

Germany - California Learning and Collaboration Tour Toward an Integrated Renewable Energy System

Bonn - Düsseldorf - Berlin | March 2014



Report by:



Renewables **100**
Policy Institute

Acknowledgements

The Renewables 100 Policy Institute would like to thank the German Consulate in San Francisco, the Fraunhofer Institute for Solar Energy Systems (Fraunhofer ISE), the German Foreign Ministry, Messe Duesseldorf, the Global Storage Energy Association (GESA), Renewables Grid Initiative (RGI), and the German Federal Environment Agency (UBA) for their organizational support that made the Tour possible.

We also extend special thanks to the California Delegates who participated in the Tour and would especially like to acknowledge the CAISO and the particular support, contribution, and leadership of Board Governor David Olsen throughout the planning, execution, and follow up of the Tour.

We additionally thank the organizations who provided travel funding for Delegates: California Independent System Operator (for their Governors and Staff), Fraunhofer ISE (for Commissioner Peterman), Energy Foundation, Stiftung Mercator, Heinrich Boell Foundation, Messe Duesseldorf, and the German Foreign Ministry with logistical support from the Goethe Institute. We also would like to thank the Stiftung Mercator for providing funding for this report.

Finally, we thank the following for their review of/contributions to this report: CEC Commissioner David Hochschild | CAISO Governor David Olsen | CPUC Commissioner Carla Peterman | Kevin Barker, Advisor to CEC Chair Robert Weisenmiller, Ph.D | Antonella Battaglina, RGI Executive Director | Stephen Berberich, CEO/President of CAISO | Julie Fitch, Advisor to Commissioner Peterman | David Lerch, Advisor to the German Federal Ministry for Economic Affairs and Energy | Philipp Offergeld, Programme Officer at Stiftung Mercator, Thematic Cluster Climate Change, Centre Science and Humanities. Also appreciated for their review of and contributions to sections of the report are: Dr. Harry Lehmann, German Federal Environment Agency General Director | Christoph Podewils, Head of Communications, Agora Energiewende | Craig Morris | Prof. Dr. Eicke Weber, Director of Fraunhofer ISE.

About this Report

The report was published by the Renewables 100 Policy Institute, a 501(c)3 non profit organization, the mission of which is to study and accelerate the global transition to 100% renewable energy.

Published July 2014

© Renewables 100 Policy Institute | www.renewables100.org

Authors:

Angelina Galiteva, Renewables 100 Policy Institute Founding Board Chair

Diane Moss, Renewables 100 Policy Institute Founding Director

Design and Photographs/Videos:

Matthias Bank, Renewables 100 Policy Institute Media & Outreach Director

Cover photos: Matthias Bank, Paul Gipe, Z22

Table of Contents

1. Introduction	1
2. Background: Germany - California Learning & Collaboration Tour Origins	2
3. Tour Program	3
3.1 Bonn and Düsseldorf	3
3.2 Berlin	7
3.2.1 Overview	7
3.2.2 Visit to Agora Energiewende and 50 Hertz	7
3.2.3 Wrap Up with Dr. Harry Lehmann, German Federal Environment Agency	9
3.2.4 Tennet/RGI/CAISO Declaration Signing	15
3.2.5 Visit to "Living Clean Energy Laboratories" & With Policymakers	17
4. Summarizing Answers to 3 Common Questions About the Energiewende	19
5. Top Ten Delegation Take Aways & Recommendations	22
6. Next Steps	26
6.1 Policy - Collaborate on Big Picture Climate Goal and Interim Targets	26
6.2 Technology – Technology Transfer, Knowledge Exchange and Grid Solutions	27
7. Conclusion	27

Attachments

- Attachment A – Tour Delegation
- Attachment B – Schedule of Meetings
- Attachment C – Comparison of Key Climate and Energy Targets
- Attachment D – Attendee List at TenneT/RGI Dinner
- Attachment E – European Grid Declaration

List of Tables

- Table 1. Sample List of Düsseldorf Meetings
- Table 2. Sample List of Berlin Meetings
- Table 3. Development of German Household Electricity Price
- Table 4. Changes in Pure Renewable Energy Support & Growth Factors 2012- 2014
- Table 5. 2014 EEG Surcharge Without Extraneous Costs
- Table 6. Industry Electricity Prices in Germany from 2000-2013 (Euro-cents/kWh)
- Table 7. Photovoltaic Price Index

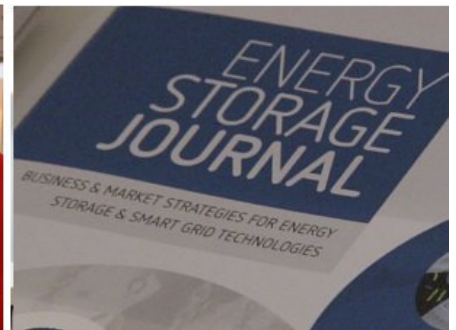
1. Introduction: Why the Visit by California Grid Operators & Energy Regulators to Germany?

Germany and the State of California are both widely recognized and globally respected leaders in the fields of environmental protection and energy. They are both frontrunners, Germany in the European Union and California in the United States, and they both enjoy overwhelming support from their citizens to pursue ambitious paths to greater integration of renewables and aggressive greenhouse gas (GHG) reductions.

Because the power grids and the role of transmission infrastructure are critical to a reliable, flexible and predominantly renewable resource based electrical system, it was clear that a high level delegation exchange focused on these areas would benefit both California and Germany.

The primary objectives of the tour were to:

- Gain insight into Germany's commitment to and plans for the next phase of the Energiewende (German energy transition).
- Learn how German grid operators are adapting to growing quantities of variable resources (such as wind and solar) on the grid.
- Since Germany also has ambitious GHG reduction policies, discover German frameworks for encouraging deployment of new clean energy technologies and market mechanisms that support the deployment of renewables in the energy, heating and transportation sectors.



2. Background: Germany - California Learning and Collaboration Tour Origins

This Germany California Learning and Collaboration Tour was aimed at creating opportunities for continued dialogue and a platform for exchange of ideas, policy, technological breakthroughs and grid management mechanisms. It was the next step in a series of high-level meetings organized and facilitated by the Renewables 100 Policy Institute, which started in 2011 and have focused on identifying areas of mutual interest and opportunities for bilateral support of meaningful climate and clean energy goals.

Germany and California enjoy a rich history of exchange on these issues. For example, California's "million solar roof" vision mirrored Germany's "hundred thousand solar roof" initiative that had been implemented a few years before. The 2004 revision process of Germany's Renewable Energy Sources Act (known in Germany as the "EEG" and popularly known as the German feed-in tariff law) considered elements of the Los Angeles Department of Water and Power's (LADWP) award-winning Green Power for a Green LA program, and LADWP's recently implemented PV feed-in tariff, in turn, was inspired by Germany's successful feed-in tariff, which has resulted in over 35,000 MWs of PV being installed in Germany since the EEG was enacted at turn of the century.

The Board of Governors at the California Independent System Operator (CAISO) and the CAISO Executive team supported the concept of a tour to Germany because it was increasingly clear that the two sides of the Atlantic were dealing with similar technical and policy frameworks on a daily basis and that it would be valuable to understand how Germany was managing their renewables integration challenges and planning the grid of the future.

The Renewables 100 Policy Institute worked in collaboration with the German Consulate in San Francisco, the Fraunhofer Institute for Solar Energy Systems (Fraunhofer ISE), the German Foreign Ministry, Messe Düsseldorf, the Global Storage Energy Association (GESA), Renewables Grid Initiative (RGI), and the German Federal Environment Agency (UBA) to organize and facilitate the logistics of setting up all the meetings and discussions that were to take place during the visit.

As the Learning and Collaboration Tour schedule began to take shape, the CAISO core team was joined by members of the California Energy Commission (CEC) and California Public Utilities Commission (CPUC), with support from the Office of Governor Jerry Brown. Joining the tour as observers were a representative from the Energy Foundation and from two California investor owned utilities (PG&E and SCE). (For a complete list of all Delegates, please see Attachment A.)

3. Tour Program

3.1 Bonn and Düsseldorf, March 23-26

The Delegation's ambitious program included traveling to three cities – Bonn, Düsseldorf, and Berlin – where participants attended numerous meetings and an international conference over five days from March 23-28. (For a detailed schedule of all meetings, please refer to Attachment B.)

The first day started with some of the Delegates visiting Bonn to meet with representatives from the International Renewable Energy Agency (IRENA) and the German Federal Network Agency (Bundesnetzagentur), which has responsibilities similar to the Federal Energy Regulatory Commission (FERC) in the United States and regulates the German grid. The IRENA representative, Dolf Gielen, briefed the group on the agency's worldwide effort to advance renewable energy. Their work includes a recently launched joint initiative with the Clean Energy Solutions Center titled the Renewable Energy Policy Advice Network (REPAN), which aims to help countries develop renewable energy policies and programs and which has gained the support of the United States Department of Energy. Both IRENA leadership and members of the Delegation expressed interest in exploring further opportunities for collaboration with California.

A smaller subgroup met with Solarworld CEO Frank Asbeck, who has long been active in solar development in both Germany and California. He expressed cautious optimism about the state of the California solar PV market, along with concern that the state and the US in general is relying too heavily on “cheap, sub-par Chinese” modules.

That evening, the Delegation was invited to a special welcome dinner hosted by Johannes Rimmel, Environment Minister of the State of North-Rhine Westphalia, of which Düsseldorf is the capitol city. At the opening speech for the dinner, the Minister expressed a strong desire to create meaningful opportunities for collaboration and exchange of best practices in the energy field between the two parties. On behalf of the California Delegation, CEC Chair Robert Weisenmiller, Ph.D expressed California's willingness to work with Germany towards our common interests in the field of energy efficiency, renewable energy, greenhouse gas reduction, and technology transfer.



Day Two of the tour marked the first day of the 2014 European Energy Storage Conference in Düsseldorf. The morning highlight was the California Keynote Panel titled “The State of Energy Transformation in California: Building a Carbon-Free Energy Future.” Moderated by Fraunhofer ISE Director and Conference Chairman Prof. Dr. Eicke Weber, the panel featured five top leaders from California energy regulatory agencies and the CAISO.¹

The panel presented an overview of California’s renewable energy programs and emphasized the fact that the state will meet, and likely exceed, its Renewable Portfolio Standard (RPS) mandate of 33% renewable electricity (excluding large hydro) by 2020. Sights are now set on identifying the next threshold and the technologies and market mechanisms that will allow for higher levels of renewable electricity penetration. The panel emphasized the fact that the 33% RPS goal is a floor and not a ceiling and that we have to set the next set of goals for GHG reduction and renewable energy requirements. Policy frameworks are critical to ensuring that we stay on track and regulators are currently working on that issue in California.

Carla Peterman, CPUC Commissioner, included in her remarks California’s recently instituted requirement of investor owned utilities to procure 1,325 MWs from storage technologies by 2020 and to interconnect these projects by the end of 2024. The mandate aims to accelerate the implementation of cutting edge, flexible, fast response power storage.



¹. A video of highlights from the California Keynote Panel, as well as from selected meetings that took place on the tour, is available on www.renewables100.org.

