

BENDING THE CURVE

LEADING THE TRANSLATION OF
RESEARCH INTO SOLUTIONS

Overarching Solutions for a Rapidly Warming California

A Public Private Brainstorm

C4S Summit Summary Report



California Collaborative for
Climate Change Solutions

Coming together to solve climate change.



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Proceedings of the Past Climate Warming Summit with Next Steps

Letter from the C4S Co-Chairs:

Thank you to all for your day-long participation in the past Climate Warming Summit in La Jolla. We are incredibly grateful to all of you for your engagement and want to express our appreciation to all of the in-person and virtual participants, noting in particular the contributions of the morning and afternoon plenary and breakout session co-chairs and participants. We are especially thankful to Fonna Forman for serving as local host and providing opening plenary remarks in Ram's unforeseen absence, and Mario Molina for providing morning keynote remarks and engaging throughout the day. We are glad it went very well with plenty of open discussions between the public-private sector which are captured in the attached Summit Proceedings, and available [here](#).

We can't overstate the importance of rapidly mobilizing this public-private consortium into an array of climate solutions for impact. Amidst recent wildfires, floods, heatwaves, and droughts in California and worldwide, there is no doubt that climate change has firmly landed in our living rooms. Transformative action is California's way of stepping up to grave risks facing our citizens, both now and into the foreseeable future. The C4S framework is transformative and collaborative by design, aiming for the lowest possible barriers to collaboration across institutions and disciplines, coming together to solve boundless climate challenges. Our goal is to provide a credible set of solutions to safeguard people, the economy and planet for generations. Through innovative and disruptive public-private partnerships, C4S promises a uniquely California-inspired model for other sub-nationals, and importantly, serving as a beacon for keeping climate change actions alive in the US.

C4S is currently engaged in conversations about next steps for creating public-private partnerships in climate solutions. We have begun to reach out to solicit the input of the plenary and breakout session chairs as we advance C4S for the common good. In the meantime, if you have suggestions for C4S, we would love to hear from you.

With sincere regards,

Benjamin Z. Houlton

Co-chair

V. Ram Ramanathan

Co-chair



“You must unite behind the science.”

– Greta Thunberg



C4S Summit Agenda

Welcoming Remarks

Fonna Forman: Director, Center on Global Justice, UC San Diego

Opening Plenary

Opening Reflections & Call to Action

Climate Urgency: A Call to Action

Mario Molina, Distinguished Professor, UC San Diego

Climate Impacts in a coastal California Town

Serge Dedina, Mayor of Imperial Beach

Fast-tracking Climate Actions via Public-Private Partnerships

Benjamin Houlton: C4S Co-Chair; Professor and Director, UC Davis Muir Institute

Climate at the Crossroads: Choosing our Planet's Future

William Collins: Director, Climate & Ecosystem Sciences Division and Era, UC Berkeley

Panel Discussion: Role of Universities

Chair

Sandra Brown: Vice Chancellor for Research, UC San Diego

Participants

Ganesh Raman: Assistant Vice Chancellor-Research, California State University

David Phillips: Assoc. VP for Energy and Sustainability, UC Office of the President

Matthew Dumlao: Environmental Policy Advisor, Office of Lt. Governor, State of California

Setting the Stage

Chair

Wendell Brase: Associate Chancellor of Sustainability, UC Irvine

Talks

Scalable Solutions that can be Fast-tracked with Private Capital

Mac McQuown: Innovator for Evidence-Based Investment & Stone Edge Farms

California's Climate Action Plans

Kate Gordon: Director, Governor's Office of Planning & Senior Climate Advisor

Beyond Fossil Fuels: Energy Industry Perspective

Sharon Tomkins: Vice President; Southern California Gas Company

Californians' access to reliable infrastructure & services including power

Cliff Rechtschaffen: Commissioner, California Public Utilities Commission

The Human Face of Climate Crisis & Need for Social Transformation

Fonna Forman: Director, Center on Global Justice, UC San Diego



C4S Summit Agenda

C4S Living Laboratories

Chair

Walter Oechel,

Dir. Global Change Research Group, Dir. Center for Climate Sustainability Studies; SDSU

Global to local: negative emissions in agriculture and California lands

Benjamin Houlton: C4S Co-Chair; Professor and Director, UC Davis Muir Institute

Microgrid for adaptation (to fires) and mitigation

Byron Washom: C4S, Director of Strategic Energy Initiative, UC San Diego

Climate Action at Caltech with the Resnick Donation

Neil Fromer: Executive Director, Resnick Sustainability Institute, Caltech

Break Out Brainstorming Sessions

Session I Climate: Societal Transformation, Governance, and Adaptation. Chaired by:

Ken Alex: Director, Project Climate, UC Berkeley Law School

Amber Mace: Executive Director, California Council for Science and Technology

Session II Technology Measures. Chaired by:

Catherine Von Burg: CEO and President of Simpliphi Batteries

Roger Bales: Director Sierra Nevada Research Institute, UC Merced

Session III Atmospheric Carbon Extraction. Chaired by:

Mac McQuown: Innovator for Evidence-Based Investment & Stone Edge Farms

Louise Bedsworth: Executive Director, Strategic Growth Council, State of California

Closing Plenary

Co-Chairs

Wendell Brase: Associate Chancellor of Sustainability, UC Irvine

Margaret Leinen: Vice Chancellor, Scripps Institution of Oceanography, UC San Diego

Summary of Brainstorming Sessions: Brainstorming Co-Chairs

Panel discussion: What did we miss thus far?

Participants

Jack Wadsworth: Honorary Chairman, Accelerator for Climate, Morgan Stanley, Asia

Kahne Krause: Regional Director, Dimensional Fund Analysis

Kate Gordon: Director, Governor's Office of Planning and Research

William Collins: Director, Climate & Ecosystem Sciences Division and Era, UC Berkeley

Open Discussion

Next Steps: Commentary from the two Chairs

Close the Meeting

Benjamin Houlton, C4S Co-Chair; Professor and Director, UC Davis Muir Institute



C4S Proposed Climate Solutions Projects

The following tables summarize each solution proposed by the many C4S collaborators across California institutions by category: science, societal transformation, market mechanisms & instruments, technology, and adaptation.

To see the full Solutions Snapshot Document, click [here](#).

SCIENCE			
No.	Title	Authors	Institution(s)
1	Urban Modeling to Prioritize Greenhouse Gas Mitigation <i>Carbon Neutrality</i>	Hong & Piette	Lawrence Berkeley National Laboratory
2	Comprehensive Study on the Impact of Transportation on Climate Change in Kern County <i>Carbon Neutrality</i>	Fuchs	CSU Bakersfield
3	Climate Change Impacts on Extreme Weather in California <i>Science Pathways</i>	Chiao	CSU San Jose
4	Environmental and Public Health Benefits of Deep Decarbonization towards Sustainable Net-zero Greenhouse Gas Emissions <i>Science Pathways</i>	Zhu, Liou, & Gu	UC Los Angeles
5	Climate Variability and the Resulting Changes in the Fire Intensity and Hydrologic Components <i>Science Pathways</i>	Lopez & Kinoshita	CSU Los Angeles CSU San Diego
6	Using Remote Sensing Products for Fire Protection <i>Science Pathways</i>	Ye	CSU Los Angeles

SOCIETAL TRANSFORMATION			
No.	Title	Authors	Institution(s)
7	Educating and Empowering Climate Stewards A. K-12: Bending the Curve for Kids! B. Teenagers as Energy Conservation Stewards C. Climate Change Solutions: Course for One Million Climate Stewards	Forman, Delmas, Ramanathan, Friese, Roper, Fandino, & Foran	UC San Diego UC Los Angeles UC-CSU Knowledge to Action Network
8	Climate Solutions Education for All: Empowering a generation of students, teachers, and adults across California, Mexico, and beyond to effectively address the global climate crisis	Ramanathan, Forman, & Molina	UC San Diego
9	Climate Change and Beach Nourishment in Morro Bay, California: Course-based Undergraduate Research Experiences (CUREs) in Biology, Chemistry, and Geology	Reece, Weinman, Brady, Person, & Mine	CSU Fresno
10	Changing the Climate Change Conversation	Seyranian	Cal Poly Pomona
11	Scaling Climate Change Education and Action in Vulnerable Communities	Cordero	CSU San Jose



