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Research Project
Energy Transitions in Cities. Lifestyle, experimentation and change

Seventh case study: San Francisco

Luís CARVALHO, Irina LAZZERINI, Erwin VAN TUIJL

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Energy transitions in cities. Lifestyle, experimentation and change

"Energy Transitions in Cities. Lifestyle, experimentation and change", is an international comparative study, with focus on a limited yet illustrative number of metropolitan realities in developed and emerging economies. This is a joint initiative of Euricur (European Institute for Comparative Urban Research) and Enel Foundation and should run for approximately 2 years, with closing date foreseen for June 2014.

The project aims at better understanding the role of cities, as players and places, in energy transitions, focusing on the user/consumer side and their changing behavior and lifestyle, but also at how new sources of energy production and distribution modes emerge, are experimented and legitimated in cities. The study involves also looking at the role played by leading utilities – in cooperation with municipal administrations, users and other urban stakeholders – in creating shared values, for the experimentation and scaling-up of more sustainable services and solutions.

The project combines desk research and the review of state-of-the-art experiences with the collection of primary, new evidence in cities. It takes place in 3 stages: 1) development of a methodological framework of analysis, tested on an urban pilot case study (Stockholm); 2) extension of the framework to 6 cities (Turin, Shanghai, Berlin, Santiago de Chile, Rio De Janeiro, S. Francisco) and in-depth investigation of the key dynamics ongoing in their respective energy sectors (megatrends); 3) synthesis and presentation of general findings. Best practices and comparative findings resulting from the case studies will be collected and applied to Rome and Barcelona for a comparative analysis.

This publication includes the results of the seventh case study: the city of San Francisco.

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Abstract

This case study explores a number of features in the energy transition processes currently unfolding in San Francisco Bay (California), namely the role of community-level action for energy innovation, the design of new business models and the localized diffusion of new energy-related knowledge. To this effect, we analyse two main developments. First, we look into the trend towards Community Choice Aggregation (CCA) of electricity demand by municipalities and counties. More concretely, we analyse the features, dynamics and challenges of the pioneer experiment in Marin County to increase the renewable content of the electricity within its jurisdiction. Second, we study the drivers behind the fast diffusion of electric vehicles in the region. Besides looking at the (favourable) regulatory framework, the case explores some important (yet less visible) localized actions carried out by multiple stakeholders with the ambition to remove remaining hurdles.

The case concludes by highlighting key insights and lessons for cities and energy utilities, as well as a number of more conceptual reflexions on the geography of energy transitions.

Keywords: Community Choice Aggregation, electric mobility, energy business models, sustainability transitions

JEL Codes: O31, O38, O48, Q42, Q48 R11, R58

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Introduction

California is widely recognised as a world leader in energy-related innovation, already for many decades[1]. Currently, about 80 percent of Californians believe in climate change compared with less that 50 percent in the United States (US) as a whole[2]. The State´s regulatory framework is highly progressive, strongly supporting energy efficiency, the adoption of renewable energy sources and energy experimentation in many domains.

This case study explores some features of the energy transitions currently unfolding in one of the most dynamic urban regions of California: the so-called San Francisco Bay area, 7.5 million inhabitants, including, among others, the cities of San Francisco and Oakland, as well as some of the wealthiest US counties and the "Silicon Valley". By doing so, it fleshes out the role of localized and community-level action for energy innovation, the design of new business models and the diffusion of new energy-related thinking. This analysis is grounded on two leading developments. First, the trend towards "Community Choice Aggregation (CCA)" of electricity demand by municipalities and counties, with an eye to increase the renewable content of the electricity within their jurisdictions; the case explores the features, dynamics and challenges of the pioneer experiment of Marin County in this field. Second, the case looks into the drivers behind the fast diffusion of electric vehicles in the region; besides looking at the regulatory framework, it explores some localized actions carried out by multiple stakeholders with the ambition to remove remaining hurdles.

This case study is part of a larger international comparative research entitled "Energy Transitions in Cities – Lifestyle, Experimentation and Change", carried out in partnership between Enel Foundation and the European Institute for Comparative Urban Research (Euricur). It is based on a diverse array of primary and secondary data sources. It relies on extensive desk research combined with in-depth and semi-structured interviews with 26 public and private stakeholders, conducted in San Francisco between February 24th and March 7th 2014. Among others, interviews focused on untangling and reconstructing processes behind the initiatives under analysis, the dynamics of different regulatory frameworks as well as the daily operations, strategies and challenges of the interviewees in their actions shaping local energy transitions.