Stephen Berberich, CEO of the CAISO, also stressed the need for storage, including large utility scale projects, such as pumped hydro. Also included among his remarks was an emphasis on the need for demand response (DR), electric vehicle adoption, and vehicle to grid (V2G) programs, in order to allow the electricity network to have the built in flexibility it needs to operate when relying on increased portions of variable renewable resources, such as wind and solar.

CEC Chair Robert Weisenmiller, Ph.D primarily highlighted the importance of putting our energy efforts in the context of reducing greenhouse gas emissions, as well as of prioritizing energy efficiency and zero emissions transportation.

CEC Commissioner David Hochschild praised Germany for its remarkable leadership in advancing renewable energy and for bringing down the prices of technologies like solar photovoltaics to the benefit of the world. Among other points made was the fact of California's abundant wide open spaces, which has influenced development of large scale renewable power projects compared to those that have been installed Germany.

CPUC Commissioner Michael Picker stressed the need to think “beyond renewable energy” to demand side management and to how to ensure a reliable cost-effective electricity system. Included in his remarks was a closing reminder that as frontrunners, Germany and California ought to not see each other so much as competitors but as allies who can learn from one another's mistakes.

Moderator Prof. Dr. Eicke Weber concluded the panel with encouragement for continuing the communication, stating:

I really think that from here we will start a more continuous dialogue between California and Germany because I really believe...we share the goals, we share the objectives, we realize what the world is up to, and we want to achieve (our objectives) as cost-effectively and as fast as possible.

The California panel was well received, with one conference attendee during the Q&A summing up a common sentiment of relief to know that Germany is not alone in its commitment to transitioning to a renewable energy system.

During the remainder of the conference, in addition to attending the regularly scheduled program, the delegation had more than 20 follow up meetings with German expert counterparts, policy makers, technology leaders and CEOs. These meetings opened the door for future information exchange, collaboration, and transfer of know-how between interested parties.

Due to the high volume of requests for focused conversations with the California Delegation, the Delegation often broke into subgroups to attend simultaneous meetings based on interests and preference. A sample list of meetings is contained in Table 1 below. The conversations in these meetings spanned the broad spectrum of energy storage related technologies and issues, including demand response, capacity markets, batteries, electric mobility, and renewable power to hydrogen and synthetic methane for uses in storage and transportation.

Table 1. Sample List of Meetings - Bonn and Düsseldorf

Meeting I of Group A
With Dr. Klaus Peter Röttgen, Head of Storage at E.ON and Vice President at EASE
Meeting II of Group A
With Didier Houssein – International Energy Agency (IEA) Director
Meeting III of Group A
With Frank Wouters, Deputy Secretary General at International Renewable Energy Agency (IRENA)
Meeting I of Group B
With Boris Schucht, CEO 50Hz
Meeting II of Group B
With Sven Becker, CEO Trianel (70 municipal utility companies)
Side Meeting A
With Gunnar Groebler, VP Vattenfall and BVES Boardmember, with Claus Wattendrup and Dr. Rene Kühne from Vattenfall
Side Meeting B
With Mr. Cosciani, CEO, FIAMM and Mr. Westgeest, Executive Director, EUROBAT

3.2 Berlin

3.2.1 Overview

The delegates then traveled to Berlin to attend meetings with German Ministry representatives, federal agencies, manufacturing facilities, environmental groups and foundations, as well as several grid operators. For a sample list of meetings in Berlin, please see Table 2 below.

Table 2. Sample List of Meetings - Berlin

Thursday March 27, Berlin	
Meeting With Agora <u>Energiewende</u> - Patrick <u>Graichen</u>	
Group A: Tour Control Center 50Hertz	
Group B: Dr. Harry <u>Lehmann</u>, General Director., German Federal Environment Agency (UBA), Climate and Energy	
<u>TenneT/Renewables Grid Initiative Dinner</u>	
Friday March 28, Berlin	
Group A: Tour BMW Leipzig	
Group B: <u>Euref Tour</u> / <u>Yunicos</u>	
Group B: Miguel Berger (Foreign Ministry), Commissioner for Energy and Climate	
Group B: Meeting with MP <u>Julie Verlinden</u>	
Wrap-Up Dinner hosted by Dr. Martin <u>Schöpe</u>, Head of Division, International and EU Affairs, Renewable Energy, BMU	

3.2.2 Visit to Agora Energiewende and 50 Hertz

Highlights of the first morning in Berlin included a meeting of some of the Delegates with Dr. Patrick Graichen, Executive Director of Agora Energiewende. Agora Energiewende is a unique platform that brings together key players from multiple sectors, including policy, nongovernmental organizations and institutions, business, science, and technology to develop common understanding of the problems, clarify options for solutions, and discuss feasible policy measures to successfully advance the Energiewende process. For that reason, Agora gathers scientific expertise on the Energiewende and asks researchers for studies on specific Energiewende topics. Dr. Graichen shared his perspective on several priority issues that have been identified by his organization. Central to all these issues is the fact that solar and wind have become the most cost-effective renewable energy technologies. This represents a sea change because power generation with these technologies is variable and dependent on weather, and installation has high upfront capital costs, while operating and maintenance costs are minimal. From this finding

stems a list of several other key factors that are important to bear in mind during the next phase of the energy transition. For example, strategic changes will need to be made in financing structures and in the electricity market, as "baseload" fossil fuel and nuclear power plants become increasingly obsolete. These changes include engaging the demand side and coordinating with the European market. The Agora team has also found that grids are cheaper than storage, that securing peak hour supply is no longer costly, and that efficiency will remain the least expensive option per kilowatt hour. Integration of the heat sector is additionally critical, along with giving value to flexibility. Currently, Agora is working on market models which are able to deal with those needs. More detailed information on Agora Energiewende's recent analysis of the German energy transition can be found in the report *12 Insights Into the Energiewende*.²

Some Delegates also toured 50 Hertz, transmission grid operator for a large swath of northern and eastern Germany. Julie Fitch, Advisor to CPUC Commissioner Peterman and former CPUC Administrative Law Judge, commented:

"One observation that sticks in my mind from visiting the transmission operator 50 Hertz is that it seems the current system is capable of more renewables integration than we think. Some of us in California have been increasingly realizing that 'flexibility' is an inherent characteristic of a system with diverse resources. The German transmission operators seem to be simply doing what needs to be done, integrating a lot of intermittent renewables, without a whole lot of fuss. They readily acknowledged that they are integrating far more renewables on a daily basis than they previously thought possible at the beginning of the Energiewende policy. It was a reminder not to be too pessimistic in our planning assumptions about the inherent resilience of the system, though that is not to say that we don't need to focus on making sure we have enough flexibility built in as we reach much higher levels of renewables penetration."



2. See: <http://www.agora-energiewende.org/topics/the-energiewende/detail-view/article/12-insights-on-the-energiewende/>

3.2.3 Wrap Up With Dr. Harry Lehmann, Federal Environment Agency

In the afternoon, Delegates had the privilege of meeting with Dr. Harry Lehmann, General Director of the German Federal Environment Agency (UBA), Climate and Energy, along with agency staff, who provided a two-hour wrap up of the tour up to that point. The discussion presented an opportunity to gain insight, background knowledge, and perspective on the German Energiewende from one of Germany's most seasoned experts on the subject, as well as to discuss questions in depth.

Lehmann's presentation started with an informative introduction to the history of the German Energiewende and a frank assessment of success stories, inevitable learning curves and unexpected outcomes that navigating previously uncharted territories can present. He showed how the Energiewende, while only a recently used moniker in the international lexicon, has actually been developing in Germany since the 1970s, with many milestones along the way, including the nuclear phase out that began with Chernobyl and that was reinforced by Fukushima, aggressive greenhouse gas targets, and the Renewable Sources Act, commonly known as the German feed-in tariff law (or "EEG" in Germany). He said the current phase could be thought of as the "EEG 2.0," in which new challenges will need to be addressed and a comprehensive, multi-sector plan for managing the transition cost-effectively must be further refined.

He offered an overview of Germany's renewable energy, efficiency, and greenhouse gas targets, making it abundantly clear that the German public and regulators were proud of all that had been achieved to date in the field of renewable energy and steep greenhouse gas reductions, but also that the transition is far from over, and Germany still has a long way to go to reach the federal goals of 40% GHG reductions below 1990 levels by 2020, 55% GHG reductions below 1990 levels by 2030, 60% GHG reductions below 1990 levels by 2040, and 80-95% GHG reductions below 1990 levels by 2050. (For an of Germany's targets, along with a comparison to California's, please refer to Appendix C.)

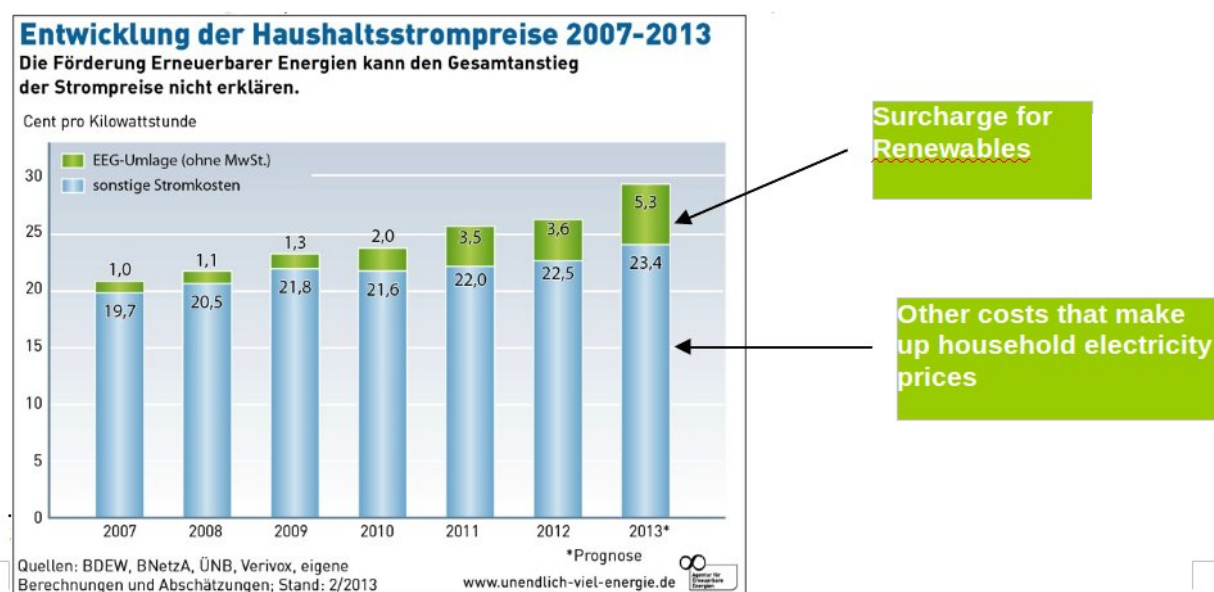
Lehmann asserted that there are several hurdles to meeting Germany's greenhouse gas targets. A major one to overcome is the current extremely low price for carbon that has been established by the European Emissions Trading Scheme, along with the initial distribution of large numbers of emissions allowances. The result is that German coal-fired electricity is relatively cheap for neighboring countries and is likely to remain so for the immediate future.