GOVERNANCE

No.	Title	Authors	Institution(s)
12	The Climate and Jobs Case for California Recycling	Press	University of Southern California
13	Creating Policy Hooks to Build Citizen Participation	Han	Johns Hopkins
14	Governor's Late 2020 Religion + C4S Summit Conferences	Miles	UC Irvine
15	Indigenous Leadership in Climate Solutions	Middleton	UC Davis
16	Smarter Building, Landscaping, and Paving with Cool Surfaces, Shade Trees, and Low-Carbon Pavements	Levinson & Ban-Weiss	Lawrence Berkeley National Laboratory University of Southern California
17	Genomic Analysis of Ecosystem Health	Shaffer, Smith, & Gillespie	UC Los Angeles
18	Advanced Energy for Disadvantaged Communities	Pincetl	UC Los Angeles
19	Adaptation for Climate-Related Exposures in Vulnerable Populations	Al-Delaimy	UC San Diego

MARKET MECHANISMS & INSTRUMENTS

No.	Title	Authors	Institution(s)
20	California's Energy Revolution and Just Transition	Pellow	UC Santa Barbara
21	Deep Decarbonization Under Multiple Regulatory Models	Carlson & Boyd	UC Los Angeles
22	Slashing Fossil Fuel usage through Massive Daytime Charging of Electric Vehicles	Kurtz	UC Merced
23	Electric Vehicle Parity by WeGo Flexible Subscriptions	Campbell	UC Santa Cruz

TECHNOLOGY – CARBON MITIGATION

No.	Title	Authors	Institution(s)
24	Leverage \$22M of California Energy Commission Living Lab Testing at the University of California	Washom	UC San Diego
25	Leverage \$44M of Advanced Energy Communities	Washom	UC San Diego
26	Leverage California Energy Commission Microgrids to 100% Renewable Supply	Washom	UC San Diego
27	Cooperative Microgrids (Co-μGrid) Enabled via Integrated Distributed Energy Resource Technology	Gadh	UC Los Angeles
28	Adaptive Electric Vehicle Charging in Microgrids with Renewables	Low & Fromer	CalTech
29	EVS smartPlug: Smart Electric Vehicle Charging with Max Green Energy	Gadh	UC Los Angeles
30	High-Temperature Low-Cost Thermal Energy Storage with Molten Sulfur	Wirz	UC Los Angeles
31	Electrolyzer-Based Renewable Hydrogen Energy Ecosystem	Samuelsen, Brouwer, & Reed	UC Irvine
32	Accelerating California's 20-Gigawatt Offshore Wind Power Opportunity	Jacobson, Lehman, & Alstone	CSU Humboldt UC Berkeley



TECHNOLOGY – CARBON MITIGATION (cont.)

No.	Title	Authors	Institution(s)
33	Shared Electric Connected & Automated Transportation	Barth	UC Riverside
34	Using Smart Meters to Reduce Electricity Consumption	Schultz	CSU San Marcos
35	Accelerating the Clean Transportation Revolution	Kammen & Matlock	UC Berkeley UC Merced
36	Miniaturized Metal Paper-Based Batteries to Power Small Portable Electronic Devices	Gomez	CSU Los Angeles
37	CO ₂ Enhancement of Anaerobic Digestion	Raju	UC Riverside
38	Electrochemical Carbon Capture for Load-Following Power	Brouwer, Samuelsen, & Reed	UC Irvine
39	Enabling Large Scale, Long Duration Energy Storage in California: Demonstrating gigawatt-scale energy storage	Kurtz & Jagerson	UC Merced Malta Inc

TECHNOLOGY – ATMOSPHERIC CARBON EXTRACTION

No.	Title	Authors	Institution(s)
40	Direct Carbon Capture Using Serpentinite Fluids	Aines & Kelemen	Lawrence Livermore National Laboratory Columbia University
41	Transforming Carbon Dioxide Emissions into Concrete	Sant	UC Los Angeles
42	Accelerating Natural Carbon Sequestration in Water Systems	Adkins	CalTech
43	Integrated Microalgae Carbon Capture System	Zabihian	CSU Sacramento
44	Smart Glasshouses for Food, Water and Energy Use	Loik, Carter, & Bentley	UC Santa Cruz CSU Sonoma
45	Evaluating and Enhancing the Resilience of Coastal Transportation Infrastructure in Response to Extreme Climate Change Events	Mazari & Lopez	CSU Los Angeles

TECHNOLOGY – SHORT-LIVED CLIMATE POLLUTANTS

No.	Title	Authors	Institution(s)
46	Clean Energy for All and Creating a Black Carbon Hole as Co-Benefit	Ramanathan, Ramanathan, & Ramanathan	Nexleaf Analytics UC San Diego Tata Power



ECOSYSTEM MANAGEMENT

No.	Title	Authors	Institution(s)
47	Determining, Predicting, Certifying, and Verifying Carbon Sequestration in Ecosystems and Agroecosystems	Oechel, Zona, Xu, De Sales, & Stow	CSU San Diego
48	Food System Modeling for Climate Change Adaptation	Allison, Crohn, & Jenerette	UC Riverside
49	Net Energy and Life Cycle Impacts of Waste Biomass Use	Rajagopal	UC Los Angeles
50	Reducing Uncertainty in Net Ecosystem Carbon Balance in Coastal Wetlands	Oikawa & Dronova	CSU East Bay UC Berkeley
51	A Forest-Restoration Strategy for California: Linking carbon, water, fire and conservation	Bales & Goulden	UC Merced
52	Multiple Benefit Land Management	Field	Stanford University
53	Microbial Population Dynamics and Greenhouse Gas Production Under Anaerobic Soil Disinfestation	Haffa, Crandall, Jue, & Kortman; Shennan & Muramoto	CSU Monterey Bay UC Santa Cruz
54	Large-Scale Fog Water Collection for Reforestation	Fernandez	CSU Monterey Bay
55	Climate Change Mitigation Potential of Compost Amendments to Rangeland Ecosystems	Silver	UC Berkeley
56	Management of California Shrublands for Carbon Sequestration Watershed, Air Quality, Wildlife, and Bioenergy	Oechel, Zona, Biggs, Beyene, Lunneberg, & Fenner	CSU San Diego
57	Seagrass Enhancement for Increasing CO ₂ Sequestration Habitat, Recreation, and Water Quality in San Diego Bay	Oechel, Zona, Hovel, & Carsh	CSU San Diego
58	Carbon capture with benefits: Enhanced weathering to securely store carbon in the world's cropland soil	Houlton	UC Davis
59	Salk's Harnessing Plants Initiative CROPS Program	Chory, Busch, Noel, Law, & Ecker	Salk Institute
60	Coral Reefs at High CO ₂ : Risks and opportunities for mitigation	Carpenter & Edmunds	CSU Northridge
61	Can Marine Protected Areas Promote Resilience in the Face of Climate Change?	Nickols, Stier, Nidziedo, & Bell	CSU Northridge UC Santa Barbara UC Los Angeles



Overarching Solutions for a Rapidly Warming California

Public-Private Brainstorming Summit at UC San Diego

November 18th, 2019

Opening Plenary

The entire opening plenary was livecast, and the recording can be viewed [here](#).

Welcoming Remarks

The welcoming remarks were given by Fonna Forman. Dr. Forman gave an update on Ram Ramanathan's absence and proceeded to discuss the vision of C4S to bring disciplines together to achieve shared goals. This event is to do just that, share knowledge and learn from one another. Dr. Forman finished with an introduction to Mario Molina.

Session: Opening Reflections & Call to Action

Climate Urgency: A Call to Action - Mario Molina

Mario Molina gave his perspective to the public on climate change, and why it is the most serious environmental issue that we face today. Climate change is a global problem—it doesn't matter where the emissions take place, impacts are felt everywhere. The Intergovernmental Panel on Climate Change works to understand the complexities of climate change and provide probabilities. They have recently increased the probability that climate change is caused by human activities from 90% to 95%. Since that report, this value has continued to increase. However, science does not tell us what to do you. It is a matter of social responsibility to do something, not only for future generations but for our own, as the impacts of climate change are already being experienced now. The Conference of the Parties is trying to do just this, but it does not appear to be working very well; emissions are still increasing. The most important message to summarize is as follows: we have an unacceptable chance for the average temperature of the planet to increase more than four or five degrees towards the end of the century. This would be terrible for civilization and future generations. Who would climb onto an airplane if they were told there's a one in ten chance that you won't make it?

Movements at universities and with young people are working despite what is happening at the White House. We have done this once already with the Montreal Protocol. It is no longer necessary to sacrifice many things; we have technologies and can even witness economic growth if we think creatively. Let's all work together.