This case is structured as follows. Section 1 briefly reviews the general tenets and framework of analysis used throughout the whole international study. Section 2 looks into the defining features of San Francisco´s Bay socio-economic and political features in relation to the energy realm. Section 3 provides a synthetic view into the region´s energy framework and recent dynamics. Section 4 explores in-depth the features of the Community Choice Aggregation scheme in Marin County, reflecting on (transferable) success factors and challenges ahead. Section 5 tours into a number of new actions, partnerships and business models associated

1 Rosenfeld, 2009
2 Leiserowitz et al., 2013

with the diffusion of electric vehicles in San Francisco. Section 6 concludes by highlighting key insights and lessons of the case study for cities and energy utilities.

1 The framework of analysis revisited

This Section briefly reviews the main tenets, the research questions and the theoretical framework guiding this international comparative study. The detailed theoretical background and framework of analysis can be found in the Working Paper 1/2013 of Enel Foundation Working Paper Series[3].

Global fundamental developments, new energy consumption patterns and technologies are triggering change in old established energy systems. Production and distribution of fossil-based energy are becoming more efficient while a new set of renewable (and distributed) energy sources is gaining ground in the energy mix of many societies. Overall, there is a recognition that large-span industrial and societal transformations should lead to more sustainable modes of energy production, distribution and consumption. Yet, the thorny issue in such *transitions* is that innovation and societal change are far from linear and predictable: new technologies, infrastructures and consumer demand for new energy "products" co-evolve through complex societal processes during long time spans and can unfold in unexpected directions.

A central premise in this study is that *cities and metropolitan areas* are increasingly the key places where such energy transitions can be observed "on-the-move". Cities are increasingly active in climate change and energy issues, both locally and through high-level international networking (e.g. the C40 initiative, and many others). Local governments worldwide support "green deals" and allocate considerable funding for that. Cities are also key places for experimentation, early adoption, market formation and societal legitimation of new energy solutions. During such early formation and scaling up processes, interaction between energy companies, local governments, academia and consumers can originate the creation of energy *shared values*, in a win-win fashion. More and more private companies are getting involved in (sustainable) urban development issues, and energy is one of these fields.

Hence, a central aim of this research is to better understand the role of cities – as *players* and *places* – in energy transitions**.** More concretely, it aims at consolidating a framework to understand how utilities, city administrations, users and other urban stakeholders interact for the experimentation and scaling up of more sustainable energy solutions. This should provide inputs for new ways of societal involvement of business, universities, governments and associations in a fast-changing global energy context. Concrete research questions are:

- Which fundamental changes can be seen in the urban behaviour of people and firms (e.g. use of the urban space, mobility)? What are the implications for energy production, distributions and consumption?

- Which energy-related urban policy trends can be seen in cities?

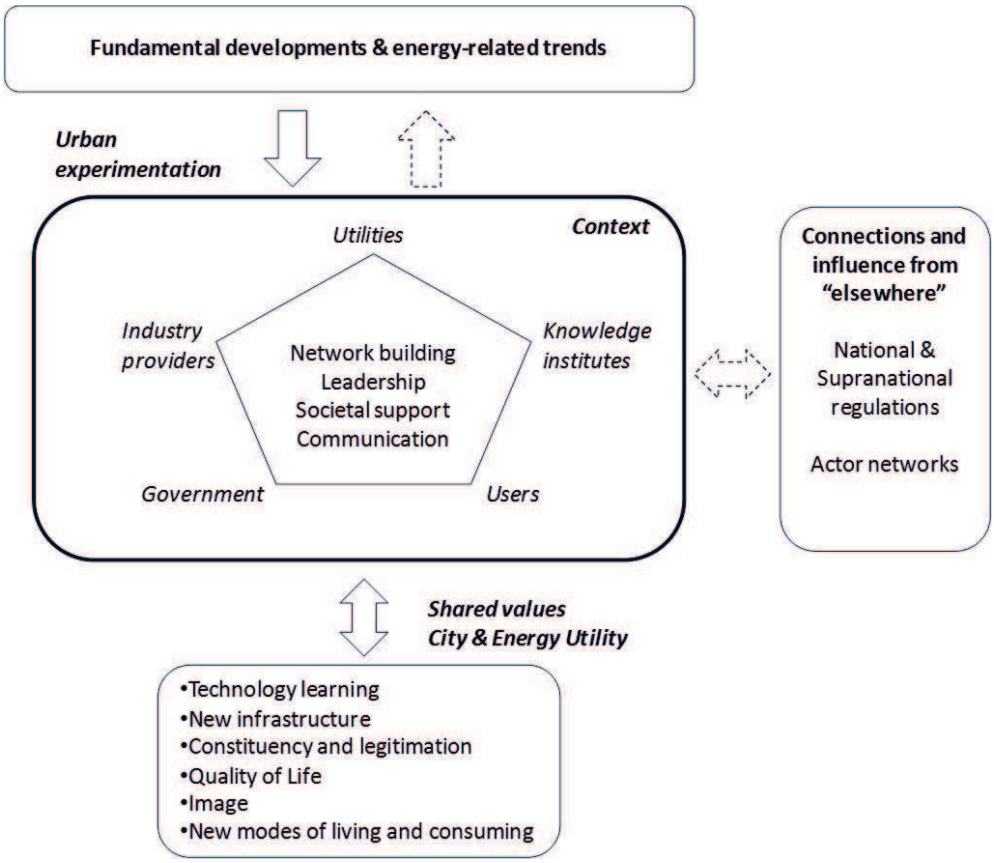
- Which modalities of energy experiments and new business models can be seen in cities?