He explained that contrary to myths found often in the media, the recent modest uptick in German coal-fired electricity generation has not been caused by domestic demand, nor has this increase in coal use had anything to do with the national decision to phase out nuclear power. Indeed, it is other European countries looking for low cost power who are buying more German coal-fired electricity, not the Germans themselves. In order to resolve this ongoing conundrum, the EU will need to develop mechanisms to ensure far higher carbon prices and to mandate ambitious greenhouse gas targets beyond 2020.

Germany will need to keep up its rapid adoption of renewable energy and strengthen its efficiency efforts, which have so far allowed the country to exceed Kyoto Protocol targets and achieve an overall trend of greenhouse gas emissions reductions since 1990. (Please refer to Attachment C for data on Germany's greenhouse gas reductions.)

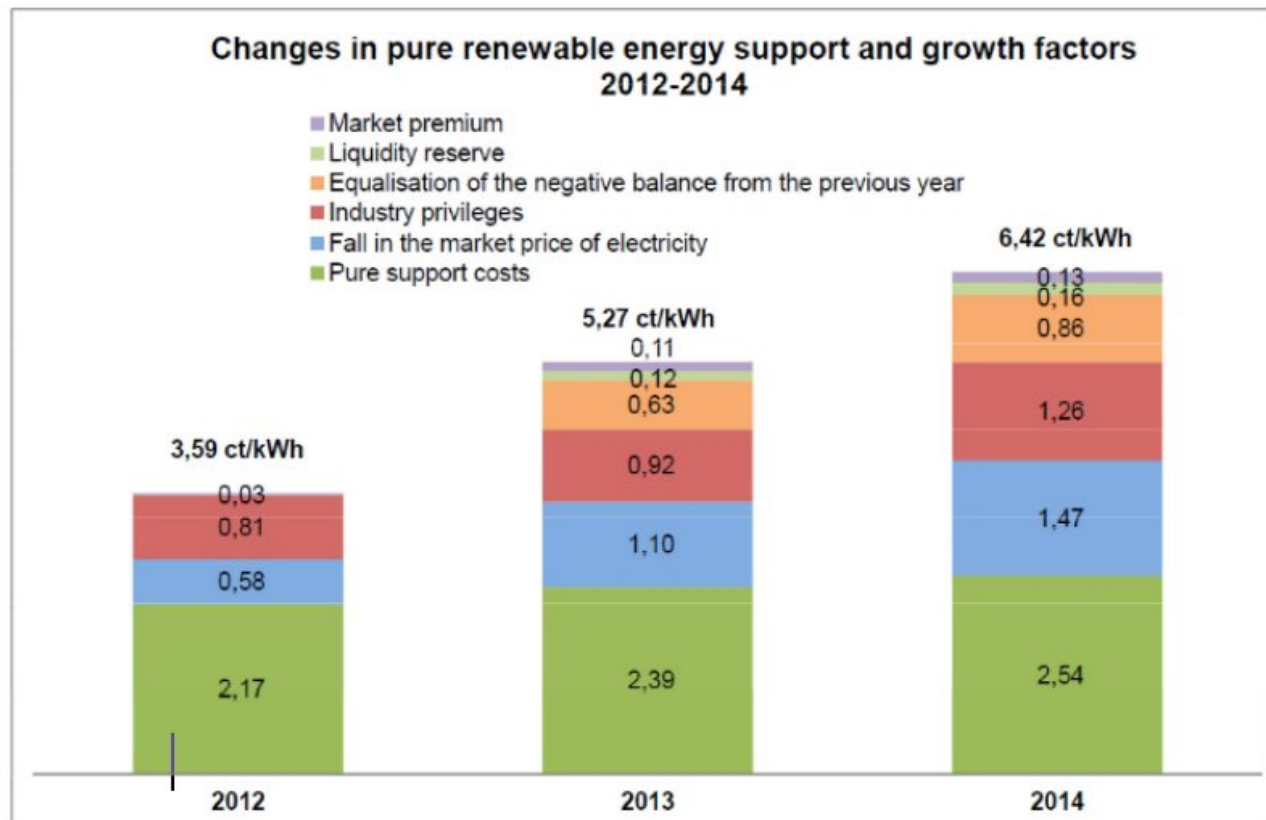
Lehmann also addressed the common criticism that Germans overpaid for their renewable energy success. He pointed out that while the feed-in tariff rate for solar did not always drop quite as fast as the market price for PV, due to PV's unexpected massive success, the amount ratepayers have contributed to the renewable electricity program is overall relatively small compared to the normal increase in energy infrastructure costs, such as costs for transmission and ongoing asset maintenance programs. See Table 3.

Table 3. Development of German Household Electricity Price



Pure support costs for renewable electricity development in Germany also currently make up less than half of what shows up on customers' power bills as the surcharge for the national renewable energy program. The rest goes to cover other costs, such as industry privileges for not paying into the renewable energy program and falling wholesale electricity prices, due to low European carbon prices and the downward pressure on spot market caused by the increase of renewables. Moreover, the controversial rising cost of the surcharge in recent years has had almost nothing to do with additional costs of direct support for renewables. See Table 4. A breakdown of actual costs paid by citizens to directly advance renewable electricity in Germany is in Table 5.

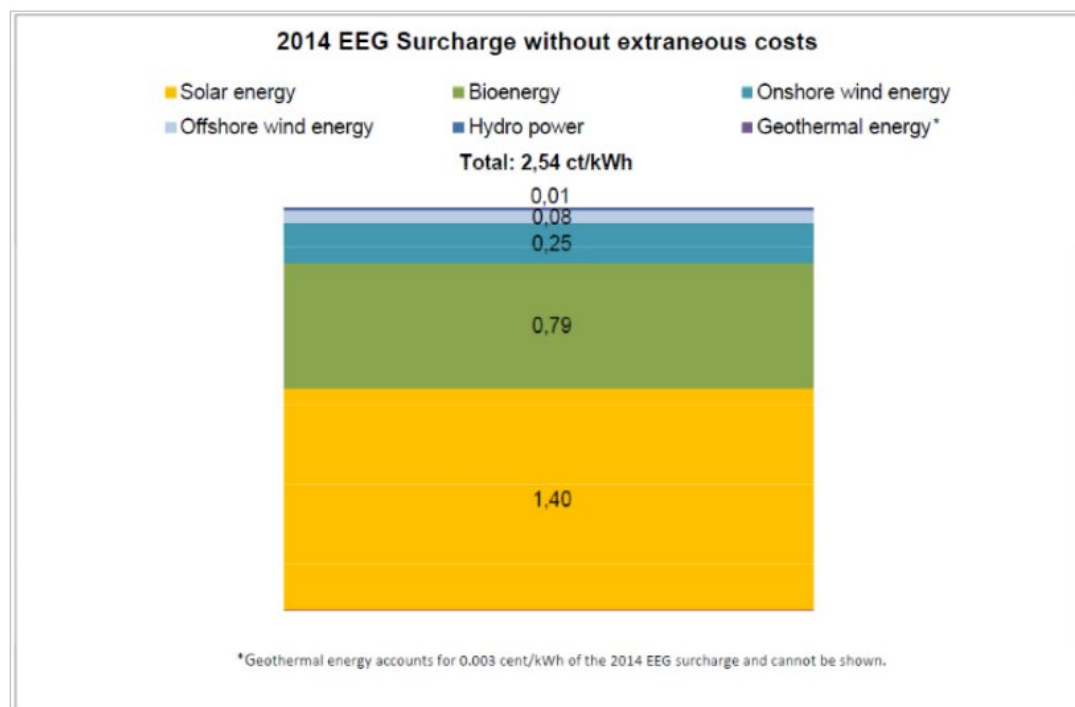
Table 4.



Source: p. 5 EEG Surcharge for 2014, BEE (September 2013)

http://www.bee-ev.de/_downloads/publikationen/positionen/2013/20130904_EEG-Surcharge-2014_Background-Paper.pdf

Table 5.



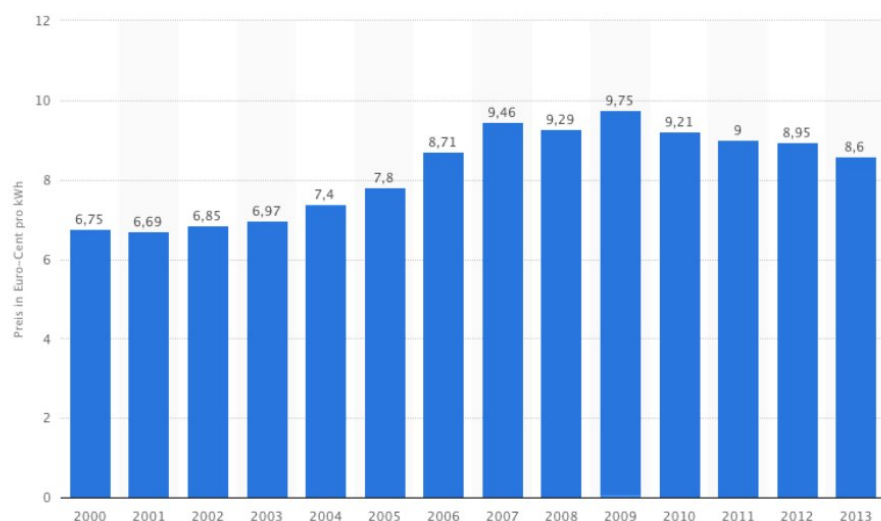
Source: p. 6 EEG Surcharge for 2014, BEE (September 2013)

http://www.bee-ev.de/_downloads/publikationen/positionen/2013/20130904_EEG-Surcharge-2014_Background-Paper.pdf

Lehmann additionally informed the group that German industry power rates are actually relatively low, with recent rates down to slightly below 2006 rates. See Table 6.