Climate Impacts in a Coastal California Town – Serge Dedina

Serge Dedina followed with a local perspective and a plea to move faster. Thanks to Scripps Oceanography, with the support of Mark Merrifield and the Center for Climate Change Impacts and Adaptations, the city of Imperial Beach has deployed a system as a pilot project to document real-time information about when coastal flooding will occur. It's important to hold people accountable for causing climate change. Based on climate attribution research, Imperial Beach was the first city to sue to fossil fuel industry along with other cities. We need to be investing in natural climate solutions such as growing sea grass and preserving salt marshes rather than growing non-native trees. The state of California needs to discuss blue carbon more. We also need to be addressing issues around public infrastructure now. Finally, we need to ensure that young people have access to blue and green ecosystems, not the world's wealthiest.

Fast-tracking Climate Actions via Public-Private Partnerships – Ben Houlton

Ben Houlton has been working with Professor Ramanathan to see how we can be stronger together, and how we can create the innovation ecosystem necessary to solve climate change. Climate change has entered our living rooms, wildfires being the most damaging example, socially and economically. These issues are boundless, and we need all people from all disciplines coming together to solve them. The C4S framework is transformative and collaborative by design, and needs funds and to come together in a way to give rise to true public-private partnerships to take on this challenge. Dedicate to maintain the lowest possible barriers to collaboration, C4S has members from all university types, and is now engaging further to get outside academia even more. Since creating a steering committee in 2018, C4S has had four stakeholder engagement events to figure out how to lead the conversation. In 2019 C4S was awarded two Innovation Center grants. Finally, C4S has also taken on a risk report to identify risks by 2030.

Climate at the Crossroads: Choosing our Planet's Future – William Collins

We are at a crossroads of our choosing. The bottom line is that we are done kicking the can down the road, and done with the idea that there is an infinite road in front of us. We have reached the end of the road, a conclusion that has been reached locally, nationally, and internationally. The IPCC's 1.5 degrees report concludes that there is a limit to predict what happens beyond 1.5 degrees Celsius. This report says we will reach the 1.5 degrees point by the year 2040. We are facing a gigantic challenge, and the reason for C4S is that this is also a gigantic opportunity for us to make a difference in a single human generation. The issue with local, down-scaled assessment is that they are looking at averages. If you were to ask what the average earthquake in California is, it would be somewhere around 3 or 4 on the Richter scale. However, we build infrastructure to deal with a magnitude 7 earthquake. We should be looking at adapting to climate change with the same kind of mentality. This is why the risk report is so crucial.

Session: Panel Discussion: Roles of Universities

Chaired by Sandra Brown, with panelists David Phillips, Matthew Dumlao, and Ganesh Raman

The panel began with a short opening remark by Sandra Brown. Dr. Brown focused on the importance of having discussion with diverse stakeholders to generate, implement, and scale up solutions. She then introduced each panelist, and asked each to make an opening remark. Dr. Brown's questions focused on the roles that universities have to address climate change solutions from the state, CSU, and UC perspectives and what the challenges are for getting these groups to work together (See appendix i for a full transcript of the panel discussion).

Ganesh Raman highlighted that the CSU system is the largest higher education system in the state. Their research is applied and connected to student success, faculty involvement, and state benefit.

David Phillips highlighted that the state of California is in a climate emergency. UC has set the goal to be climate neutral by 2025, 10 years ahead of the state. Wants to focus on this operational goal.

Matthew Dumlao focused on how climate change is the number one problem we face, and the number one solution to that problem right now is collaboration.

“There’s one issue that will define the contours of this century more dramatically than any other, and that is the urgent and growing threat of a changing climate.”

– Barack Obama



Session: Setting the Stage

Chair Remarks – Wendell Brase

The UCs commitment to carbon neutrality by 2025 should not be taken for granted as exceptional leadership and university-wide commitment. The benefits to having this goal are: 1) the public commitment to global climate leadership that this goal represents, 2) having many researchers doing distinguished work in climate solutions, and we need to walk the walk to be credible, and 3) we need to discover what the challenges are going to be to getting to carbon neutrality. It is necessary to collaborate, and this is where our panel comes in. We need to listen better, and do this more often.

Scalable Solutions that can be Fast-tracked with Private Capital – Mac McQuown

We have two fundamental problems to solve to avoid catastrophic consequences. First, the conversion from fossil fuel sourcing to renewables. Stone Edge farm in Sonoma has been working to demonstrate that small-scale microgrids work. The marginal cost of electricity at Stone Edge Farms is zero. There are no economies of scale. You can create small or massive microgrids and they both have the same marginal cost. Likewise, we can create hydrogen from rainwater, and a small percentage of rain that falls on a 2000 ft² home is enough to create enough energy to bridge the gap between summer and winter. The marginal cost of hydrogen is also zero, and this makes it an important topic. Hydrogen can power cars with equal efficacy as electric vehicles. We need to move towards renewables as fast as possible. The second problem is that we already have over 400 ppm of CO₂ in the atmosphere, ensuring global warming. The question now is, how many degrees and when does that translate into? The technology required to pull carbon out of the atmosphere is not well-developed, especially if you calculate the energy requirements of said technologies.

California's Climate Action Plans – Kate Gordon

Governor Newsom wants to go from ambition to action. Former Governor Brown, and many others, were able to put incredible ambitions into place, one of them being a commitment to carbon neutrality by 2045 across the state. We also need to reduce climate risk while transitioning to carbon neutrality. So, how do we get to these goals? First, Newsom wants to take assessment of where we are on existing goals. We have hundreds of goals on climate change. This assessment showed we are doing really well on electricity, but are not doing well on transportation. Transportation is 41% of our emission—51% if counting oil and gas production. California is currently increasing emissions in the transportation sector by 6% per year, mostly from single occupancy vehicle miles traveled, which is related to California's housing affordability crisis. California could also improve on having a better articulated goal of natural and working lands policies. The last big area that could be improved upon is climate resilience, which is cross-cutting and needs to be considered across every agency.

There is a huge role for universities to play, as every piece of this is underpinned by research. We cannot do risk-based analysis without risk projections. What is not helpful for the state is a million different scenarios with a million different assumptions. Rather, what is needed is coherence and benchmarking across scenarios. The state also needs the type of data analysis being done by the private sector such as with insurance companies. There is not enough interaction presently between the state and the private sector so that policy can work in tandem with innovation.

Beyond Fossil Fuels: Energy Industry Perspective – Sharon Tomkins

Fossil fuel is the engine of our economy, but we are still making strides on other ways. California has one of the cleanest electric systems out there. This is because California invested early on, and incentivized solar and wind to move away from coal. Natural gas has been a part of cleaning up this system, as California received about 40% from its energy from natural gas. It is the unsung hero behind renewables. SoCalGas is behind the 2050 carbon neutrality goal. To do this, we will need to innovate and develop carbon capture use and sequestration. SoCalGas has committed to replace 20% of its tradition gas supply with renewable natural gas (RNG).

We also need a resilient energy system. Currently we have the electric and gas sectors. If we move to just one of those solutions, we're moving to a less resilient system. We need to start thinking about our energy system as an integrated system that considers solar, wind, renewable natural gas, fuel cells, hydrogen, etc. This will create a more resilient system, and one that is affordable. RNG is a critical technology to reducing carbon emissions from the agricultural sector and waste streams. Replacing less than 20% of the traditional gas supply with RNG has the equivalent greenhouse gas reductions as building electrification at less cost and consumers don't need to switch out their energy infrastructure and appliances. To get to carbon neutrality we need to use all of the energy systems we have today, and adopting them at scale by 2030, along with additional solutions like carbon capture. We are behind the times when it comes to power-to-gas. We need to think globally and holistically. How we innovate matter.

Californians' access to reliable infrastructure & services including power – Cliff Rechtschaffen

California is pioneering innovative climate mitigation policies, but also pioneering what climate change looks like. We've had 7 of the 10 most destructive wildfires in the past four years. Fire season has increased by 78 days over the last 40 years. Currently, 45% of the state is in high fire areas. Expenditures are outpacing budgets, and are close to \$900 billion per year, strongly impacting the utilities and causing a climate-induced bankruptcy. Wildfires are causing great costs in damages and insurance. In response, we have seen an increased reliance on public-safety power shut offs. The PUC is trying to provide programs for greater resiliency. Utilities will face very large expenditures to deal with climate change and wildfires. The three largest energy utilities will spend around \$3.2 billion on wildfire mitigation plans this year alone.

