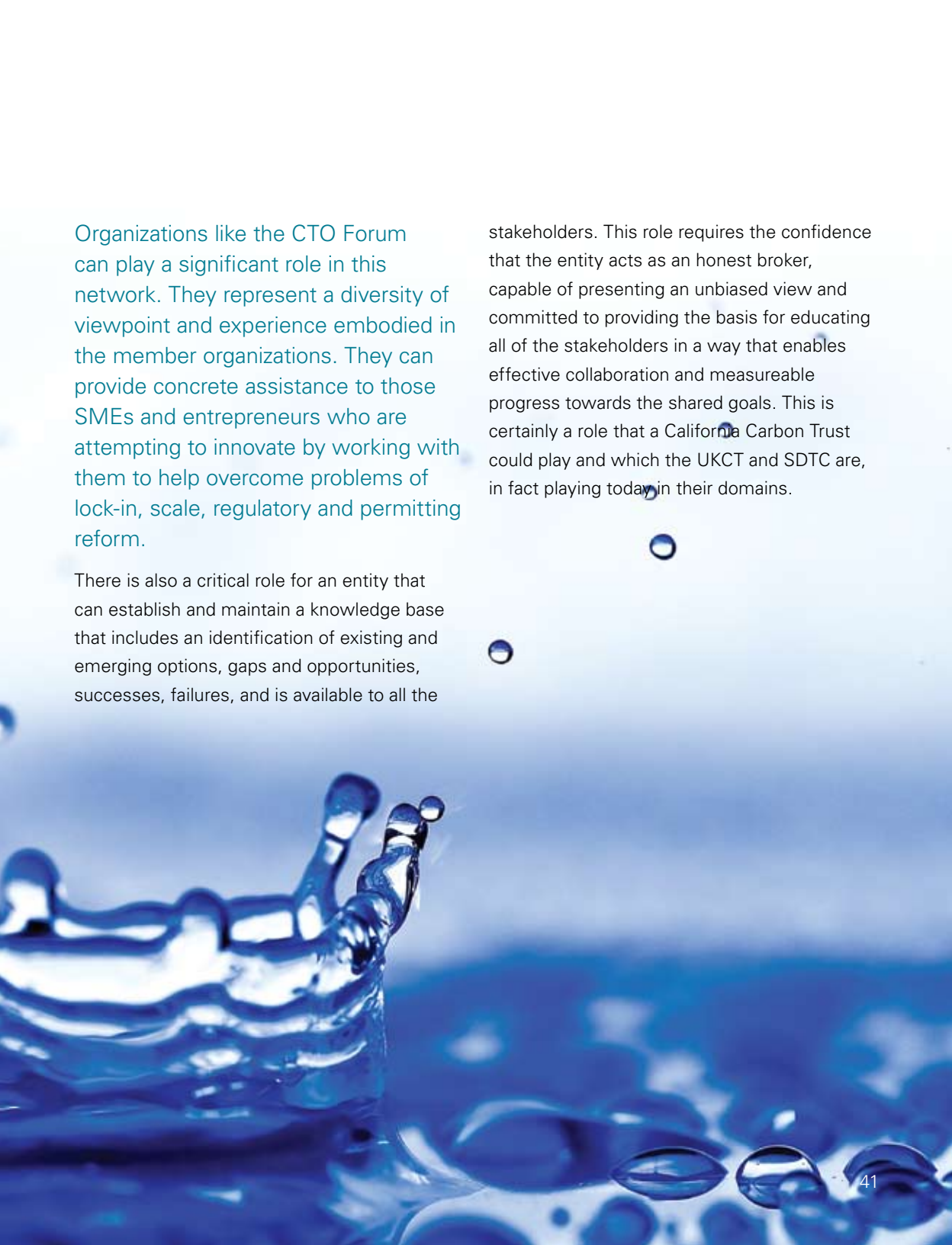
California CT as the "honest broker"

"Lock-in" refers to those aspects of a service supply chain, which have evolved over time and become institutionalized politically, economically, and culturally. Three major stakeholders are involved: the government agencies that regulate and permit the service providing industry; the service providers and their immediate supply chain members; and the consumers of the service. For an innovation to succeed on market entry one or more of these "lock-ins" need to be circumvented. In the case of disruptive technologies that frequently occurs downstream in the provider supply chain, or with the consumer themselves. In the energy services arena this is made more complicated by the individualized nature of consumer behavior relative to energy, as well as by the highly evolved and regulated character of the provider supply chain.

Overcoming this and the other identified obstacles requires a clear, shared vision that connects to all of the stakeholders. This can provide the basis for creation of a network that can effectively link the stakeholders and support the development of "champions" to provide leadership needed to drive measureable results in the transformation of the entire supply chain. This includes helping to articulate and develop strategies to deal with the mismatch of timeframes that characterize some of the essential elements: innovation, policy and political changes, and consumer adaptation and acceptance.