Table 6. Industry Electricity Prices in Germany from 2000-2013 (Euro-cents/kWh)

Industriestrompreise in Deutschland in den Jahren 2000 bis 2013 (in Euro-Cent pro Kilowattstunde)

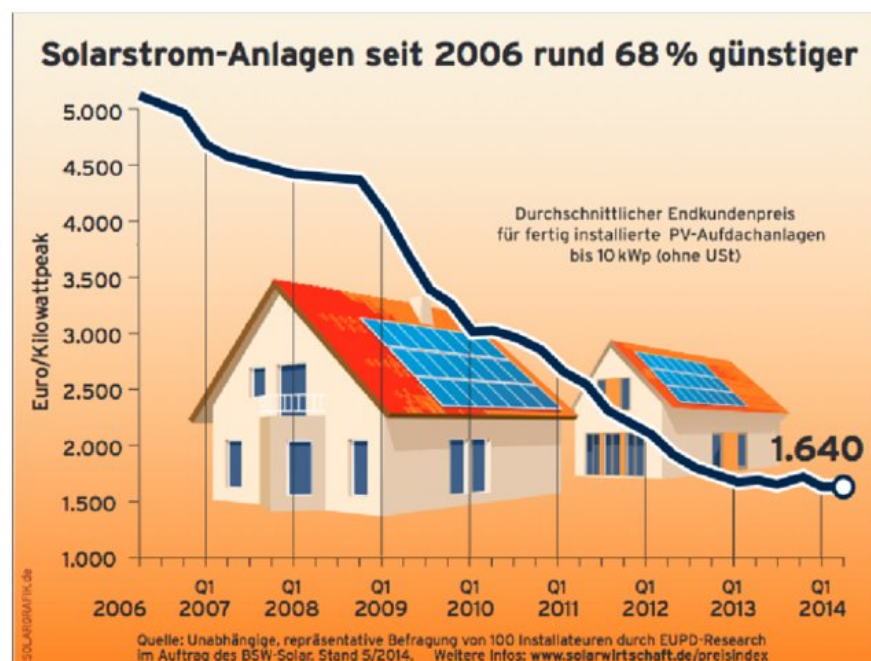


Weitere Informationen:
Kostenlosen Basis-Account freischalten

Quelle:
Kostenlosen Basis-Account freischalten
© Statista 2014

Lehmann also mentioned the fact that because of Germany's steadfast investment in renewable power development and favorable feed-in tariff provisions, today Germans installing renewable electricity technologies, such as solar panels, enjoy extremely low prices. Prices for electricity generated by renewable resources have been rapidly declining since Germany implemented its advanced feed-in tariff law in early 2000. Average installed home PV system prices have fallen 68% since 2006. See Table 6.

Table 7. Photovoltaic Price Index



Of course, the implementation of any ambitious plan has its share of ongoing challenges, and Lehmann shared that the Energiewende is now at a crossroads at which “everyone is trying to influence” where the society ends up in five years. “There will be losers and winners,” he stated, and this struggle for economic relevance among various energy industries is creating significant tension and subsequently coloring the energy policy debate in Germany.

One major challenge faced by Germany, California, and elsewhere is encouraging efficiency in buildings, which are now the source of a significant amount of energy consumption and greenhouse gas emissions. Some regions in Germany, like the state of Baden-Württemberg, have succeeded in implementing aggressive energy efficiency standards and boast numerous developments built to stringent Passive House Standards that use as little as 15 kWh of heat per square meter annually³, along with "Plus Energy Homes" that produce more energy with renewables than they consume.

3. For more information on Passive House Standards, please see: <http://www.passivehouse.us/passiveHouse/PassiveHouseInfo.html>

Lehmann pointed out that the potential for cost savings from increased energy efficiency and renewable energy development is a major opportunity for Germany. However, ongoing political pressure from homeowners' groups, among others, have to date kept Germany's federal government from sticking with and consistently enforcing policies that maximize the potential of energy efficiency programs for buildings. As in the United States, architects are also not uniformly trained in efficient building design, with some being among the most skilled in the world and others falling substantially below what is necessary.

Commissioner Hochschild shared that California has a goal to make all its new residential buildings net zero by 2020 and to make all new commercial buildings net zero by 2030. The group agreed that this could be a valuable area of focus and collaboration for a follow up visit of German energy leaders to California.⁴

The German leaders with whom the California Delegates met were in agreement that with Germany having crossed the threshold of 25% renewable electricity and reaching more than 70% renewable power penetrations at peak hours, it is not too soon to begin thinking about a new set of policies and regulatory mechanisms that will be needed to address the needs of a post 50% renewable electricity era. One of the concepts that the Federal Environment Agency is supporting and following carefully as a potential solution for integrating up to 100% renewable power into the grid is power to gas, in which excess renewable electricity from variable sources like solar and wind are used to create synthetic methane that can be stored or distributed via the existing gas grid. Because of the potential for using available infrastructure, Lehmann explained that this technology appears to present the most large-scale feasibility for Germany compared to other storage options.

Another policy area that some Delegates expressed keen interest in discussing was the permitting structure in Germany for solar projects. Cumbersome permitting processes can be a serious impediment for new installations in California.

⁴ The California Net Zero goals for new buildings have some parallel to Germany's Climate Neutral goal for all buildings. Please see Attachment C for more details.

The California contingent was interested to hear that installing rooftop solar systems in Germany does not require a permit. The absence of this barrier is one reason why installed costs of solar panels in Germany are about half of what they are in California and why Germans have installed about 5 times as much solar power (or more than twice as much per capita) as Californians.⁵ Lehmann and his colleagues said that permitting is, however, required for large projects in Germany (which comprise the minority of installations), and the group determined that similar time frames are needed in Germany and California for this process.

3.2.4 TenneT/RGI/CAISO Declaration Signing

Another major highlight of the Berlin portion of the tour was a dinner sponsored by grid operator TenneT and organized by RGI in collaboration with CAISO, with logistical support from the Renewables 100 Policy Institute. In attendance were a wide group of stakeholders ranging from NGOs, utility companies, transmission operators, regulators, policymakers, foundations and a variety of government representatives from several countries including China. (For a complete list of all attendees at the dinner, please refer to Attachment D.)

RGI has succeeded in bringing traditionally opposing parties, such as NGOs and environmental activists on one side and utility companies and grid operators on the other, to the negotiating table to discuss needs and strategies for expanding and modernizing the grid to support 100% renewable energy. Like the Renewable Energy Transmission Initiative in California, the RGI collaborative identifies ways this can be done to minimize environmental impacts and protect ecosystem integrity. RGI helps build public acceptance of new transmission infrastructure to counter the inevitable opposition to new transmission. The collaborative is also working to coordinate Balancing Areas across the continent and to create a single integrated European market to facilitate sharing renewable energy across national borders.

⁵. According to industry figures, as of the end of 2013, 35.7 GW of solar power had been installed in Germany, and approximately 7.136 GW had been installed in California. Sources: http://www.solarwirtschaft.de/fileadmin/media/pdf/2013_2_BSW-Solar_fact_sheet_solar_power.pdf and <http://www.seia.org/state-solar-policy/california>

The CAISO presented RGI with a Unanimous Statement of Support to the European Grid Declaration endorsing the principles upon which the organization was founded and supporting the vision for building a green grid. (For a copy of the actual Declaration, please refer to Attachment E.)

The main take away from the dinner discussion was the realization that the EU grid operators and the CAISO face many similar challenges in integrating a fast increasing portion of renewable resources on the grid. An increasingly green grid will require a fleet of cutting edge, modern, flexible resources, as well as innovative demand response, energy efficiency, and market-based, dispatchable programs that grid operators can rely on during peak demand. Therefore, there was overwhelming consensus that a long term close collaboration between the principal players would be of significant value to all parties involved and could potentially lead to more efficient and faster results in facilitating the transition to a greener network.

The energy transition is ongoing at the global level. Everyone is confronted with challenges and engaged in finding solutions. There is not a ready made recipe on how to move to a fully decarbonised, largely renewable sector, but a lot of different and very valuable ideas are emerging. For this reason, the visit of the Californian delegation to Europe was extremely useful because we can learn from each other and also challenge mindsets that are sometimes overly conservative.

- Antonella Battaglini, Executive Director of RGI



3.2.5 Visit to "Living Clean Energy Laboratories" & With Policymakers

On the last day of the tour, Delegates got to visit living laboratories of Germany's progress toward a post-fossil and post-nuclear energy economy. For example, InnoZ on the EUREF campus in the center of Berlin



is conducting cutting edge research aimed at developing a cleaner future of transportation, including analyzing the feasibility of V2G and tracking millions of car sharing practices around the world.

At Younicos, Delegates saw how the company is working to integrate large scale storage with innovative grid control and energy management solutions to move society toward 100% renewable energy.



A visit to BMW's manufacturing facility in Leipzig allowed participants to see the potential for the automotive industry to run entirely on renewable energy sources. The facility is powered completely with wind and is responsible for manufacturing the BMWi electric vehicle series. California Energy Commissioner Hochschild pointed out that California has a similar sized electric vehicle plant – Tesla – and that there may be potential for mutually beneficial information exchange on shared issues, such as battery technology development. BMW Vice President of Government Affairs, Frank Breust, remarked after the visit:

"The collaboration between California and Germany in the fields of sustainable mobility and renewable energy is of great value to all, including the BMW Group. It has been in the past – and it will be in the future. California and Germany both take our efforts seriously to achieve emissions-free mobility and are preparing our energy grid, as well as the whole political framework, to handle and support this development. Our governments are committed to achieving ambitious goals within the next decades, as we work toward emissions-free individual mobility, and there is and will be a lot to learn from each other."

Additional meetings on the last day with Miguel Berger, Commissioner for Globalization, Energy and Climate Policy at the German Federal Foreign Office, and MP Julie Verlinden, along with a closing dinner hosted by Dr. Martin Schoepe, Head of Division, International and EU Affairs, Renewable Energy at the Foreign Ministry of the Environment (BMU)⁶ also underscored Germany's strong interest in working with California's leadership to drive forward innovation, to create close working relationships with a variety of stakeholders in the energy and environmental field and to accelerate the global transition to binding, meaningful GHG reduction targets.



6. Dr. Schoepe is now at the Ministry of Economics and Energy.

4. Summarizing Answers to 3 Common Questions About the Energiewende

Throughout the dialogues that took place during the Tour, German experts offered responses to a broad range of the California Delegation's questions about Germany's energy transition. The following aims to summarize answers to three basic issues commonly discussed.

1. Is Germany's decision to phase out nuclear power causing Germans to consume more coal power?

- When it comes to consumption in Germany, renewables are more than making up for the loss of nuclear power resulting from the phase out over the last decade.⁷
- In the first quarter of 2014, German power generation from hard coal was actually down by 17.4 percent, and power from lignite was down by 4.8 percent.⁸
- German coal-fired power generation increased by a few percentage points in 2012-13, although this was not due to the nuclear phase out, but rather driven primarily by rising demand from neighboring countries for cheap, imported German coal power, along with cold weather and rising natural gas prices. The main reason German coal-fired electricity is so cheap is that flaws in the European Trading System have resulted in very low carbon pricing, which was approximately 4 euros in 2013.⁹ Additionally, the large growth of renewable power, which has priority on the German grid, is leading to conventional plants sitting idle more often, which is driving down wholesale prices for coal-fired electricity. Surges in coal power generation may well recur in Germany, most likely for export. These could be slowed, if federal and/or European policies change to make German coal power less economical.¹⁰
- Hard coal, which makes up about half of German coal production, will no longer receive subsidies for mining in Germany starting in 2018. The vast majority of the country's hard coal is imported, with Russia and the United States being the biggest suppliers.¹¹ While the long-term economic outlook for hard coal is therefore unfavorable, lignite is

7. <http://energytransition.de/2014/06/german-coal-conundrum/>

8. <http://www.renewablesinternational.net/coal-down-renewables-up/150/537/79063/>

9. *The German Energiewende and its Climate Paradox*, Agora Energiewende, April 2014

10. *ibid.*; <http://us.boell.org/sites/default/files/german-coal-conundrum.pdf>;

Report in English about German Federal Environment Agency statement: <http://www.germanenergyblog.de/?p=15461>

11. https://www.genesis.destatis.de/genesis/online;jsessionid=6B55267B1D7F3B4F9080ECEF676073EC.tomcat_GO_1_1?operation=previous&levelindex=2&levelid=1406682555460&step=2

abundant in Germany and likely to remain attractive for export unless policies shift to make it more expensive than cleaner sources or unnecessary due to neighboring countries' adoption of renewables and increased efficiency.