3 Carvalho et al., 2013

- What is the role of utility companies in such experiments?
- Through which types of governance arrangements do they operate?
- How cities and energy utilities engage towards the creation of new shared values?

To carry out this study and assure comparability across cases, a theoretical framework was devised, to be progressively tested and fine-tuned during the study (see Figure 1).

FIGURE 1 - Towards a theoretical framework



Source: own elaboration

Four main building blocks, as well as a number of relations between them compose the theoretical framework.

Urban experimentation and piloting of new energy solutions (e.g. new sources, new distribution and consuming modes, integration between systems and value chains) is the central building block. It refers to on-going, energy-related change associated with notable pilots and experiments in cities. Such experiments rely and take place in specific urban

contexts – such as the city´s history in promoting energy and "green"-related initiatives, the presence of local "champions" (e.g. leading utility companies and other providers) and perceived threats and opportunities faced by the city in energy-related domains. Energy experiments are carried out by constellations of stakeholders such utilities, industrial providers, different government tiers, knowledge institutes and, importantly, citizens and users. Among others, the success of coalitions fostering energy experimentation may rely on a number of relevant organizational factors, such as leadership, the development of strategic partnerships, societal support and communication.

The concrete urban experiments under analysis are catalyzed by a number of fundamental developments and energy-related trends. Those can be general megatrends – e.g. resource depletion and climate change, IT convergence, new mobility patterns in cities, fast urbanization or new consumer expectations – but can also be city or region specific (e.g. Latin America, Scandinavia, Asia, etc). They tend to provoke changes in the "rules of the game", pushing for new developments and transitions. It is assumed that the development of energy experiments in cities can eventually feedback and influence those fundamental developments, but to a limited extent, depending on the influencing capacity of the city and involved actors (thus the "dashed" feedback arrow in the figure).

Through those experiments or pilots, a number of shared values can be created between city and other stakeholders, notably energy utilities. Examples of shared values are technology learning processes, new infrastructure development, legitimation and embedding of new energy solutions in society, enhanced quality of life and image of a city, and the emergence of new models of living and consuming (including new business models). However, shared values do not happen automatically: a number of conditions should be in place (e.g. the abovementioned organizational features). Moreover, after a certain moment, such outcomes may start to influence the development of the urban experimentation, steering (or hampering!) it further towards larger adoption and scaling up. The "bi-directional" arrow in the figure illustrates this.

Finally, cities are not independent "islands" – actually, the capacity to steer a transition further relies also on the relations established between cities, their actors and relevant connections at other spatial scales (influence from "elsewhere"). On the one hand, cities (and its actors, such as utility companies) simultaneously rely on and influence policy schemes, standards and regulations at other levels (e.g. national, international). On the other hand, cities are often plugged into higher transnational spaces through the business and knowledge networks of its actors (e.g. corporate networks, R&D networks, city lobbying platforms), and those can support (or reduce the interest) in energy-related developments at the local level.

