Panel: The Responsible Transition to Low Carbon Alternatives & Renewables
Moderator: David Dornfeld, Director, Laboratory for Manufacturing and Sustainability, UC Berkeley

- How Behavioral Science Can Lower your Energy Bill
  Jacob Levine, Director for Strategy, Opower Inc.,
- Climate Science & Industrial Impacts
  William Collins, Head, Climate Science Department, LBNL
- Architectural Design for Climate
  Edward Ng, Professor of Architecture, Chinese University Hong Kong
- Green Spirals of Clean Energy Grown
  John Zysman, Professor, UC Berkeley
- Modeling for a "Switch" to Clean Energy
  Dan Kammen, Professor, UC Berkeley

Bill Collins: How to get to a more sustainable situation?
- Influence on greenhouse effect demonstrated using data in Oklahoma over 20 years
- Previous models agree with the observations
- Changes in the greenhouse effect are directly linked to fossil fuel emissions
- There is firm evidence that fracking is influencing the greenhouse effect
- The chemicals can be seen in the data sets
- Spikes from methane leaks show up in the data
- We have moved from model speculation to observational confirmation!

Jacob Levine: How to engage consumers on the demand side?
- How many people have checked Facebook this week? Who has checked their finances? Have you checked your energy consumption?
- We spend less than 10 minutes a year thinking about our energy consumption!
- The Prius is an engineering marvel of energy efficiency but behavioral science plays a big part as well: dominant real time MPG dashboard influences consumer behavior
- Opower have saved more than 6 TW electricity in the first 6 years and it scales: this year 3 TW are projected (about to exceed the amount produced by the Hoover Dam)
- State policy has to enable companies like Opower
- We have to engage people along with the built environment

Edward Ng: Urbanization and sustainable architecture
- Over 50% of people living in cities, this will go up to 70% by 2050
- China builds cities fast, it produces one "London" in 5 years, densification
- People move up to middle class from farming and energy demands go up
- Two key points, **capacity** and **needs** to deal with cities in the future
- We know the problem and we know to solve it, but translation into action is difficult
- Policy happens on a 5 year term, little interest in the long term
- We are still locked into 19th century methods in making cities

Jon Zysman: Green Spirals
- What generates policy support for green technologies?
- Doing things from the top down is difficult, bottom up approach generates spirals
- The problem: "green" starts with significant disadvantages, it is more expensive, nuclear is either completely green or black (catastrophe), etc.
- Coalitions aimed at specific small problems are more successful
- Resistance overcome as companies make money of substituting pollutants
- Green jobs strategy starts addressing a concrete problem
- The key is not only choosing the most effective policies but also the ones that keep going and are sustainable

Dan Kammen: China and US, how could they cooperate on green energy?
- Solution science, interface of energy projects and information, e.g. understanding how many jobs are created per investment, etc.
- Countries can cooperate so that companies can compete
- High resolution models of regional energy systems are needed
- On grid vs. Off-grid world, micro grids need to be able to plug in at a later stage and become assets
- Example of solar lights: company growing from 0 to 150000 customers in a year due to scalability

General Questions by David Dornfeld
- How can we engage companies to speed up
- Life cycle assessment
- California has strong regulations
- Innovation and clear policy environment leads to private sector activity
- Grid companies are powerful channels for delivering and aligning these incentives
- Simple models needed for businesses to make assessments and justify the expenses, because not all companies have the resources for large assessments

Can we learn from the experience in energy to address the water situation?
- Agencies are banking on the water cycle remaining the same it has been for centuries
- Water does not disappear but it will fall down in different places, wet areas will get wetter and dry areas drier
- Water table dropping by several feet a year in southern states
- It is a non negotiable resource
- We need to start pricing water and use big data to be more honest about water use, because if you do not measure it, you do not know if you are doing a better job
- Energy and water are not separate
- Cities need to be designed based on locally available resources

Discussions from the audience
- At a 2.5% level of leakage, gas is as bad as coal, real leakage can be 7-8%
- EPA characterizes point sources, their estimates are to low by a factor of 2

- Gas will probably not remain cheap or remain the ideal fuel