- Germany began developing new coal plants in 2005-2007 as part of a European trend catalyzed by low carbon prices on the European market and tightened power plant efficiency regulations. However, that trend is unlikely to be repeated. Increased coal capacity has not been matched by proportional increases in coal power generation, making the new coal plants not necessarily economical and causing many new coal projects to actually be cancelled.¹²
- In order to reach its 2030 Energiewende targets, German coal-fired power sector has to drastically decrease from its current levels of 45% of the mix to 19% in 2030.¹³

2. *Is reducing greenhouse gas a goal of the Energiewende?*

- Reducing greenhouse gas reductions is a primary pillar of Germany's energy transition. The federal government has set aggressive targets for up to 2050, at which time emissions are to fall 80-95% below 1990 levels. Germany far exceeded its already ambitious Kyoto Protocol reduction targets for 2012 of 21% and also already exceeded binding European Union targets for 2020 far ahead of schedule, despite the shutdown in recent years of 8 nuclear reactors.¹⁴
- Germany's national target for 2020 - a non-binding goal of 40% reductions below 1990 levels – is twice as high as the EU's. The German Federal Environment Agency and Agora Energiewende, among others, have expressed doubt whether this goal will be reached without more aggressive policies to curb greenhouse gas emissions. Such policies include reform of the European Emissions Trading System, which covers half the nation's greenhouse gas emissions, and aggressive adoption of renewable power technologies, efficiency upgrades, and zero emissions transportation.¹⁵

12. <http://us.boell.org/sites/default/files/german-coal-conundrum.pdf>

13. *The German Energiewende and its Climate Paradox*, Agora Energiewende, April 2014

14. See Attachment C for more details.

15. Report in English about German Federal Environment Agency statement: <http://www.germanenergyblog.de/?p=15461>

3. Have Germans been paying too much for the energy transition?

- The extra costs for the energy transition that the German public is expected to have to pay until 2025 (approximately 300 billion euros) is estimated to be only 5-8% of total energy expenses. From that point on, according to government projections, Germans will be saving compared to what they would have paid, if they'd stuck to status quo conventional fuels.¹⁶
- Ratepayer surcharges to pay for the renewable power transition, which are often at the core of the criticism, have so far accounted for less than 1% of average household costs in Germany.¹⁷
- Thousands of German industrial firms are largely exempt from the renewable electricity surcharge, and their power rates are the cheapest that they have been in close to a decade, as well as less expensive than other EU member states like the UK.¹⁸
- Like in the U.S., Germans have paid far more in public funds for fossil and nuclear fuels than they have for their transition to renewables.¹⁹
- More than 2 million people in Germany so far have become renewable power entrepreneurs who get compensated for the electricity they generate. Roughly 380,000 people are employed by the renewables sector. And Germany's energy policies and mature industry allow the average rooftop solar installation in Germany to cost about half of what it does in the United States. These kinds of opportunities for citizen participation have helped most Germans remain in favor of the Energiewende, despite the transition's expenses and learning curves.

16. Dr. Harry Lehmann presentation, March 27, 2014, from slide courtesy F. Staiss 2013, based on data from BMU

17. www.energytransition.de

18. Dr. Harry Lehmann presentation on March 27, 2014, data from Ecofys/Fraunhofer ISI (2013)

19. <http://www.unendlich-viel-energie.de/mediathek/grafiken/kumulierte-staatliche-foerderung-der-stromerzeugung-1970-2012>

5. Top Ten Delegation Take Aways & Recommendations

The five-day Tour consisting of a packed program and intense meetings ended successfully with a strong desire on both the California and German sides to work together and establish an organized and focused process for dealing with mutual policy and technology challenges that naturally emerge in the process of decarbonizing our economies. There was an effort on all sides to come to practical and actionable recommendations and next steps in almost every meeting.

The top ten major take aways and recommendations identified by the California Delegates are listed as follows:

1. The Big Picture -- Adopt Comprehensive Climate and Energy Policies

Effectively reducing greenhouse gas emissions, transitioning to a renewable energy system, and advancing energy storage, energy efficiency programs, flexible grid management and advanced transportation solutions cannot be dealt with in individual silos, but rather require an integrated and strategic policy approach. While there are many numerous individual pieces of the puzzle to solve, each problem should be viewed with the “big picture” in mind.

2. California and Germany: Natural Partners on Bold Climate Targets

Both California and Germany have called for reaching the IPCC recommended goals of reducing greenhouse gas emissions by at least 80% by 2050. (See Attachment C.) The German states of Baden-Wuerttemberg and North Rhine-Westphalia have codified such ambition into law.²⁰ Germany has thus far been particularly aggressive about reducing greenhouse gas emissions, as well as setting (and to date reaching) significant interim targets, despite its heavily industrialized economy, making it the policy and GHG emission reduction leader in the EU. Similarly, California has also been a clear leader within the United States. Both are role models for other States to follow. Both also face serious challenges to getting to the ultimate goal, and both stand to benefit from supporting one another in achieving these ambitious targets.

20. Baden-Wuerttemberg's Climate Protection Act calls for 25% greenhouse gas emissions reductions below 1990 levels by 2020 and 90% greenhouse gas emissions reductions below 1990 levels by 2050. <http://energiewende.baden-wuerttemberg.de/en/all-articles/basics/energy-transition-in-baden-wuerttemberg/> North Rhine-Westphalia's Climate Protection Law similarly calls for 25% greenhouse gas emissions reductions below 1990 levels by 2020 and 80% greenhouse gas emissions reductions below 1990 levels by 2050. (In German) <http://www.klimaschutz.nrw.de/klimaschutz-in-nrw/klimaschutzgesetz/>

Germany has already established interim, non-binding goals of reducing the country's GHG emissions 55% below 1990 levels by 2030 and 60% by 2040. The European Union meanwhile is seriously looking at adopting its next round of enforceable targets for the year 2030, with Germany and others recommending minimum 40% below 1990 reductions as the goal. In California, the Air Resources Board recently recommended as a top priority that the state set enforceable, science based interim greenhouse gas reduction goals. In its *First Update to the Climate Change Scoping Plan*, the agency proposes framing a path for reducing California's greenhouse gas emissions by a steep 5.2% a year below 1990 levels starting in 2020 in order to reach 80% reductions by 2050.²¹

It is recommended that the state of California emulate the leadership of the states of North Rhine-Westphalia and Baden-Wuerttemberg and codify into binding law its goal of reducing greenhouse gas emissions by at least 80% below 1990 levels by 2050. Given their common ambitions, it is also recommended that California work with leading German states to explore potentially declaring parallel interim GHG reduction targets for 2030 and 2040.

3. Continue Forward With Long Term Targets To Decarbonize the Grid

California and Germany also share a deep, long time commitment to advancing renewable electricity generation. Both have similar 2020 targets for renewable electricity that they are on track to achieve (33% for California and 35% for Germany). Germany has additionally set ambitious renewable power targets beyond 2020 of 50% by 2030, 60% by 2040, and 80-100% by 2050.²² California ought to make similar long term plans and concrete targets, as the decisions for what energy system the state ends up with in 2050 are largely being made now or in the near future. As California looks to set goals beyond 2020, and as both California and Germany strive to determine the most reliable and economical paths to transition to a power system based predominantly on and even entirely on renewable resources, continuing on the path of parallel targets and committing to regular open dialogue would stand to benefit both sides. Such a process would result in faster learning curves and carry the strength of powerful alliance.

21. See p. 94, *First Update to the Climate Change Scoping Plan*; CARB, May 2014

22. The Renewable Sources Act calls for 80% renewable electricity by 2050. The Federal Environment Agency (UBA) is urging 100% as the 2050 target, having determined that this would be feasible using resources within Germany. See <http://www.umweltbundesamt.de/sites/default/files/medien/publikation/add/3997-0.pdf>

4. Find Solutions for Next Phase of Building Efficiency Upgrades

California and Germany have also long been frontrunners and innovators on highest efficiency standards, e.g. for lighting and appliances. Both recognize that a remaining top priority is turning buildings from carbon emitting energy guzzlers into carbon neutral energy savers – or even into carbon absorbing energy generators. How to encourage this on a mass scale is a serious challenge both sides face. Both also share interest in further exchanging ideas, sharing experiences, and supporting one another in setting and advancing ambitious targets. This applies not only to new buildings, but also to retrofits. Notably, more than half of California's 13 million residential buildings and more than 40 percent of the commercial buildings were built before 1978, when the state first implemented Building Energy Efficiency Standards.²³ More than 75% of 18 million German residential buildings were built before 1979, when efficiency standards similarly were not yet in place.²⁴

5. Exchange Grid Management Models

Clearly Germany is accomplished at managing the grid with manual controls, while CAISO has succeeded in optimizing automatic dispatch and transmission system usage in every 15-minute period. The automated model results in substantial cost savings, facilitates reliably integrating larger percentages of renewables, and could be a beneficial tool for Germany's grid operators. Additionally, Germany's regional coordination of resources and balancing grid issues through resource diversification may hold lessons for California, as the state balances electricity load with its western neighbors.

6. Refine Forecasting of Renewables

Perfecting models for wind output in particular, and solar to a lesser degree, remain a challenge for both sides, and a collaborative effort to develop better tools would be of mutual benefit. This knowledge could also be transferred and would apply to any other region seeking to integrate variable resources on the grid.

23. <http://www.energy.ca.gov/2011publications/CEC-400-2011-007/CEC-400-2011-007-SD.pdf>

24. <http://www.dena.de/en/projects/building/energy-performance-certificate-for-buildings.html>

7. Optimize Demand Response Programs

Germany and California are both in need of developing some form of capacity markets for demand response programs. As they forge ahead, information sharing about optimal market signals could be beneficial for all.

8. Efficient Use of Remaining Fossil Fuels During Transition to a Renewable Grid

For instance, flexible resources, i.e. state of the art fossil units that start, stop and ramp up quickly can enable additional renewable resources to be integrated into the power grid while operating more efficiently. Experts from Germany and California can share the solutions each has developed.

9. Adopt Policies to Use All Available Renewable Power

Over-generation of renewable power from renewable sources like the sun and wind is a significant issue for both German and California grid operators. New and innovative ways of using the excess renewable produced power should be developed to prevent curtailing of valuable green generation. California has passed a revolutionary energy storage mandate and is actively looking at a wide range of solutions to implement it most effectively. While a great deal of attention has been focused on battery storage research, development, and integration on both sides, the Germans lately have been focusing increasingly on using excess power from renewables to produce hydrogen and synthetic methane for use in fuel cells and the existing grid, with impressive pilot programs underway. Innovation could make such approaches economical in California. Information sharing both sides' experience is of interest.