2 San Francisco and the Bay area: socio-economic dynamics and administrative context

Located at the western coast of the United States (US), San Francisco is one of the most dynamic and densely populated North-American cities. The city has roughly 850 thousand inhabitants but it is estimated that more than one million people are present in the city on a daily basis, due to commuting and tourism. Moreover, population grew by four percent (vs. 2.9 percent in California) over the last five years (US Census Bureau, 2014). San Francisco is surrounded by the so-called Bay Area (Figure 2), counting 7.5 million inhabitants. Beyond San Francisco, the Bay Area encompasses cities like Oakland and Berkeley (East Bay), the famous Silicon Valley (Palo Alto-San Jose-Santa Clara) and some of the wealthiest counties in the US (such as Marin, alongside the Northern Bay).

FIGURE 2 - San Francisco Bay Area

Source: this map has been released into the public domain by its author (Perry Planet at wts.wikivoyage-old.org)

The population and economy of the Bay Area grew substantially over the last decades, namely through net migration and to the emergence and consolidation of new high-tech industries. San Francisco is a cultural, business and financial centre, and together with Silicon Valley, it has been home to many leading technology companies such as Apple, Intel, Oracle, Cisco, Facebook, Google, and many others. The area boosts one of the most dynamic innovation ecosystems in the world, with top-notch universities (Stanford, Berkeley) and networks of venture capitalists tied together by a strong risk-taking and entrepreneurial culture[4]. Over time, the success of the area has led to permanent flows of new companies and capital, knowledge networks, unique talent pools and the emergence of new industries[5].

Many of the new industries moving to the area are in the field of cleantech and energy (e.g. clean transport, solar), drawing on previous IT competences, venture capital and experimentation culture, coupled with progressive energy and environmental policies at the State and local levels (see Section 3). For example, Silicon Valley is home to Tesla, one of the trend-setting and fastest-growing electric car companies, as well as many other related industries (e.g. batteries). California and the Bay area lead cleantech venture investment in the US, with almost 50 percent of the total nationwide and growing[6]; the lion´s share of those investments has been on energy-related activities[7].

San Francisco´s population is highly educated. Already in 2006, roughly 45 percent of the adult population had a bachelor degree or higher. Moreover, highly educated young migrants flock into the city every year. This population bracket largely includes what has been called the "creative class"[8], a socio-economic group whose jobs and occupation relies on creativity and new-idea generation. According to the author, the presence of talent, tolerance and technology in cities like San Francisco contributes to attract more talent and creativity, leading to sustained levels of innovation and prosperity. During 2008-2012, the per capita money income in San Francisco reached an average of more than USD 47.000 (vs. USD 29.000 in California as a whole)[9].

As in other North American cities, wealth and high prices (salaries, housing) in San Francisco co-exist with rampant poverty. More than 13 percent of the city´s inhabitants live below poverty level[10]. There are also significant socio-ecological contrasts within the Bay area. Wealthy and environmentally preserved counties co-exist with others disproportionally affected by pollution. One example is the so-called "Toxic Triangle", an area between the cities of Richmond (Chevron´s oil refinery), Oakland and Bayview Hunter´s point (South San Francisco).

California, in general, and San Francisco, in particular, are considered progressive world leaders in the fight against climate change and the use of renewable energy (e.g. Elkind,

4 Saxenian, 1996
5 Kenney and Patton, 2006
6 Asmus, 2009
7 Stack et al., 2007
8 Florida, 2002
9 US Census Bureau, 2014
10 US Census Bureau, 2014

2013; Section 3), with several policies, initiatives and regulations in that field. One example is the Assembly Bill (AB) 32 – the Global Warming Solution Act of 2006 – that sets the framework for cutting greenhouse gas emissions back to 1990 levels by 2020. The same goes for tight energy efficiency and building standard[11]. The oldest (1892) and largest grassroots environmental organization in the US (Sierra Club) was founded in San Francisco, illustrating the historic drive towards climate and environmental preservation, driven by different types of stakeholders and organizations. On the flip side, the Bay Area has also some of the most active *Not-In-My-Back-Yard* (NIMBY) conservationism movements in the US. As a result, the development of renewable generation facilities has been limited in many areas[12]; moreover land scarcity has led real estate prices to rise sharply over the years (e.g. Glaeser, 2011).