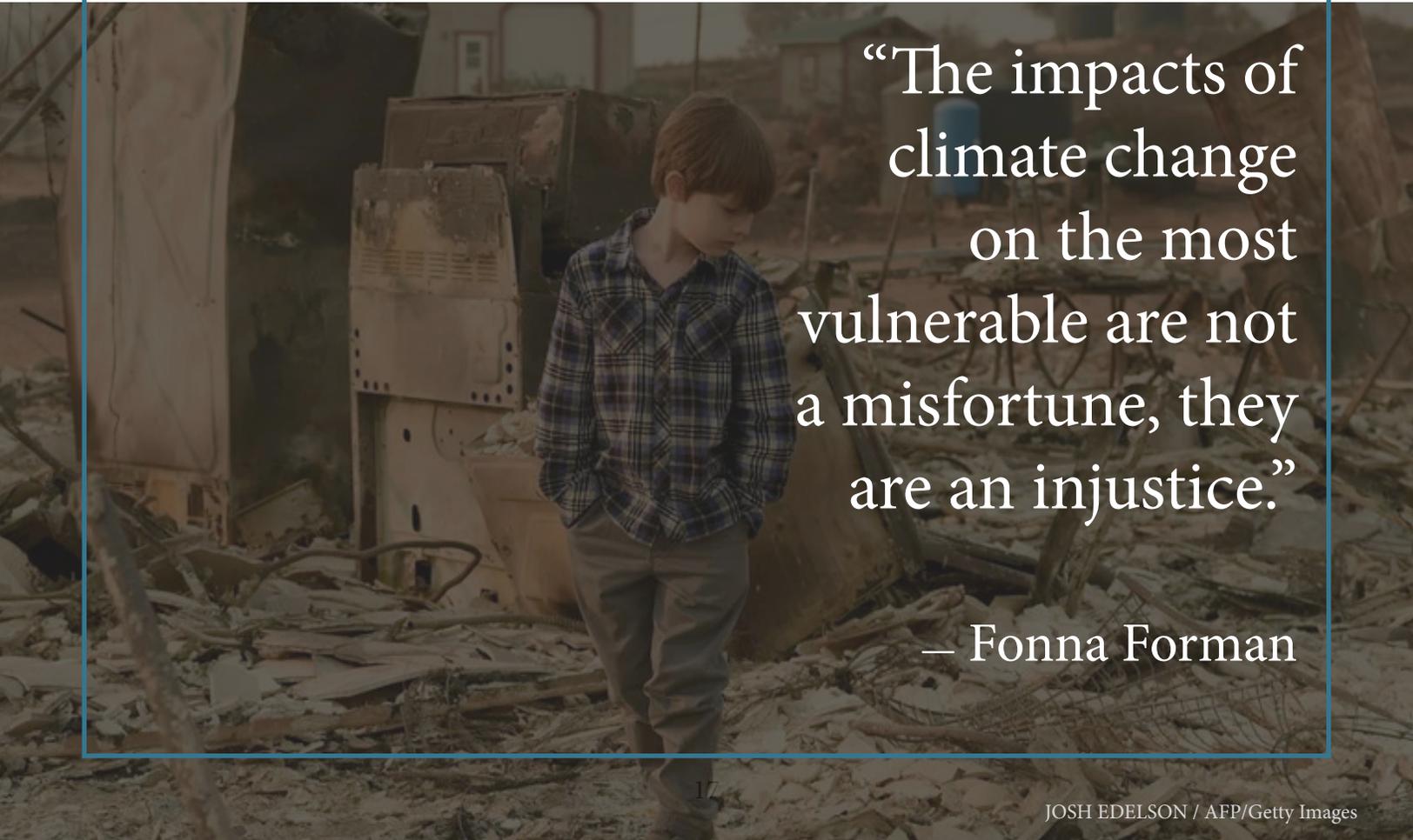
Large scale investments will be needed to keep the grid resilient. Beyond those investments, to meet our climate goals everything will need to be electrified—we will need grid decarbonization, and transportation and building electrification. Although we have made considerable progress in decarbonizing our electricity system, we have not made very much progress yet in decarbonizing our transportation and building sectors. The building sector poses a particular challenge. California's existing building stock relies significantly more on gas rather than electricity (as compared to the rest of the US). California will need to spend a lot of money to electrify, while at the same making investments to maintain the safety of our gas system until we transition away from use of gas. There is a need for lots of incentive money for retrofitting buildings and encouraging purchases of electric vehicles, as well as for the development of new technology to speed electrification in these two sectors.

The Human Face of Climate Crisis & Need for Social Transformation – Fonna Forman

There is a difference between misfortune and injustice. Where to draw the line between these two and assign responsibility is a political act. The impacts of climate change on the most vulnerable are not a misfortune, they are an injustice. Ultimately, climate justice is about a responsibility gap. Climate change is predicted to become the biggest driver of human displacement over the next decade, with 10% of the global population at risk. Climate justice demands that those who cause harm, and those who benefit from harm, bear primary responsibility to remediate and mitigate harm.

Social solutions need to keep pace with other climate solutions. Broad climate literacy is essential to saving millions of tons of carbon in the US and across the world in the coming years. People who are not motivated by social justice or public goods, or who are inured to the status quo, will not be moved by justice claims, so we need to find a different approach. People are likelier to support climate friendly policy when the negative effect of climate change are made concrete and relevant—local and meaningful—rather than something far off like melting ice caps. Public health can also be a lever for social change. We will be more effective communicating if we reframe our message from a language of duty to a language of prudence; from a language of climate justice toward a language of personal health well-being. From a language of the other, to the language of the self.

UC San Diego Community Stations are a network of field stations in four communities located on both sides of the border where University researchers and community-based non-profits collaborate on climate education, clean energy solutions, and adaptation strategies. Bending the Curve looks to develop sophisticated research-based tools for climate solution literacy at all ages. The course mobilizes students to think about values and collective action. The goal now is to keep expanding, into Mexico as well.

A young boy with reddish-brown hair, wearing a blue and white plaid shirt and grey pants, stands in a field of rubble and debris. He is looking down and to his left. The background shows a destroyed building with exposed rebar and a blue water container. The scene is dimly lit, suggesting a somber or desolate atmosphere.

“The impacts of
climate change
on the most
vulnerable are not
a misfortune, they
are an injustice.”

— Fonna Forman

Session: C4S Living Laboratories

Chair Remarks – Walter Oechel

Walter Oechel opened with a discussion on how model systems can show what can be done about climate change. In the Arctic, a flip in net sink to a net source of carbon due to warming and drying over recent decades has been demonstrated. There is a feeling of pessimism because science has been relatively well understood since the late 1970s. It has been much harder to get effective policy going. On the other hand, we have fantastic minds and solutions along with the government of California, which gives optimism.

Global to local: negative emissions in agriculture and California lands – Benjamin Houlton

10 x 10 x 2050, what does this mean? The first 10 is the billion tons of CO₂ that we need to find a way to capture from the atmosphere starting in 2050 that needs to be scaled to 20 billion tons by 2100. The second 10 is the population approximation in billions of people. We have to address both of these challenges simultaneously.

What if people changed their diets? There are some useful arguments for dietary shifts, but it's a challenging problem from the perspective of choice. Even if people did follow such a diet like the EAT-Lancet diet, you still have no chance of getting to negative emissions. For every investment in something like dietary choice, you get double the greenhouse gas benefits through a technological innovation. If we want a world that has more food for more people in a nutritious way, we have to incentive new technologies in agriculture, and agriculture thereby becomes the single greatest vehicle to getting to negative emission. We estimate you can get to -30 billion tons of carbon capture through technological innovations that are already at our disposal.

New agricultural technologies have pretty reasonable price points, estimates are between \$10 and \$300 per ton of CO₂ consumed. This is in comparison with other new technologies like direct air capture, which is close to \$600 per ton.

Can we accelerate Earth's natural climate brakes in a way that brings about substantial co-benefits in food production and soil health? With this project, rather than capturing the carbon in its organic form, we put it into an inorganic form, a very stable way to secure carbon and keep it locked up for tens of thousand of years. This proposal was put together through the C4S Working Lands Innovation Center, and was funded by the Strategic Growth Council. This project also includes working with biochar and compost. We have asked the farmers, what do they want to see? The idea is to deploy these technologies, then measure the things they are most interested in such as yield estimates, increased water and nutrient efficiency, and crop resilience, among other things.

Microgrid for adaptation (to fires) and mitigation – Byron Washom

The future of California's energy system needs to be supported by a flexible and robust distribution and transmission infrastructure. This part is weakened and failing, due to public safety power shutoffs. Microgrids have been mentioned as a possible solution, but they have in the past been designated for primarily high reliability clients (e.g. hospitals, military bases, airport, universities, etc.).