10. Advance Zero Emissions Transportation

Germany and California are tackling similar questions on zero emissions transportation and can exchange information on infrastructure siting, costs, rates for electric vehicle charging, and how to get renewable hydrogen for use in a variety of transportation fuel solutions.

6. Next Steps

In addition to and based on the above set of recommendations, the following set of concrete action steps are proposed as the basis for a future collaboration program. These next steps are broken into two specific categories - policy and technology - as they will require different teams with specific expertise to work on each one.

6.1 Policy - Collaborate on Big Picture Climate Goal Interim Targets

The Tour made clear that leadership in both California and Germany see that forging a strong alliance around meaningful, long term climate and energy targets has great potential value for both sides. The next recommended step is to continue the dialogue established by the group on this trip with a focus on reaching the “big picture” goal of reducing greenhouse gas emissions at least 80% below 1990 levels by 2050. Specifically, the discussion should build on the already overlapping climate and energy goals shared by Germany and California and seek to establish a subnational coalition of the willing between California and leading states in Germany that works on a framework of parallel targets for:

- science-based, greenhouse gas emissions reductions from 2020 - 2050, with interim targets for 2030 and 2040 (e.g. percentage or per capita based goals)
- decarbonizing the electric and natural gas grids (e.g. with parallel targets beyond 2020)
- decarbonizing transportation (e.g. by advancing zero emissions vehicles, car sharing, walking, bicycling, and public transportation)
- increasing energy efficiency (e.g. by encouraging net zero buildings and incentivizing, as well as enforcing energy efficiency upgrades of existing buildings)

Subsequent visits to California by German policymakers have already begun to take place, and there is also interest in follow up trips to Germany by California policymakers. A series of upcoming global events that could serve as goals by which to first concretize and then begin to roll out and advocate for such a mutual agreement include the UN Climate Change Summit in New York City in September 2014, the UNFCCC Conference of Partners (COP 20), which will take place in Lima in December 2014, and COP 21, which will take place in Paris in November/December 2015.

6.2 Technology – Technology Transfer, Knowledge Exchange and Grid Solutions

Following up on strong interest expressed during the Tour, a recommended next step is to continue the technology discussion with a focus on identifying a workable process and platforms for effective knowledge exchange, technology transfer and learning. A series of follow up visits of German technology experts to California to introduce German grid operators and other relevant experts to CAISO's Full Network Model, which automatically optimizes dispatch and transmission system usage in every 15-minute period is already starting to take shape and should be institutionalized. A follow up trip of California experts to Germany to gain insights into renewable integration and grid optimization would also be useful.

This structure would serve as a basis for future collaboration on relevant issues of interest, such as the mutual interest in exchanging experiences with various storage options, particularly updates on Germany's research and development of renewable power to gas/hydrogen program, California's research and development of battery storage options, and both parties' data on vehicle to grid technologies

7. Conclusion

All participants and Delegates in the Germany Tour were in agreement that this was an invaluable exchange and that the dialogue that started and relationships that were established across the Atlantic with this trip should continue. There was a common belief that both the German and California sides stand to greatly benefit from deepening their cooperation. The challenges for the group in the immediate future will be to work towards a meaningful set of objectives and platforms that enable a long term exchange of best practices on both the technology and policy sides, which can potentially become the matrix for a post 50% and beyond renewable resources energy system.

Clearly the first major step has been successfully completed, and momentum on next steps has already begun. California and German decision makers on energy and climate issues must be sure to work together towards meaningful targets and milestones to continue the progress made to date.

ATTACHMENT A – Tour Delegation

TOUR DELEGATION	
California Regulators & Staff	
<p>California Independent System Operator (CAISO) Stephen Berberich, CEO/President Angelina Galiteva, Governor David Olsen, Governor Keith Casey, Staff Mark Rothleder, Staff</p> <p>California Energy Commission (CEC) Robert Weisenmiller, Chair David Hochschild, Commissioner Kevin Barker, Advisor to Chair Weisenmiller</p>	<p>California Public Utilities Commission (CPUC) Carla Peterman, Commissioner Michael Picker, Commissioner Nicolas Chaset, Advisor to Commissioner Picker Julie Fitch, Advisor to Commissioner Peterman</p>
Organizing & Logistics	
<p><u>California</u></p> <p>Renewables 100 Policy Institute (also managed audio-visual media/reporting) Matthias Bank, Media and Outreach Director Angelina Galiteva, Founding Board Chair Diane Moss, Founding Director</p> <p>In coordination with Janice Lin, Co-Founder and Chair, Global Energy Storage Alliance GESA, Founder and Manager, Strategen, and staff from CAISO, CEC, and CPUC</p>	<p><u>Germany</u></p> <p>Fraunhofer ISE Prof. Dr. Eicke Weber, Director Dipl.-Phys. Gerhard Stryi-Hipp, Head of Energy Policy</p> <p>Federal Ministry for Economic Affairs & Energy David Lerch, Advisor</p> <p>Messe Duesseldorf Sabine Hartmann, Assistant to the Head Heiko Stutzenger, Head of Renewable Energy Fairs</p> <p>RGI Antonella Baggatini, Executive Director</p>
<p>Observers: Gregg Ander, Energy Foundation, VP Power Program, Caroline Choi, SCE, VP Integrated Planning & Environmental Affairs, Fong Wang, PG&E, Senior VP, Energy Procurement</p>	

California Delegation @ Energy Storage Europe 2014 and Berlin
March 24-28, 2014

SCHEDULE OF MEETINGS

Monday, March 24 - Bonn/Duesseldorf

Bonn

Meeting With Dolf Gielen, IRENA (Head of IRENA's Technology Innovation Center)

Meeting With Annegret Groebel, Bundesnetzagentur (Head of Department International Relations)

Duesseldorf

Welcome Dinner on Invitation of North-Rhine Westphalia Environmental Minister Johannes Rimmel

Tuesday, March 25 - Duesseldorf

Morning Coffee Meeting: Hildegard Müller, Chairwoman bdew, German Association of Energy and Water Industries

Conference Session: Opening Session of Energy Storage Europe

Conference Session: California Keynote Panel and Q&A

Conference Session: Speech of Minister Rimmel (Environment Minister State of North Rhine Westphalia)

Conference Session: CEO Panel: German Market Design

Meeting I of Group A

With Dr. Klaus Peter Röttgen, Head of Storage at E.ON and Vice President at EASE

Meeting II of Group A

With Didier Houssein – International Energy Agency (IEA) Director

Meeting III of Group A

With Frank Wouters, Deputy Secretary General at International Renewable Energy Agency (IRENA)

Meeting I of Group B

With Boris Schucht, CEO 50Hz

Meeting II of Group B

With Sven Becker, CEO Trianel (70 municipal utility companies)

Side Meeting A

With Gunnar Groebler, VP Vattenfall and BVES Boardmember, with Claus Wattendrup and Dr. Rene Kühne from Vattenfall

Side Meeting B

With Mr. Cosciani, CEO, FIAMM and Mr. Westgeest, Executive Director, EUROBAT

Conference Session: Panel on Framework and Policy for Storage in Germany

ATTACHMENT B – Schedule of Meetings

Wednesday, March 26, Day 2 of the Energy Storage Europe	
Meeting I of Group A	
With Dr. Carsten Dippel, German Ministry of Economy and Energy (BMWi) + Representatives (Federal Level, Berlin)	
Meeting on Power to Hydrogen and Gas/Grid Integration of Renewables	
With Hannes Seidl, Division Dir., dena	
Hendrik Sämisch, Geschäftsführung/Managing Director, Next Kraftwerke GmbH	
Markus Emmert, Managing Director, ComBInation GmbH - on eMobility	
Dr. Christof Wittwer, Division Head Smart Grid Fraunhofer ISE	
Prof. Dr. Henning (Fraunhofer ISE)	
Prof. Dr. Sterner and Dr. Hebling (Division Director Fraunhofer ISE)	
Conference Session: Markets and Demand for Micro Grid and Hybrid Solutions	
Meeting with Alfons Westgeest on E-mobility (Executive Director, EUROBAT)	
Meeting I of Group B	
Discussion moderated by Janice Lin, Executive Director of CESA and GESA, on modeling efforts incorporating storage technologies for GHG currently underway in Germany and the US and to identify potential avenues for collaboration.	
Thursday March 27, Day 3 of the Energy Storage Europe/Berlin	
<i>Duesseldorf</i>	
Conerence Session - Storage Excellence in the State of North Rhine-Westphalia	
- Dr. Frank-Michael Baumann, Managing Director, EnergyAgency NRW, tbc	
- Garrelt Duin, Minister of Economic Affairs, Energy and Industry of the State of North Rhine-Westphalia	
<i>Berlin</i>	
Meeting With Agora Energiewende - Patrick Graichen	
Group A: Tour Control Center 50Hertz	
Group B: Dr. Harry Lehmann, General Director., German Federal Environment Agency (UBA), Climate and Energy	
TenneT/Renewables Grid Initiative Dinner	
Friday March 28, Berlin	
Group A: Tour BMW Leipzig	
Group B: Euref Tour / Younicos	
Group B: Miguel Berger, Federal Foreign Office, Ambassador, Commissioner for Globalization, Energy & Climate Policy	
Group B: MP Julie Verlinden	
Wrap-Up Dinner hosted by Dr. Martin Schöpe, BMU, Head of Division, International and EU Affairs, Renewable Energy	

This schedule does not include some private side meetings that individual or small groups of Delegates had during the Tour.

**SNAPSHOT COMPARISON OF KEY CLIMATE AND ENERGY TARGETS
IN GERMANY AND CALIFORNIA
(2014)**

Initiative	Targets		Status	
Greenhouse Gas Reduction	Germany	California	Germany	California
	<p><u>Federal:</u>¹ (below 1990 levels) - 40% by 2020 - 55-65% by 2030 - 70% by 2040 - 80-95% by 2050 (non-binding, but supported by series of sector specific laws)² - Federal Environment Agency proposes reductions to 1 tonne annual CO2 equivalent per capita by 2050 to reach 95% reductions.³</p> <p><u>European Union:</u>⁴ <i>Emissions Trading System</i> - 20% below 1990 levels by 2020 EU wide (binding) - Roadmap under discussion only: 40% by 2030, - 60% by 2040, and - 80% by 2050.</p> <p><u>Global:</u>⁵ <i>Kyoto Protocol</i> (non-binding) - 21% below 1990 levels by 2012</p>	<p><i>AB 32 (binding):</i> 1990 levels by 2020</p> <p><i>2005 Executive Order S—3-05 (non-binding):</i> 80% below 1990 levels by 2050⁶</p>	<p>2000-2012: 8% GHG reduction⁷</p> <p>1990-2013: 23.8% GHG reduction.⁸</p> <p>10 tonnes annual CO2 equivalent per capita (2013)⁹</p> <p>Federal 2020 target: Threatened by coal-fired electricity use, driven by international demand and emissions trading market loopholes, not domestic demand/market</p> <p>EU 2020 and Kyoto targets: Exceeded</p>	<p>2000-2012: 1.7% GHG reduction</p> <p>12.1 tonnes annual CO2 equivalent per capita (2012)¹⁰</p> <p>2020 target (AB 32) On track</p> <p>2050 target Roadmap for meeting this, along with interim targets and laws to support them, are still in development.</p>
Total RE (electricity, heating/cooling, transportation)	<p><u>Federal policy (non-binding)</u>¹¹ 18% by 2020 60% by 2050</p>	<p>No specific target, but Low Carbon Fuel Standard calls for 10% carbon reductions from transport fuels by 2020.¹²</p>	<p>12.3% (2012-2013) 25.4% power 5.3% transport fuel 9% heat fuel</p>	<p>N/A</p>