San Francisco and the Bay Area´s political standings are markedly progressive, with Democrats and Greens dominating political representation since the 1960s (McGhee and Krimm, 2012). Overall, this meant structural support for green agendas and the willingness to challenge private monopolies. However, a closer look reveals the co-existence of rather nuanced types of environmental standpoints (e.g. McGhee and Krimm, 2012) and "environmentalisms" within the Bay Area, for example:

- conservational environmentalists (e.g. in Marin and Sonoma counties), standing for the preservation of rural land, natural scenery, organic food and natural ecosystems (see e.g. Guthey et al, 2003);

- socially-progressive environmentalists (e.g. in Berkeley), strongly anti-pollution and pro-renewable energy[13];

- health-environmental advocates, willing to reduce the impacts of pollution for their families and communities well-being (e.g. Richmond, "Toxic Triangle")

The State of California has fully-fledged legislative powers in many domains – including the environment and energy policy – although some issues are coordinated at the Federal level. The political system in the Bay Area is organized through Counties and Cities. San Francisco is both a City and a County. It has a Mayor´s Office and a Board of Supervisors. Cities tend to be more independent, while Counties (as an administration layer) are usually more powerful in less urbanized areas. This is very much the case in Marin County (Section 4), in which cities are relatively small and have few competences, leaving the County with strong influence. The opposite happens in San Francisco, in which the Mayor´s Office has strong powers vis-à-vis the County[14].

11 Asmus, 2009

12 Due, for example, to the impact that new wind turbines may have on the landscape, natural scenery and birds' ecosystems, or else to the conflicts between development of solar farms and preservation of rural land (e.g. Asmus, 2009

13 Klein and Western, 2004

14 In some cases, local authorities team up with each other in order to increase critical mass to access funding sources. E.g. the City of San Francisco and other municipalities successfully obtained funding to improve air quality. This shared budget is, for instance, used to facilitate the growth of electric vehicles in the Bay Area see section 6.

California is one of the eleven States in the US that allow for legislatively-referred and direct initiative statutes, constitutional amendments and referenda (also known as "ballot measures" or propositions)[15]. This means that besides elected legislative bodies, citizens can also propose laws to be voted, both at local and state level[16]. This allows for advanced forms of (direct) democracy, as well as to better disentangle voters preferences[17]. Under this system, also companies (e.g. energy utilities) – just as regular citizens – can raise propositions, organize systems of donations and sponsor media campaigns. As we will explore in the next sections, energy policy has been an important issue in some of these ballots in California and San Francisco.

15 IRI, 2013

16 For example, if citizens and groups think that the government is not legislating fast enough.

17 Citizens can vote for elected representatives and their parties, but also for a series of "unbundled" propositions in every election.