Vehicle-2-Grids is a program where an electric vehicle can not only receive a charge for transportation purposes, but it can also return electricity to the grid. These vehicles can provide residences and business an opportunity for short-term back-up supply rather than diesel or gas generators. This is just one example of the work that is being done at the UC.

It is imperative that we now increase our emphases on distributed energy resources. Whether it be a nanogrid, the size of the building, or a microgrid the size of a campus, and really show the ability that this is a mitigating measure for public safety power shut off that affects millions of Californians. Distributed energy resources may come in a box, but integrating them into nano and micro grids does not, and that is the challenge we have before us.

Four years ago, we suggested that rather than seeing the natural maturation of commercialization of a technology, we needed the big bang with a high growth and immediate demand and a responsiveness of technology. I was incorrect by suggesting that the big bang was going to come from technology innovation. It in fact has come from public policy. It has come from the authorization to allow regulated utilities in time of need to shut off electricity to large areas of California.

Climate Action at Caltech with the Resnick Donation – Neil Fromer

At the end of September, we were given an extraordinary commitment by the founders of the Resnick Institute at Caltech of \$750 million dollars over the course of ten years to supplement the programs at Caltech towards environmental sustainability and fighting climate change. This is both a very large sum of money and also, it is a drop in the bucket compared to what needs to be spent on climate change and environmental sustainability given all of the major challenges we are facing. We have been taking very seriously the fact that we need to collaborate with others to think about new technologies and ways of thinking about the problems that we need to solve, but also to do this in a way that is true to the guiding principles and strengths of Caltech as an institution.

Resnick Institute was founded ten years ago with a mission to foster transformational advances in energy science and sustainable use of natural resources. This new investment is going to expand that along three key directions. One is investment in state-of-the-art facilities for research. Another is investing in sustainability education. The third, and bulk of this, is developing science and engineering research programs that have the potential to facilitate this transformational change. With this gift we are focusing on four main areas of research: sunlight-to-everything, climate sciences, water resources, and ecology & biosphere engineering. These are areas with the potential for global impact and that leverage strengths at Caltech and the Jet Propulsion Laboratory.

This opportunity is giving us a chance to start a broader discussion across the campus on how to embed sustainability education into the undergraduate and graduate curriculum, so that all students will have learned about science through the lens of sustainable use of natural resources.

Closing Plenary

The entire closing plenary was livecast, and the recording can be viewed [here](#).

Co-Chaired by: Wendell Brase & Margaret Leinen

Summary of Brainstorming Sessions

In this session, both chairs from each group went up to present their summaries. Below is a combined synopsis of their final thoughts (see appendix ii for list of chairs and participants of each session).

Session I Climate: Societal Transformation, Governance, and Adaptation

Take home message is two words: shark tank. Actually, carbon tank. This session discussed how C4S could create more of a process that would allow the researchers who are developing these ideas to connect better, this is a systems-thinking approach. These are tremendously complex problems that cannot be addressed individual. So, how can C4S create the infrastructure to connect these researchers with expertise they need for a systems response?

Discussed how C4S could evolve the model beyond just an academic research proposal perspective where C4S is stepping up more as a translator, connector, and convener along with their original vision. The idea behind this is having a dashboard of metrics where you can take a proposal and see how it's doing along these metrics that have been previously identified. We see C4S as really having this function of connecting experts to help further evaluate and refine the proposal.

Session II Technology Measures

There was a lively discussion, which gave rise to four general areas where we saw promise for C4S investments or at least for investigations over the next six months. One technology that did not receive a lot of attention in the snapshot document was offshore wind, which is becoming a much more mature technology in other parts of the world. The second one was in the general area of storage. There is one hydrogen project in the portfolio at Irvine that has the momentum, but perhaps get more information for what else is out there in terms of hydrogen. Third, there was interest among the group with microgrids, which may be more of a technology for reliability than a solution to reduce warming. However, microgrids can support other solutions. Perhaps C4S could help define what a microgrid is. There is the DOE working definition, but, based on the technologies covered in our group, the issue is that it should be a dynamic platform that can involve all the different technologies that we covered. There is also the importance of a roadmap in terms of microgrids to facilitate deployment. Fourth, other topics of discussion included how the transportation sector relate to energy storage, and how that plays into microgrid independence. The Strategic Growth Council in their wisdom initiation a transportation study and we should tap into some recommendations from that group.

Additionally, there was a discussion around software, and the importance of how microgrids and the ability to have AI, blockchain, and other features that allow a new energy market where distributed assets and players can play with large top-down assets. With all of the technologies covered, the point is that it is not an "either/or", it's an "and".

Session III Atmospheric Carbon Extraction

The conversation was kicked off by a short presentation from the Salk Institute about their plant project, which then led most of the conversation that was focused on biological means of extracting CO₂. One challenge, which was mentioned earlier in the day, is the lack of a target for natural and working lands at the state level, translating into a lack of resources for growers and farmers. There was an extensive conversation around accounting and verification, that it is costly and burdensome. Also discussed was the general status of accounting for carbon in the natural and working lands sector. We need transparent accounting and trends.

There was a lot of conversation around the price of carbon, and whether or not this is something that is key to the discussion and considering whether we should be talking about these solutions as something that is low cost or high cost. We also discussed translating solutions into the private sector, considering the environmental impact of a solution versus the return on investment which can become a tension for some companies.

Next steps for C4S could include trying to match these challenges with policy levers. What does that look like for C4S as an organization? Perhaps doing a request for information from the state. Lastly, who is in the room during these discussions? Make sure we have the right group of people. The C4S model seems like a logical conduit to provide information that is germane to decision-making in Sacramento at a variety of places.

One major takeaway from the discussion is that we're going to need a multiplicity of solutions. The second major takeaway is that it is high time we allow science and data to drive policy and not the other way around.

Panel discussion: What did we miss thus far?

Panelist included Jack Wadsworth, Kahne Krause, Kate Gordon, William Collins

The panel began with a short introduction of panelists by Wendell Brase, who then asked each to make an opening remark (See appendix iii for transcript of the remainder of the panel Q&A, and subsequent open floor discussion).

Jack Wadsworth, what did we miss? First, energy savings (see: Reinventing Fire). Shows that a lot can be done with energy savings if you focus on rates of return and existing technologies. Second, the extrapolation and multiplication of the microgrid to solve the energy problems of the future. Finally, the end game for California is a microgrid and no PG&E, and I'd like to see C4S lead some research that will deal with that end game.

Kahne Krause, place here today is from the private sector. Dimensional Fund Advisors are an investment management company that takes some of the best financial science and implementing into solutions for investors. Manage just under \$600 billion in asset. A few years back, we put together a sustainability council of financial advisors. Our intention here today is to expand our learning in how we think about applying sustainability scores to public companies. Topics from today can impact how we engage with companies. There's so much that the private sector can bring in helping academia, C4S, and public policy.

Kate Gordon, we talked about California as if it's its own island ecosystem without relationships to other places. California should have the conversation regarding regional grid and connecting with other entities. We are very solar focused in this state, but there are a lot of other things out there to consider. Policy is not just about regulation and setting metrics, it's also about finance. Because state investments are taxpayer dollars, there is a heightened responsibility to be fiscally responsible. Economic prosperity may not last forever, and we need to consider where the private sector can be leveraged to offset government grants.

William Collins, as a physicist I look at climate change through the lens of incentives, what incentivizes people to do the right thing? C4S should consider what is going to make doing the right thing the easy thing. That is an important tipping point. Thinking of the issue of tipping points, both positive and negative, is critical. The other gap is that for C4S, which also applies to Berkeley and LBNL, is the point of being able to work across sectors. This is critical for the success of C4S, and something that is deeply antithetical to the way that most universities function. There needs to be a relay race where everyone is passing the baton, but no one person being asked to run the entire race.

Next Steps – Wendell Brase & Margaret Leinen

Wendell Brase: There was one elephant in the room today, seasonal storage. Mentioned often, but no one proposed any type of study or policy for it. This is a big problem that we do not want to ignore. Private sector contribution and participation in this is invaluable.

Margaret Leinen: What we've heard is a big call for using the convening power of C4S. A next step is for C4S to engage in an internal process to ask, are we ready for that? What would it take? Engage with primary stakeholders to see if they're willing for C4S to step up to the plate. Perhaps it is not broad enough, or does not include enough constituencies. Discussions should be around if they're ready to move to the next level and what that would take in terms of partners and resources.