ATTACHMENT C – Comparison of Key Climate & Energy Targets

Initiative	Targets		Status	
Renewable Electricity (non large hydro)	Germany	California	Germany	California
	<p><u>Renewable Energy Sources Act (targets non-binding)</u>¹³</p> <p>35% by 2020</p> <p>50% by 2030</p> <p>65% by 2040</p> <p>80-100% by 2050</p> <p>In addition to targets, law established priority interconnection, along with differentiated, cost-based, periodically degressing feed-in tariffs for renewable electricity generation.</p>	<p><u>2012 CA Senate Bill 2 (target binding)</u>¹⁴</p> <p>33% by 2020</p> <p>(Interim Goal of 25% by 2016)</p> <p>This is the state Renewable Portfolio Standard, supported by a variety of programs (California Solar Initiative offering state rebates for rooftop solar, net metering for small PV systems, RAM, feed-in tariff, etc.)¹⁵</p>	<p>25.4% of total generation as of end of 2013¹⁶ (27% Q1 of 2014)¹⁷</p> <p>Solar PV: 36 GW (4.5% of total)</p> <p>Wind: 35 GW (7.9% of total)</p> <p>Biomass: 8 GW (6.8%)</p> <p>Small Hydro: 5.6 GW (3.4%)</p> <p>Household Waste: .8%</p>	<p>IOUs 22.7% of total generation as of end of 2013¹⁸</p> <p>Solar: 3 GW</p> <p>Wind: 6.2 GW</p> <p>Biomass: 1.1 GW</p> <p>Small Hydro: 1.6 GW</p> <p>Geothermal: 2.7 GW</p> <p>**large hydro: 12.3 GW</p>
Energy Storage for Renewables	<p>No specific target. Federal policies include:</p> <p>Promoting Energy Storage Initiative (R&D)</p> <p>Environment Ministry subsidies and low interest loans by federal development bank cover 30% of upfront costs and finances up to 100% of costs of battery systems for small (>30 kW) PV systems.</p> <p>Systems must consume peak load production onsite. 25 million euros available in first year of program (2013)^{19 20}</p>	<p><u>AB 2554 (state law)</u>²¹</p> <p>1,325 MW must be procured by IOUs by 2020 and installed by 2024.</p>	<p>As of May 2014, 4,000 solar batteries were installed through federal program.</p> <p>KfW awarded for low-interest loans of nearly 66 million euros and grants of over 10 million euros.²²</p>	<p>As of March 2014, IOUs submitted procurement applications to CPUC.²³</p>

ATTACHMENT C – Comparison of Key Climate & Energy Targets

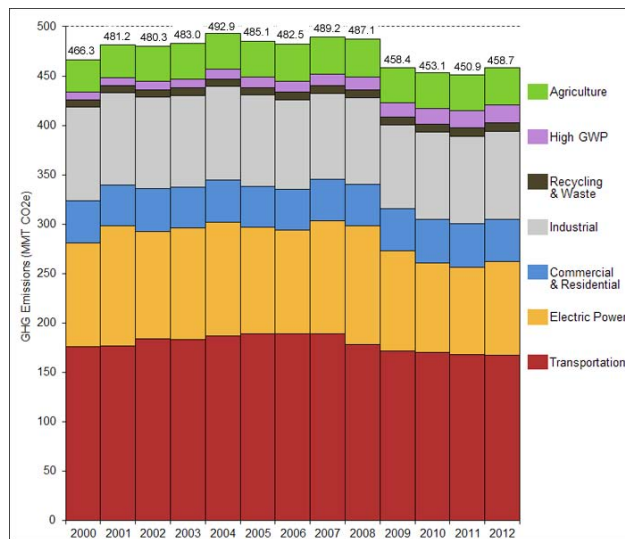
Initiative	Targets		Status	
Zero Emissions Vehicles (plug in and fuel cell)	Germany	California	Germany	California
	<u>2009 National Development Plan for Electric Mobility</u> ²⁴ 1 million vehicles by 2020	<u>2012 Executive Order</u> ²⁵ 1.5 million vehicles by 2025	Approximately 12,156 sold as of 01/2014 ²⁶	Approximately 92,866 sold 2011-2014 ²⁷
Building Efficiency Targets	<p><u>Energy Concept of 2010</u>²⁸ (non-binding, although owner eligibility for state support will depend upon meeting targets)</p> <p><i>Retrofit 2% of existing stock annually</i></p> <p><i>Electricity consumption</i> -10% below 2008 levels by 2020 and - 25% by 2050</p> <p><i>Heat demand</i> - 20% below 2008 levels by 2020</p> <p><i>Primary energy demand in buildings</i> - 20% below 2008 levels by 2020 and - 80% by 2050</p> <p><i>Climate Neutral (nearly)</i> All buildings by 2050 (Introduce standard by 2020)</p> <p>Specific Ordinances/Laws supporting these targets: See <i>The Federal Government's energy concept of 2010 and the transformation of the energy system of 2011.</i>²⁹</p>	<p><u>Energy Upgrade California:</u> Existing buildings (non-binding):</p> <p><i>Energy consumption: lower approx 40% by 2020</i>³⁰</p> <p><i>Energy efficiency home retrofits: 100,000</i>³¹</p> <p><i>State budget for goals: approx. \$1.2 billion</i>³²</p> <p>New buildings (non-binding):³³</p> <p><u>Net Zero</u></p> <ul style="list-style-type: none"> - all new residential by 2020 - all new commercial by 2030 - all new state buildings and major renovations that begin design after 2025: 50% of the square footage of existing state-owned building area by 2025 (Executive Order B-18-12) <p>Specific Laws/Regulations supporting these targets: See <i>2013 Integrated Energy Policy Report</i>³⁴</p>	<p>2005-2011: 10.3% decrease in household final energy consumption (excluding transportation)</p> <p>However, household electricity consumption is showing a trend of increasing (4.7% from 2005-2012) due at least in part to rising use of communication, digital, and entertainment devices. Policy discussions are focused on reigning this in.³⁵</p>	<p>12,200 homes retrofitted (end of 2013)</p> <p>Electricity use per capita has remained generally flat for the past 20+ years.³⁶ <i>This is likely the result of a mix of policy and non-policy factors (CA's mild climate, etc.)</i>³⁷</p> <p>Total residential natural gas consumption has remained fairly flat for the past decade <i>But</i> Natural gas consumption per household has been on a consistent downward trend for the past several decades.³⁸</p>

MORE KEY VARIABLES WHEN COMPARING GERMAN – CALIFORNIA ENERGY PROFILES:

- California (423,970 km²) is larger than Germany (348,672 km²) but about half as populated.³⁹
- Germany's access to renewable energy sources (like sun, wind, and hydropower), along with lower carbon fossil fuels (namely natural gas), is substantially more constrained than California's.
- Germany's economy is based more on energy intensive industry relative to California. Manufacturing and other heavy industry (automobiles, chemicals, machinery, metals, etc.) makes up 28% of the German GDP (CIA), whereas manufacturing comprises only approximately 10% of California's (Bureau of Labor Statistics, 2008).
- German homes' largest energy demand is for heat, peaking in their cold winter. California homes' largest energy demand is for electricity, peaking in the summer when air conditioning demand rises.
- Germans tend to keep their homes for longer periods of time – often generations – than Californians.
- Germany's largest emitter is its energy production industry, and while this is also a big emitter in California, California's largest emitter is its transportation sector. The transportation sector in the state emits 36-37% of its carbon emissions (CARB, 2012), while only about 16% in Germany. Factors contributing to this could be that the German public transportation system is far more developed than California's, Californians tend to commute longer distances, and Germans tend to drive smaller cars. See Table 8 on the next page for a comparison of GHG emissions by sector.

ATTACHMENT C – Comparison of Key Climate & Energy Targets

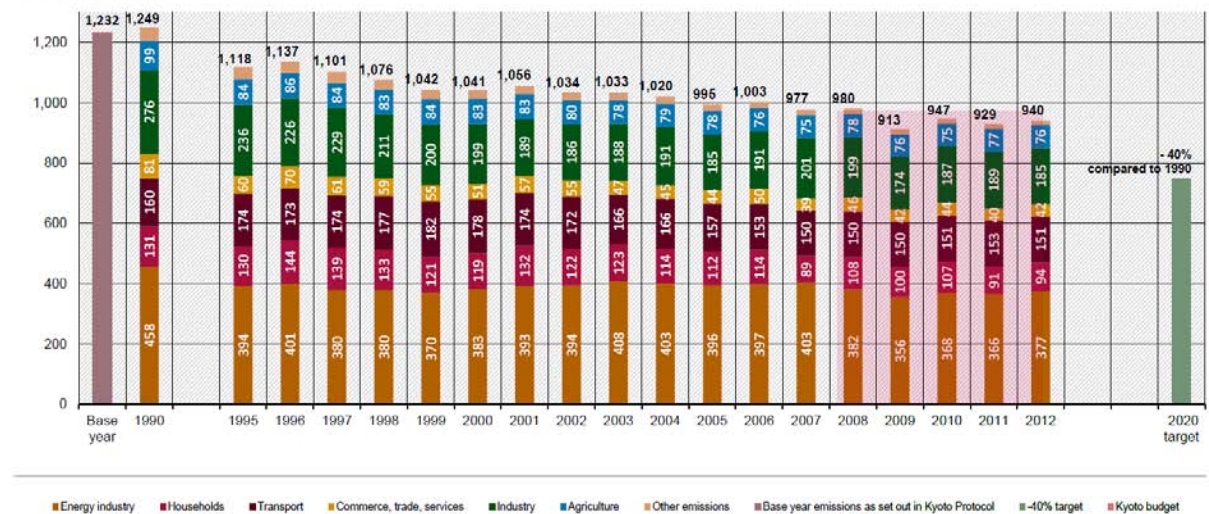
California GHG Emissions by Sector (2012)⁴⁰



Germany GHG Emissions by Sector (2012)⁴¹

Development of greenhouse gas emissions in Germany per sector

Figures in million tonnes CO₂ equivalents



Source: Federal Environment Agency (UBA) 7 January 2014

ATTACHMENT C – Comparison of Key Energy & Climate Initiatives

ENDNOTES

¹ Germany Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMU), <http://www.bmub.bund.de/en/topics/climate-energy/climate-initiative/general-information/#c20236>

Note that the targets beyond 2020 are still in discussion, and the German Federal Environment Agency is pushing for the higher targets.