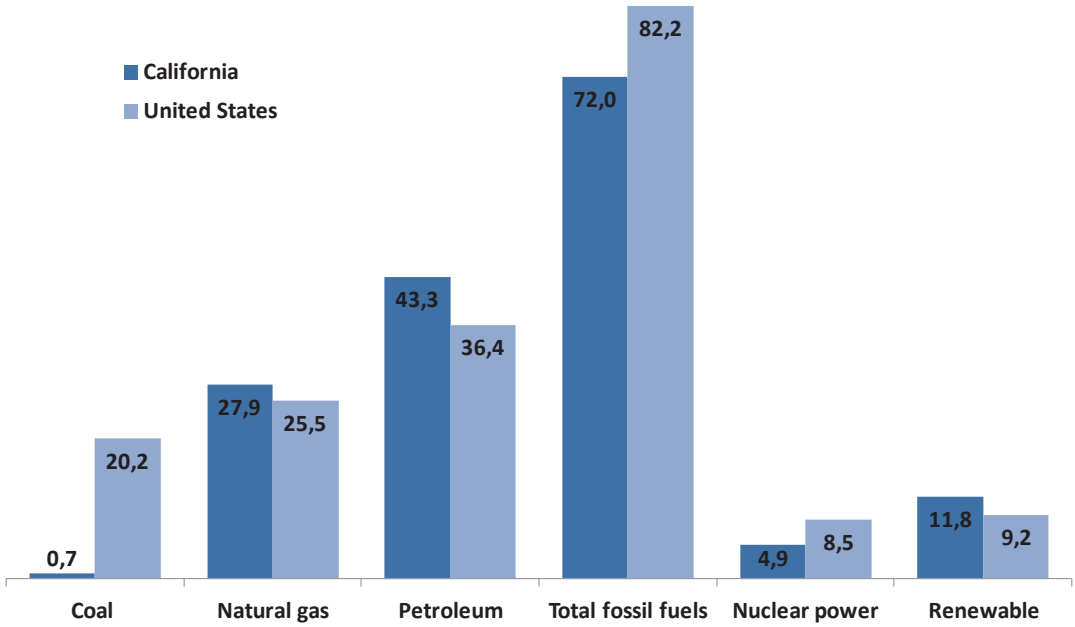
3 Energy framework

In this section we explore the main features of California´s and San Francisco´s energy framework, namely its energy profile (Section 3.1), main players and key policies (3.2). Our objective is not to be fully comprehensive – see Asmus (2009), for a detailed analysis – but to provide a bridge to better understand the Community Choice Aggregation (CCA) initiative of Marin (Section 4) and the new EV business models emerging in San Francisco Bay (Section 5).

3.1 Energy profile

Overall, the energy framework in California is considered to be relatively clean, especially when compared with the US average (Figure 3). While coal is still a relevant energy source in the US, it is rather marginal in California. On the contrary, the share of natural gas and renewable energy consumption is higher in California. However, the consumption of petroleum is relatively higher in California vis-à-vis the rest of the US, namely due to individual, extensive car-based mobility. Indeed, transportation is the biggest contributor to greenhouse gases (GHG) emissions in California – 38 percent vs. 20 percent in the electricity sector[18] – putting pressure on cleaner mobility solutions and fuel sources.

FIGURE 3 - Energy consumption: estimates by energy source, California and the United States, 2011 (% of Trillion Btu – British thermal unit)

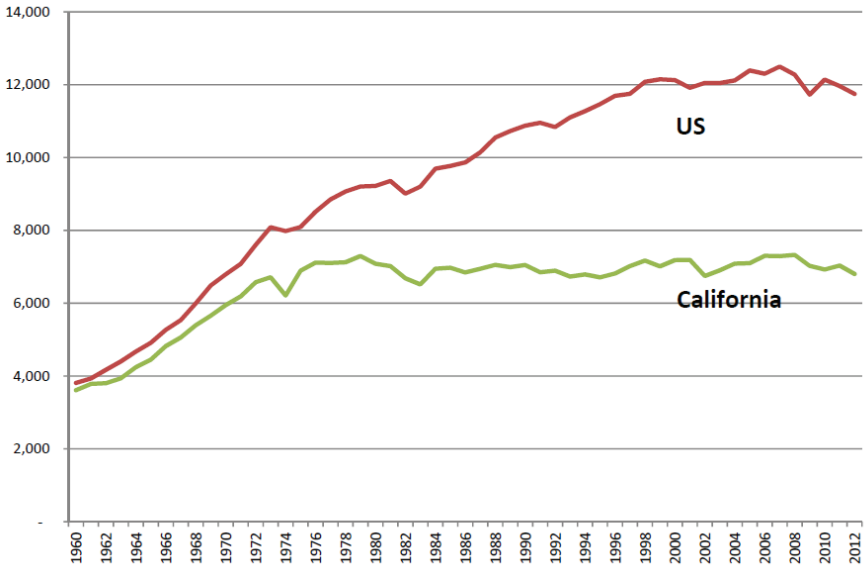


Source: EIA – US Energy Information Administration (2013)

18 Elkind, 2013

Energy efficiency is also considered a success story in California (e.g. Rosenfeld, 2009) and "America's cheapest and cleanest energy resource"[19]. Since the early 1970s, a number of pioneering laws, regulations, R&D incentives and standards (e.g. for more energy-efficient buildings and appliances) contributed to flatten the per capita energy consumption in California (vis-à-vis the consistent growth in the US) (Figure 4). California´s policies and regulations have been adopted ever since by other States and countries[20].