It is interesting to see changes from the first meeting in over a year, people are calling for a lot more this time. This is a testament to C4S and the credibility they've developed and the magnitude of the problem.

Close the Meeting – Ben Houlton

The simple hypothesis that we all subscribe to is that we're better together than we are apart. C4S has brought a group together through convening power and identified major opportunities to continue dialogue to solve the challenge in front of us. The goal of C4S is impact. Academia has not been successful on climate change. We have to invert the way we function. Today we also identified some of who's missing from the meetings.

One thing C4S can do is identify the trade-offs to any kind of intervention. That's where the science comes in to inform policy. Of all the goals set out, we are way behind on the carbon extraction front. We have no scalable example of carbon being extracted from the air in a meaningful way.

What is C4S going to do next? Originally, we had this notion of a solutions report. The feedback from today is that this needs to be much broader and include C4S strategy. We are going to convene with the steering committee to discuss next steps. For example, how we can help provide a roadmap on mitigation and adaptation and not separate the two.



Appendix i

Opening Plenary Session: Panel Discussion: Roles of Universities

Chaired by Sandra Brown, panelist included David Phillips (DP), Matthew Dumlao (MD), and Ganesh Raman (GR)

1. Question – What is the most important roles for universities to play in advancing climate solutions?
Answers –
GR: Ensuring intergenerational equity, producing authentic data, and focusing on education.
DP: Agreed with GR, but also emphasized that universities should also be living laboratories and testing grounds.
MD: The state can demonstrate that cap and trade can work, that climate change policies can work, and that solutions can work to be scaled worldwide. Also, state leadership can tap into universities via grants and by coordinating amongst universities and stakeholders.
GR: Funding cannot be on a start/stop basis, but rather needs to have long-term stability for university research towards solutions.
DP: We have a need for scalable solutions, and UCs as a large institution can tap into renewable energy, something that can't be done individually. All the work being done by C4S can be shared with other networks beyond the US.
2. Question – What challenges are faced when universities and the state try to work together?
Answers –
GR: Universities cannot work in isolation, and need to improve clarity about threats from the onset.
DP: Universities need to improve their listening about state's needs.
MD: Long-term research should be supported by the state, cultivating relationships with Universities to get scientific feedback.



Appendix ii

Working Group Sessions

Session I Climate: Societal Transformation, Governance, and Adaptation

Chaired by: Ken Alex & Amber Mace

C4S Notetaker: Bridey Sculley

Participants: Wael Al-Delaimy, Jeffrey Ball, Biff Barnard, Max Beller, Johnathan Cole, Bill Collins, Eugene Cordero, Serge Dedina, John Foran, Fonna Forman, Neil Fromer, Kate Gordon, Vince Hall, Julie Henderson, Tianzhen Hong, Glenda Humiston, Charles Kennel, Megan Matson, Mike Mielke, Jyoti Mishra, David Nielson, Cliff Rechtshaffen, Matt St. Clair, Jim Thebaut, Sharon Tomkins, Karen Umland, Mark Wenzel, Durwood Zaelke.

Session II Technology Measures

Chaired by: Catherine Von Burg & Roger Bales

C4S Notetaker: Astrid Hsu

Participants: Roger Bales, Matt Barth, Wendell Brase, Elliott Campbell, Michael Davidson, Jorge Elizondo, Jeff Ghilardi, Lars Herlitz, Lars Herlitz, Mark Jacobson, Pramod Khargonekar, Sarah Kurtz, Ronnen Levinson, Peter Luchetti, Tapan Pathak, Wendy Pulling, Jeffrey Reed, Catherine Von Burg, Jack Wadsworth, Byron Washom.

Session III Atmospheric Carbon Extraction

Chaired by: Mac McQuown & Louise Bedsworth

C4S Notetaker: Lifang Chiang

Participants: David Ackerly, Roger Aines, Justin Allen, Joaquin Busch, Joseph Chi, Joanna Chory, Matthew Dumlao, Leah Fisher, Kiki Goshay, Ashley Green, Ryan Hanna, Josiah Hunt, Ken Janda, Ben Houlton, Kahne Krause, Walt Oechel, Clyde Ostler, David Phillips, Greg Stangl, Tony Stiegler, Josette Lewis.



Appendix iii

Closing Plenary Panel discussion: What did we miss thus far?

Panelist included Jack Wadsworth (JW), Kahne Krause (KK), Kate Gordon (KG), and William Collins (WC)

1. Question - Some view it as useful, because they incentivize progress. Others view policymaking that picks winners and losers is a mistake. What are your views about having specific climate policies in California?

Answers/discussion –

JW: Policies in China are designed to pick winners and losers. Sometimes it works and sometimes it doesn't. The one place that is has worked in climate change. At the Energy Institute there are initiatives in the cities, industries, transportation, manufacturing, buildings, etc. I would not subscribe to that in the US. We have a system that works well based on market incentives and policy at an overriding level, and I think we got it right.

KG: Agreed. China is picking winners and loser, but with a different set of metrics than we are. They're looking primarily at air quality, because it's an immediate issue. They also made a decision in their 5-year plan that they wanted to be a net exporter of clean energy technologies. These are really air quality and export policies that work because they do everything at scale. We should reflect on our own metrics. Policies should set clear metrics, and allow for innovation within that, rather than going to the level of picking winners. In reality, there are areas where that is very difficult, such as with transportation where we picked the combustion engine as the winner.

KK: I believe that markets work, and I have a lot of confidence in the markets. But this is a complicated question because sometimes the things that drive government are not always based on data and science because other political things get involved, and it gets messy. A lot of this can be addressed if left to market forces. In an ideal world, I see the market as part of the solution. We try to influence good behavior in corporate governance.

WC: Agree that markets work. We also should recognize that that the fossil fuel economy is built on hefty subsidies that have skewed the market. So, the market is responding to false subsidies the government has put in place. We have not expressed a lot of costs that are associated with climate change and risk. A lot of mutual funds do not assess climate risk as part of their fiduciary responsibility. This is something that could be incentivized through public policy. To put it bluntly, the climate cares about the amount of CO₂ in the atmosphere, that is the metric that drives the greenhouse effect.

KG: This comes up a lot in the private sector, where people always say solar is a great example of the market working because the prices came way down. But climates came down because of Chinese and German policy. Together, these policies created a whole ecosystem of solar which drove US prices down.

2. Question – If we were actually incurring the full cost of carbon, both as individuals and as corporations, then policy could be more goal specific and less mean specific, is that what you're saying?

Answers/discussion –

WC: Speaking as a physicists and not an economics, that is what economics who have looked at this problem tell me. Exposing the true cost of carbon and its risks would help put financial incentives around moving away from emitting.

KG: It would also create all kinds of complicated transition issues. People have made choices based on an existing system that is artificially cheap. If it were then incorporating the full cost would become much more expensive, and there is a differential ability to deal with that. These transitions issues are difficult for the market to deal with.

WC: In response, the idea is to give the money back to the private citizens. You get stung at the gas pump, as a negative signal, but in the end you're not economically disadvantaged if you integrate it over a year.

JW: There's a very important debate going on in the world of investing about the stress between short-term thinking and long-term thinking. Optimistic that long-term thinking is gaining momentum. Solar panels coming from China is a clever long-term investment plan. If we had a reliable global social cost of carbon that would be a big help. There's the Sustainable Accounting Board that is dedicated to reliable disclosure of environmental harm that's done by publicly traded companies. These types of initiatives will produce data that will make pricing expensive, which will translate into the stock process of these companies.



3. Question – What do you see as the big transitions needs for microgrids to expand as part of the electrical grid?
Answers/discussion –
JW: Eliminating regulations that inhibit the creation of the microgrid.
KG: Let's go back to the not picking winners comment. These are complex systems. For example, Los Angeles has a large proportion of the state's transmission lines, coming in from Oregon. It's a small-scale solution, and I'm not convinced it's the only solution for every part of the state.
KK: Microgrids are really cool, but this is going to require multiple solutions. They can be part of the solution, and can also provide inspiration.
4. Question – (for Cliff Rechtschaffen) What sorts of things need to happen to allow that option to grow as appropriate?
Answers/discussion –
CR: Microgrids do not bend the curve. They are very important for resiliency and as an adaptation tool. The CPUC is promoting microgrids and coming up with a roadmap and tariff. Microgrids are only part of the puzzle.
5. Question – (for Bill Collins) You raised the tipping point of coal. What about other tipping points, ones that you or the audience are thinking of that would be important for C4S to look into?
Answers/discussion –
WC: One is the issue about what happens when insurers get extremely nervous homes at the exurban forest interface. This will alter the conversation around how we manage that perimeter quite a bit. Another one is that it is currently cheaper to operate an electric vehicle than a gas vehicle. What is holding people back is purchase price and range. Slight regulatory prohibitions could radically alter the cost-benefit analyses that companies are making.
JW: The history of mankind predicting trends is really quite good, but predicting timing is pretty terrible. One tipping point we may be look back on is Saudi Aramco going public. Selling their only asset to build a service economy, which is going to be hard.
KK: California is a tipping point. We're ahead of the curve thinking about these things.
KG: There is a tipping point on carbon removal. Combination of federal law that gives incentives for carbon removal and the California low carbon fuel standard which gives bigger and more valuable incentives creates a moment of oil and gas companies diversifying into carbon removal.