² See: http://www.justiceandenvironment.org/_files/file/2011%20CC%20DE.pdf

³ http://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/germany_2050_a_greenhouse_gas_neutral_country_lan_gfassung.pdf

⁴ European Commission, http://ec.europa.eu/clima/policies/roadmap/index_en.htm

⁵ BMU, <http://www.bmub.bund.de/en/topics/climate-energy/climate/international-climate-policy/kyoto-protocol/>

⁶ California Air Resources Board (CARB) <http://www.arb.ca.gov/cc/cc.htm>

⁷ UBA,

http://www.umweltbundesamt.de/sites/default/files/medien/376/bilder/dateien/entwicklung_der_treibhausgasemissionen_in_deutschland_nach_sektoren_1990bis2012_pi-2014-03_anlage_e.pdf

⁸ UBA, <http://www.umweltbundesamt.de/en/press/pressinformation/greenhouse-gas-emissions-rise-again-slightly-in>

⁹ UBA, <http://www.umweltbundesamt.de/en/press/pressinformation/a-greenhouse-gas-neutral-germany-is-almost-possible>

¹⁰ CARB, <http://www.arb.ca.gov/newsrel/newsrelease.php?id=612>

¹¹ BMU, <http://www.erneuerbare-energien.de/en/topics/research/general-information/?cHash=816f8cc23fe06c8f81ed0897140ba585>

¹² Low Carbon Fuel Standard is pursuant to AB 32 and 2007 S-Q1-O7Exec.. See CARB:

<http://www.arb.ca.gov/fuels/lcfs/lcfs.htm><http://www.bmwi.de/DE/Themen/Energie/Energiedaten-und-analysen/arbeitsgruppe-erneuerbare-energien-statistik,did=629806.html>

¹³ BMU <http://www.erneuerbare-energien.de/en/topics/acts-and-ordinances/renewable-energy-sources-act/eeg-2012/>

UBA has called for a 100% renewable electricity target by 2050 and has completed a feasibility study showing it is realistic:

<http://www.umweltbundesamt.de/en/press/pressinformation/energy-goal-for-2050-100-renewable-electricity>

¹⁴ Text of law: http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.pdf; Background:

<http://www.cpuc.ca.gov/PUC/energy/Renewables/overview.htm>

¹⁵ See California Energy Commission's *2013 Integrated Energy Policy Report* for more details on state and federal policies aimed at advancing California's renewable electricity target: <http://www.energy.ca.gov/2013publications/CEC-100-2013-001/CEC-100-2013-001-CMF.pdf>

¹⁶ BMWi/AGEE: <http://www.bmwi.de/DE/Themen/Energie/Energiedaten-und-analysen/arbeitsgruppe-erneuerbare-energien-statistik,did=629806.html>

¹⁷ BDEW (German) <http://www.bdew.de/internet.nsf/id/20140509-pi-bdew-veroeffentlicht-erste-quartalszahlen-zu-erneuerbaren-energien-de>

¹⁸ California Public Utilities Commission: <http://www.cpuc.ca.gov/PUC/energy/Renewables/index.htm>

¹⁹ <http://www.solarenergystorage.org/en/energiespeicher-in-der-diskussion-um-die-eeg-novelle-2014/>

²⁰ KfW, https://www.kfw.de/KfW-Group/Newsroom/Aktuelles/Pressemitteilungen/Pressemitteilungen-Details_107136.html

²¹ <http://www.cpuc.ca.gov/PUC/energy/Renewables/overview.htm>

²² BSW-Solar (German): <http://www.solarwirtschaft.de/presse-mediathek/pressemeldungen/pressemeldungen-im-detail/news/bereits-4000-solarstromspeicher-gefoerdert.html>; English report: <http://www.solarserver.com/solar-magazine/solar-news/current/2014/kw20/german-solar-battery-subsidy-supports-4000-systems-in-first-year.html>

²³ <http://www.cpuc.ca.gov/PUC/energy/electric/storage.htm>

²⁴ Germany Federal Ministry for Economic Affairs and Energy (BMWi) <http://www.bmwi.de/EN/Topics/Economy/Industrial-policy/electric-mobility.html>

²⁵ Office of the Governor of California, <http://gov.ca.gov/news.php?id=17463>

²⁶ KBA via best-selling-cars.com (Note it is unclear whether these are pure EVs or includes PHEVs and FCEVs) <http://www.best-selling-cars.com/germany/2014-germany-total-number-electric-cars/>

²⁷ California Plug-In Electric Vehicle Collaborative <http://www.pevcollaborative.org/>

²⁸ Source: Germany Federal Environment Agency, Presentation by General Director Harry Lehmann March 27, 2014; Also see: https://www.germany.info/contentblob/3043402/Daten/1097719/BMUBMWi_Energy_Concept_DD.pdf

²⁹ https://www.germany.info/contentblob/3043402/Daten/1097719/BMUBMWi_Energy_Concept_DD.pdf

³⁰ Energy Upgrade California <http://www.energyupgradeca.org/en/learn/california-state-energy-goals>

³¹ California Energy Commission: http://www.energy.ca.gov/releases/2011_releases/2011-03-01_energy_upgrade_california.html

³² California Energy Commission: http://www.energy.ca.gov/releases/2011_releases/2011-03-01_energy_upgrade_california.html

³³ California does not have a major industrial base like Germany does, so only building efficiency targets are addressed

³⁴ 2013 IEPR: <http://www.energy.ca.gov/2013publications/CEC-100-2013-001/CEC-100-2013-001-CMF.pdf>

³⁵ (German) <http://www.heizungsfinder.de/blog/deutsche-haushalte-setzen-vermehrt-auf-erneuerbare-energien-beim-heizen/>;

(German) UBA <http://www.umweltbundesamt.de/daten/private-haushalte-konsum/endenergieverbrauch-der-privaten-haushalte>

³⁶ California Energy Commission: http://www.energy.ca.gov/renewables/tracking_progress/documents/statewide_energy_demand.pdf

³⁷ <http://energyathaas.wordpress.com/2013/08/05/deconstructing-the-rosenfeld-curve/>

³⁸ California Energy Commission: http://energyalmanac.ca.gov/naturalgas/residential_natural_gas_consumption.html

³⁹ California population: 38.04 million (2012); German population: 81.89 million (2012)

⁴⁰ California Air Resources Board: http://www.arb.ca.gov/cc/inventory/data/graph/bar/bar_2000-12_by_scopingplan.htm

⁴¹ German Federal Environment Ministry (UBA): <http://www.umweltbundesamt.de/en/press/pressinformation/hendricks-strives-for-more-ambitious-climate>

ATTACHMENT D – Attendee List at TenneT/RGI Dinner

Attendee List at TenneT/RGI Dinner, Thursday, March 27 in Berlin
In alphabetical order

Antonella Battaglini

RGI

Christoph Bals

Policy Director at German Watch

Matthias Bank

Renewables 100 Policy Institute Media and Outreach Director

Shenyu Belsky

Program Director for Southern China at Rockefeller Brothers Fund

Stephen Berberich

CAISO CEO/President

Professor Zhou Dadi

General Emeritus & Sr. Researcher at Energy Research Institute of the National Development & Reform Commission of China

Geoffrey Feasey

Corporate Affairs Manager at ENTSOE

Julie Fitch

Advisor to CPUC Commissioner Peterman

Angelina Galiteva

Renewables 100 Policy Institute Founding Board Chair, CAISO Board of Governors

Paul-Georg Garmer

Senior Manager of Public Affairs at TenneT

Hal Harvey

CEO of Energy Innovation, Policy and Technology LLC

David Hochschild

CEC Commissioner

Tor Eigil Hodne

Director of Stattnet, Norwegian Grid Operator, EU Office

Dr. Gao Hu

Deputy Director of Energy Research Institute of the National Development

Continued next page

ATTACHMENT D – Attendee List at TenneT/RGI Dinner

Continued

Dr. Kathrin Jordan-Korte

Economic Specialist at the U.S. Embassy Berlin

Jochen Kreusel

Head of ABB Smart Grid Program

Dr. Harry Lehmann

General Director of the German Federal Environment Agency (UBA)

David Lerch

Advisor at the German Federal Ministry for the Environment (BMU)

Auke Lont

CEO of Stanett

Felix Matthes

Research Coordinator Energy & Climate Policy at Oeko-Institute (Institute for Applied Ecology)

Wolfgang Neldner

Director of Berlin Energie

Michael Northrop

Program Director for Sustainable Development at the Rockefeller Brothers Fund

David Olsen

CAISO Board of Governors

Immi Patterson

Head of Global Affairs at the U.S. Embassy Berlin

Michael Picker

CPUC Commissioner

Gerard Reid

Founder Managing Partner at Alexa Capital

Kirsten Maria Rippel

Head of Energy Policy at 50 Hertz

Mark Rothleder

CAISO Staff

Christian Schmidt

Vice Chair Working Group 3 at German Federal Ministry of Economics: Division Energy Law, Electricity&Gas Regulation, NSCOGI

Gerhard Stryi-Hipp

Head of Energy Policy at Fraunhofer ISE

Continued next page

ATTACHMENT D – Attendee List at TenneT/RGI Dinner

Continued

Heiko Stubner

Research Associate at Office of MP Nina Scheer *Continued*

Sven Teske

Renewable Energy Director at Greenpeace International

Antje von Broock

Team Leader Climate & Energy at Friends of the Earth (BUND)

Bettina von Kuptsch

Head of Public & International Affairs at Swissgrid

Robert Weisenmiller

CEC Chair

V. John White

Executive Director at Center for Energy Efficiency and Renewable Technologies



California Independent System Operator Corporation

March 20, 2014

Statement of Support for the European Grid Declaration

The European Grid Declaration on Electricity Network Development and Nature Conservation in Europe (European Grid Declaration, 2011) commits signatories to work collaboratively to accelerate the modernization and expansion of Europe's power grids to access and deliver renewable resources, in ways that simultaneously preserve and protect species and ecosystem integrity.

Signatories include Transmission System Operators in Belgium, Denmark, Italy, France, Germany, Norway, Spain, Switzerland and the UK; Non-Government Organizations (NGOs) having environmental protection missions with members across Europe; and supportive foundations and energy industry groups.

In signing the Declaration, grid operators commit to help meet Europe's objectives to protect nature, for example by working to minimize risks to birds from power lines. NGOs commit to support grid development for the integration of renewables from larger centralized and smaller local generation sources. Both pledge to encourage transparency and build public acceptance of renewables-grid development.

The California Independent System Operator Corporation (CAISO) is responsible for reliable operation of the grid in most of the state. We make the following statement in support of the European Grid Declaration:

- The CAISO Board of Governors applauds the collaboration of the parties working together to put the principles of the European Grid Declaration into practice;
- the transmission development in California is based on similar principles and California policies require grid development in the state to be done in ways that minimize and mitigate environmental impacts;
- the California ISO works collaboratively with stakeholders to ensure that grid expansion meets environmental and public interest goals, and supports renewables integration; and
- the California ISO manages transmission planning to ensure transparency and stakeholder involvement.

Because the California ISO is in support of the European Grid Declaration and uses similar principles, we are pleased to submit this statement in support of the European Grid Declaration.

Robert Foster, Chair

Ash Bhagwat

Angelina Galiteva

Dave Olsen

Richard Maullin