Organizations like the CTO Forum can play a significant role in this network. They represent a diversity of viewpoint and experience embodied in the member organizations. They can provide concrete assistance to those SMEs and entrepreneurs who are attempting to innovate by working with them to help overcome problems of lock-in, scale, regulatory and permitting reform.

There is also a critical role for an entity that can establish and maintain a knowledge base that includes an identification of existing and emerging options, gaps and opportunities, successes, failures, and is available to all the stakeholders. This role requires the confidence that the entity acts as an honest broker, capable of presenting an unbiased view and committed to providing the basis for educating all of the stakeholders in a way that enables effective collaboration and measureable progress towards the shared goals. This is certainly a role that a California Carbon Trust could play and which the UKCT and SDTC are, in fact playing today in their domains.



Building the System

Recommendations from Deep-Dive Workshops

Success Elements

- Business respect
- "One Stop Shop" for engagement
- Doesn't duplicate or "crowd out" the market
- GHG is a lead metric for success

Independent

- Transparency : decisions, portfolio, operations
- Governance: Clear accountability, processes

Funding leverages private monies

- Funding certainty needed
- Consortium approach of SDTC – all investors / stakeholders share risks

Gaps

Reaching SME's as to what impacts and benefits would exist in moving toward a low carbon economy

Policy gaps in California that discourage innovation

- Sales tax waivers don't exist for all manufacturing equipment for GHG reduction equipment
- Business investment horizon don't match incentives
- Complexity in applying for grants is a barrier for most businesses to understand/ overcome

Needs to be strategy driven based on California's capabilities and resources (what does end game look like)

- Who holds the scenario planning for the carbon budget
- Long –term duration of the funding needs to be secured from an operational and political

How do you get started? – for instance can you start small

Who holds the scenario planning for the carbon budget

Two "Valleys of Death" for cleantech need to be overcome

- Applied R & D
- Project finance gap

Long –term duration of the funding needs to be secured from an operational and political security point of view

Possible Combinations

Identify constituencies

- SME
- Finance/Investors
- Large Corporations

Build upon existing Academic, NGO and Business collaboration

X-prize approach (California Clean Tech open) for technology and business process

- CCT could be a co-sponsor of existing prizes
- Create its own prizes

Create an integrated view

- Describe the Innovation Ecology including existing programs
- Develop permitting and regulatory approaches that are transparent, simple, flexible and still "fit for purpose"

State procurement model

- Government could lead on EE building innovation such as state building competitive bids for comfort levels to create incentives for private sector to invest

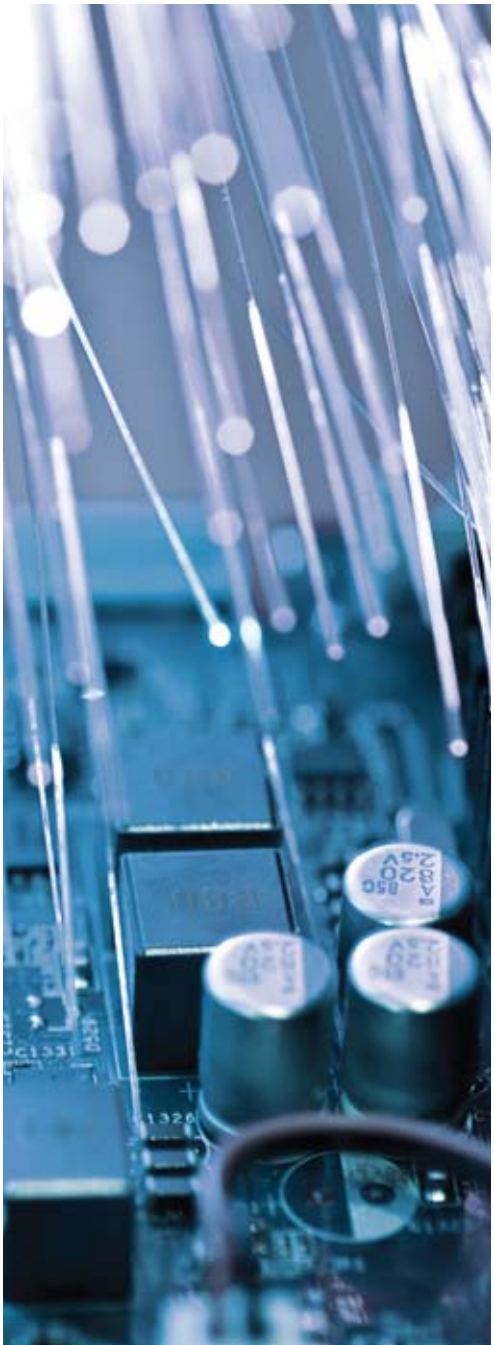
Create the Organization: Government backed, independent non-profit

Create a Portfolio Management Process that allows for innovation to be assured access to funding

Attract private money

- CEC provide initial seed funding
- Purchase offsets for voluntary market
- Allow for strategic investment by business
- Bond issuance similar to Stem cell approach by California
  - o Investment successes could provide funding to pay back bonds
- Presidio Trust approach – 15 years to be secure self funding
- Carbon revenues pay for Carbon Trust

The "success elements" identified in this session are very similar to those discussed earlier that arose directly from the experiences of the UK Carbon Trust and SDTC. Business respect is essential, as well as a connection to critical members of the business community, such as small to medium employers (SMEs). This is the case not only in terms of stimulating the innovation process, but also to develop the necessary political support to encourage initial and sustainable funding as well as regulatory reform; to create a meaningful description of the current, and the desired innovation ecology required to support success; to encourage participation in the consortia and investment pools designed to leverage private funds. Establishment of this credibility is an essential foundation for building the needed partnerships, and for encouraging collaboration between the private and public sectors.