Closing Plenary Open Discussion with Panel

Wendell Brase: What did we miss, what should we still discuss?

1. Question (**Wael Al-Delaimy**) – Who are the largest population of skeptics that we need to talk to? How can we scale from California to others where there is still a resistance?
Answers/discussion –
KK: These ideas are taking hold across the country. These messages are affecting people's day-to-day buying decisions. Continue educating others, the attitudes are already changing. Investments for future (retirement) is shifting, and younger generation are driving these things.
WC: Another tipping point is if we could get climate change to be sexy, that is half the battle. Need to appeal new demographics.
KG: Talk to people from where they are starting and understand where they are. Not a moral argument. Be honest about solutions and the time of transition that we're in.
2. Question (**Ken Alex**) – What is missing is a focus on short-lived climate pollutants (methane, black carbon, and CFC).
Answers/discussion –
WC: The state has made large strides on black carbon. Methane remains as issue. Discussion today about how clean methane is. We need to keep in mind that information we're getting today is vastly underestimated.
3. Question (**Daniel Fernandez**) – Isn't hydrogen just a form of energy storage?
Answers/discussion –
Mac McQuown: Yes. Beauty of hydrogen is that it not only stores energy, but readily transforms into electricity.



4. Question (**Kiki Goshay**) – How will C4S influence policy that would help accelerate this?
Answers/discussion –
WC: State is beginning to embrace legislative measures around adaptation, but there's room to grow there. That is an opportunity for C4S to be highly influential. C4S is going to be intentionally impactful in discussion existential threats to the state that need to be quantified so the state can start thinking through strategies for existential threats.
KG: There is already a thing that C4S is doing that the state would find extraordinary helpful in shaping policy, and that's the risk report.
5. Comment (**Mario Molina**) – Connecting the last question to the first. The elephant in the room is the White House position on climate change. Announcement that the US pulling out of the Paris Accord, which has an international impacts. California should be seen as an example of what has to be done internationally.
6. Comment (**Catherine von Burg**) – With regard to policy and a hard and fast example, I represent industry. We have projects all over California that can't get sign off on interconnection rules from PG&E, Southern California Edison, and San Diego Gas & Electric. Microgrids aren't the singular solution. There are many technologies that need to work in concert with microgrids. We don't have a free market, they are skewed by the PUC and policies that won't allow commercial industrial and residential owners to purchase the technology to put out that capital themselves, they're being delayed for months, and now their power is being shut off. How can we create a market when consumers themselves see the solution and they are being prevented and not supported?
7. Comment (**Jack Wadsworth**) – Is there a role for C4S in a leadership position to develop priorities around climate policy?
8. Comment (**Glenda Humiston**) – We are going to have a hard time moving policy and science forward if we don't get a larger percentage of the public engaged and on board. We need to bring in a lot more partners, for example the community colleges. Cooperative Extension should have been a part of putting together these proposals. We are not utilizing UC county offices. We need to create more opportunism for citizen science. We have a scientifically illiterate public. We have to turn that around. Need to use the infrastructure we have, and not reinvent it.

Closing Plenary Closing Remarks

Question, do others have suggestions for next steps?

1. **Greg Stangl:** Cannot encourage C4S enough or engage in the policy sphere. If you don't know a senator, you can't build anything in his state. Let's act urgently. California functions on policy, it cannot be side stepped.
2. **Kate Gordon:** Job is to look out for the entire state, and that means every region and sector and community. When you're engaging with policy you have to consider unintended consequences. It's a balancing act.
3. **Wael Al-Delaimy:** Group of epidemiologist has started to produce evidence base policy briefs such as on climate and health. I propose this group with little training, and I am happy to help can create a policy brief for policy makers. Need to be short, to the point and focused. This can help move policy and is missing. Also, health is going to be a way to target those who are in denial and are saying it is irrelevant. I can provide a book with Ram on climate and health for reference.



Appendix iv

List of Summit attendees, by sector

Attendees: Academic Sector

David Ackerly

Dean, College of Natural Resources, UC Berkeley

Roger Aines

*Energy Program Chief
Scientist, UC LLNL*

Wael Al-Delaimy

*Professor and Chief of the
Division of Global Health,
UC San Diego*

Ken Alex

*Director of Project Climate,
UC Berkeley*

Justin Allen

*Project Manager of CROPS,
The Salk Institute*

Roger Bales

*Professor of Engineering,
UC Merced SNRI*

Aimee Barnes REMOTE

*California-China Climate
Change Institute, UC
Berkeley*

Matt Barth

*Director of the College of
Engineering Center for
Environmental Research and
Technology, UC Riverside*

Darbi Berry

*Climate Adaptation
Specialist, San Diego
Regional Climate
Collaborative, USD*

Wendell Brase

*Associate Chancellor for
Sustainability, UC Irvine*

Sandra Brown

*Distinguished Professor,
Psychology & Psychiatry;
Vice Chancellor for
Research, UC San Diego*

Wolfgang Busch

*Associate Professor of Plant
Molecular & Cellular Biology,
The Salk Institute*

Elliott Campbell

*Gliessman Presidential Chair
in Water Resources and Food
Sustainability, UC Santa
Cruz*

Joanne Chory

*Director of Plant Molecular
and Cellular Biology Lab,
The Salk Institute*

Jonathan Cole

*Professor of Physics,
Mira Costa College*

Bill Collins

*Director, Climate & Ecosystem
Sciences Division and
Environmental Resilience
Accelerator, UC Berkeley LBL*

Eugene Cordero

*Professor of Meteorology and
Climate Science, CSU San
Jose*

Michael Davidson

*Assistant Professor, School of
Global Policy and Strategy, UC
San Diego*

Fernando De Sales REMOTE

*Assistant Professor of
Geography, CSU San Diego*

Zaelke Durwood

*Visiting Professor, UC Santa
Barbara; President of IGSD*

Ivan Evans

*Professor of Sociology;
Provost at Eleanor Roosevelt
College, UC San Diego*

Laura Fandino REMOTE

*Assistant Dean; Professional
and Continuing Education,
UC San Diego Extension*

Daniel Fernandez REMOTE

*Manager of the Sustainable
City Year Program, CSU
Monterey Bay*

John Foran REMOTE

*Professor of Sociology, UC
Santa Barbara*

Fonna Forman

*Associate Professor of
Political Science; Director of
the Center on Global Justice,
UC San Diego*

Neil Fromer

*Executive Director of the
Resnick Institute, CalTech*

Ashley Green

*Director of Development, UC
Davis*

Ryan Hanna

*Postdoctoral Researcher,
Jacobs School of
Engineering, UC San Diego*

Tianzhen Hong REMOTE

*Computational Staff, UC
Berkeley LBL*



Academic Attendees cont.

Ben Houlton

Professor & Chancellor's Fellow; Director of the John Muir Institute of the Environment, UC Davis

Glenda Humiston

Vice President, Agriculture & Natural Resources, UC Office of the President

Ken Janda

Professor and Dean, Department of Chemistry, UC Irvine

Mark Jacobson REMOTE

Director, Atmosphere and Energy Program, Stanford

Daniel Kammen REMOTE

Professor and Chair, Energy and Resources Group & Goldman School of Public Policy, UC Berkeley

Charles Kennel

Professor Emeritus, Scripps Institution of Oceanography, UC San Diego

Pramod Khargonekar

Vice Chancellor for Research; Distinguished Professor of Electrical Engineering and Computer Science, UC Irvine

Sarah Kurtz

Professor at the UC Merced School of Engineering

Margaret Leinen

Director, Scripps Institution of Oceanography, UC San Diego

Ronnen Levinson REMOTE

Energy/Environmental Policy Staff Scientist/Engineer, UC Berkeley LBL

Michael Loik REMOTE

Professor of Environmental Studies, UC Santa Cruz

Jack Miles REMOTE

Distinguished Professor Emeritus of English & Religious Studies, UC Irvine

Jyoti Mishra

Assistant Professor of Psychiatry, UC San Diego

Walter Oechel

Director of the Global Change Research Group, CSU San Diego

Tapan Pathak

Specialist in Climate Adaptation in Agriculture, UC Merced

David Pellow REMOTE

Director of the Global and Environmental Justice Project, UC Santa Barbara

Michelle Perez

Campus Energy Engineer, UC San Diego

David Phillips

Associate Vice President for Energy and Sustainability, UC Office of the President

Daniel Press REMOTE

Executive Director of The Center for Agroecology and Sustainable Food Systems, UC Santa

Wendy Pulling

Director of ESG Integration, UC Office of the President

Ganesh Raman

Assistant Vice Chancellor for Research, CSU System

V. Ram Ramanathan

Frieman Presidential Chair in Climate Sustainability, Scripps Institution of Oceanography, UC San Diego

Jeffrey Reed

Chief Scientist, Advanced Power and Energy Program, UC Irvine

Dominique Roche

CROPS Project Manager, Salk Institute for Biological Studies

Leila Sievanen REMOTE

Program Officer, Multicampus Research Programs and Initiatives, UC Office of the President

Matthew St. Clair

Director of Sustainability, UC Office of the President

Anthony Stiegler

Harnessing Plants Initiative Advisor, The Salk Institute

Katarina Trojnar

Senior Director of Development, UC San Diego

Byron Washom

Director of Strategic Energy Initiatives, UC San Diego Deep Decarbonization Initiative

Richard Widick REMOTE

Visiting Scholar, Orfalea Center, UC Santa Barbara

Erin Zlotnik

Director of Development, Corporate Relations, UC San Diego



Attendees: Private Sector

Jason Anderson
*President & CEO,
Clean Tech San Diego*

Biff Barnard
CIO, United Religions Institute

Michael Callahan
*Group Manager, Applied Engineering
Team, National Renewable Laboratory*

Joseph Chi
*Vice President,
Dimensional Fund Advisor*

Jorge Elizondo
*CTO and Lead Engineer,
Heila Technologies Inc.*

Jeff Ghilardi
*Vice President of Technical Strategic
Initiatives, EDF Renewables*

Kiki Goshay
Founder, Goshay Productions

Lars Herlitz
*Managing Partner,
Herlitz Capital LLC*

Josiah Hunt
CEO of Pacific Biochar

Kahne Krause
*Regional Director,
Dimensional Fund Advisors*

Josette Lewis
*Director of Agricultural Affairs, Almond
Board of California*

Peter Luchetti
*Partner, TableRock Capital;
Former Bank of America Executive*

Megan Matson
Partner, Tablerock Capital

Mac McQuown
*Co-Founder & Director,
DCI Investments*

Mike Mielke
*Sr. Vice President,
Silicon Valley Leadership Group*

David Nieson
*Emergency Doctor,
Kaiser Permanente Climate Disaster Plan*

Clyde Ostler
*Director, McClatchy;
Former Vice Chairman of Wells Fargo Bank*

Greg Stangl
CEO, Phoenix Energy

Sharon Tomkins
*Vice President of Strategy and Engagement,
Southern California Gas Company*

Karen Umland
Vice President, Dimensional Fund Advisors

Catherine Von Burg
*CEO and President,
Simpliphi Batteries*

Jack Wadsworth
*Honorary Chairman,
Morgan Stanley, Asia*



Attendees: California State Government Sector

Louise Bedsworth

Executive Director, California Strategic Growth Council

Serge Dedina

Mayor, Imperial Beach, San Diego

Matthew Dumlao

Environmental Policy Advisor, Office of Lieutenant Governor, State of California

Leah Fisher

Senior Research Advisor, California Strategic Growth Council

Kate Gordon

Director, Governor's Office of Planning and Research

Julie Henderson

Deputy Secretary for Health and Public Policy, California Environmental Protection Agency

Cody Hooven

Sustainability Director, City of San Diego

Cliff Rechtschaffen

Commissioner, California Public Utilities Commission

Lydia Van Note

Director of Community Impact & Environment Initiatives, San Diego Foundation Climate Initiative

Mark Wenzel REMOTE

Climate Change Adviser, California Environmental Protection Agency

Attendees: NGO/NPO Sector

Vince Hall

CEO, Feeding San Diego

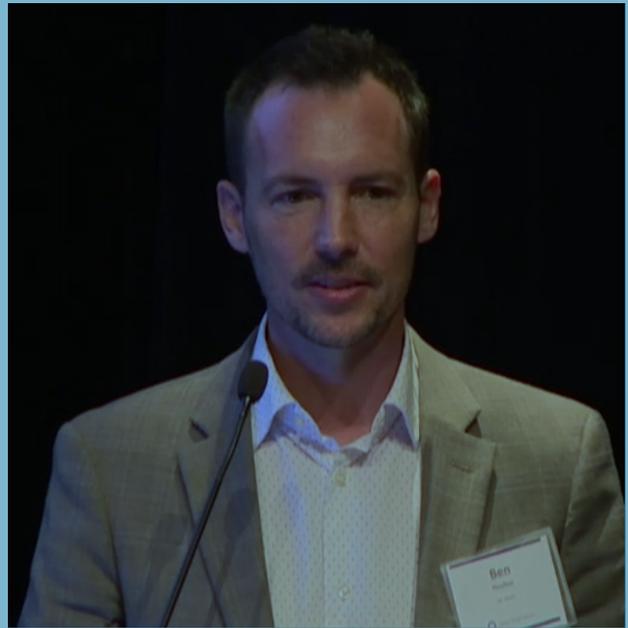
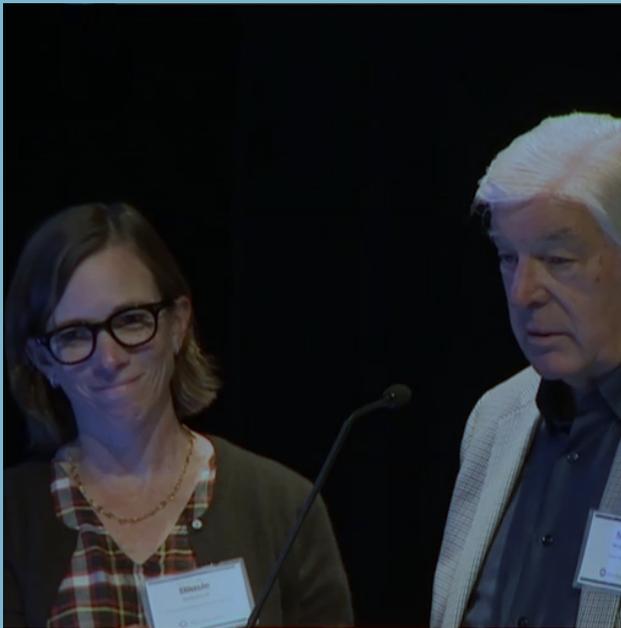
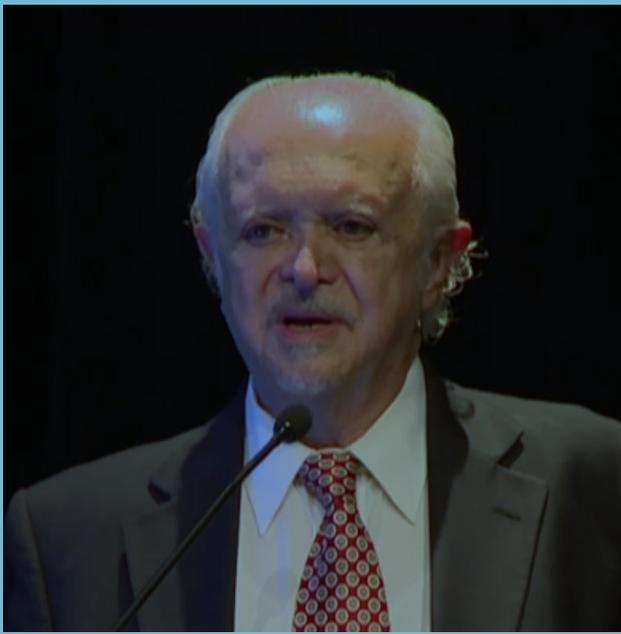
Amber Mace

Executive Director, California Council on Science and Technology

Jim Thebaut

President / Executive Producer, Chronicles Group, Inc.







California Collaborative for
Climate Change Solutions