Another element of generating and maintaining that respect is the establishment of an independent, not for profit entity that functions as a "one stop shop" for all of the resources, financial, intellectual and political needed for innovation success. The entity needs to create transparent processes for its governance, for its acquisition and use of funds, for its portfolio management practices, and for the metrics it uses to establish its value. The entity also needs to be attuned to the innovation ecology in order to avoid competing with other, successful routes to encouraging innovation and early stage investment. In addition, it needs to be one of the designers and interpreters of the scenarios for the long term carbon budget. This connects directly with its role in helping to define and subsequently shape the innovation ecology. It is also essential for robust portfolio management that assesses both risks and value. This is a critical role given the uncertainty of the success of particular pathways to the ultimate reduction goals.

In a role potentially unique to California, this entity might also take the lead in developing the framework for the permitting and regulatory reform needed to remove the roadblocks that exist for accelerating the entry of low carbon innovations into the market. This requires developing a constituency within the government and among business leaders, as well as with labor, since all are involved in trying to reform or trying to maintain the existing framework.

Not surprisingly, the other critical element is funding. Neither of the approaches taken by the UK Carbon Trust or SDTC is likely to fit with California's political and economic environment. The UKCT's funding was derived from a carbon tax, which at the moment, is not what California is anticipating. The SDTC's funding has been allocated in "chunks" which has the benefit of providing some financial certainty, but requires large outlays initially. Some hybrid of these approaches might fit for California, but past the initial government funding there is a need to attract and leverage substantial private investment, and this step will almost certainly require both time and the creation of credible outcomes as a basis for assessing risks.

In 2009 California venture capital firms received about $ 2.1G in funds for cleantech. Down significantly from 2008, but still large. The reductions were a result of a number of factors: "…Venture capital declines have been due to (1) a general concern about investment risk, (2) the lack of capital from traditional investors such as university endowments and public pension funds, (3) the collapse of the market for new public offerings (4) the collapse in valuations from mergers and acquisitions, (5) more cash required by existing portfolio companies due to a shortfall in their revenues, and (6) decline in energy prices from cyclical highs in the first half of 2008."13.)

Despite this level of investment, there is still inadequate funding for what are perceived to be riskier attempts to change the basis of energy services, including pilot to large scale demonstrations of technology. Public funding, leveraging private investment by providing some risk mitigation, could enhance both the quantity and quality of cleantech investments in California.

Conclusion

There already exists, outside California, a significant body of experience in the design and operation of public-private collaboration to encourage critical investment in early stage technologies designed to reduce GHGs.

In addition to the UKCT and SDTC, Ireland and Finland also have clean energy investment funds, and all four are members of the United Nations Environmental Program Sustainable Energy Finance Initiative14.). The Initiative supports member exchange of best practices, pooling of resources, launching of joint projects, and assisting other governments in establishing new or similar financing models.

California faces significant economic, political, and institutional challenges in establishing a "Carbon Trust". At the same time the state has an existing mandate, a group of committed state agencies, including CARB and the CEC, experienced venture capital firms, a broad range of companies already engaged in the energy, transportation, and renewable energy markets, major research institutions engaged in renewable energy related research, and a wealth of entrepreneurial talent.

Dan Sperling, in his closing remarks reminded the audience what is at stake:

"...What we are talking about is creating jobs, supporting new companies, new technologies, new investments and leveraging a lot of private investment...The CTO Forum has a large role to play in this. It may continue to be the driving force for a Carbon Trust in California, and at least it will continue to host workshops and discussions to get people talking..."

He followed with a call to action:

"...This is a crucial time in California. We are at the point where we are starting the rule-making process toward the cap and trade program in California. Now is the time to start raising the profile and start pursuing this. I'm energized; I think there are a lot of great insights. Yes we can!"

These views were reiterated by of the attendees during the wrap-up session of the workshop.

The CTO Forum Technical Council meeting was designed as a step in the larger process of identifying and wrestling with the challenges. Even more critical is a focused and timely effort to engage the existing resources to develop and implement the actions needed to address the challenges and define a "fit for purpose" approach within California. That is the next critical step in creating a "Model for a California Carbon Trust".

This event was made possible by the CTO Forum Advisory Board.

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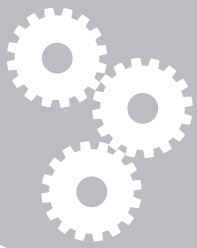

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