FIGURE 4 - United States vs. California: evolution of per capita annual energy consumption (excluding self-generation)- KWh/hab



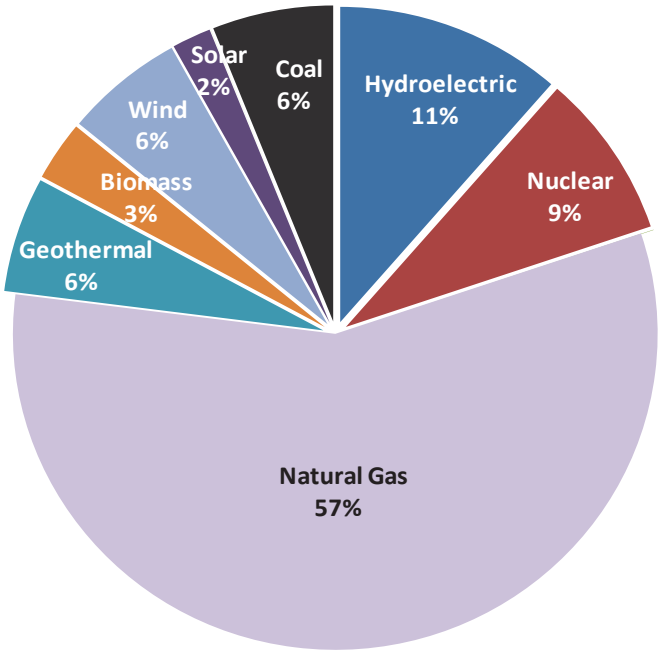
Source: California Energy Commission (2013)

Electricity generation in California is primarily reliant on natural gas (mostly imported from other States). Its share in the mix increased substantially over the last decades, namely due to lower initial capital requirements, cleanness and relatively low prices. Nuclear and hydro generation are relevant in California but have been declining over the years, namely due to plant closures and draughts, respectively. Coal burning has also been declining, representing today only about six percent of all the energy generated in California (Figure 5 and Figure 6).

Renewable energy sources in the electricity mix are still modest though increasing (Figure 6 and Figure 7). Wind and geothermal sources are the most significant, but biomass and solar are also on the rise, and are actively promoted by Californian policymakers. A number of Senate Bills (in 2002 and 2006) established and accelerated the so-called "Renewable Portfolio Standard" (RPS), now requiring electricity retailers (both investor-owned and municipal utilities) to procure 33 percent of their electricity from eligible renewable sources by 2020[21].

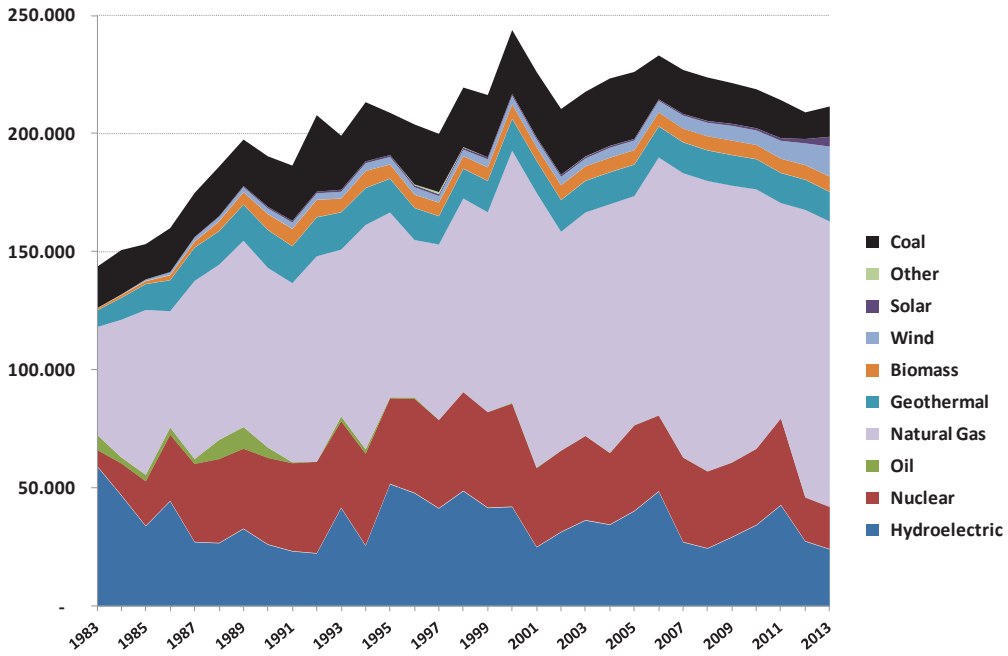
19 NRDC, 2013
20 NRDC, 2013
21 The RPS excludes large hydro production, such as through large dams. Moreover, State energy regulators are now allowed to push it even beyond 33 percent, making it a floor instead of a ceiling (Elkind, 2013).

FIGURE 5 - Electricity generation by source, California, % GWh, 2013



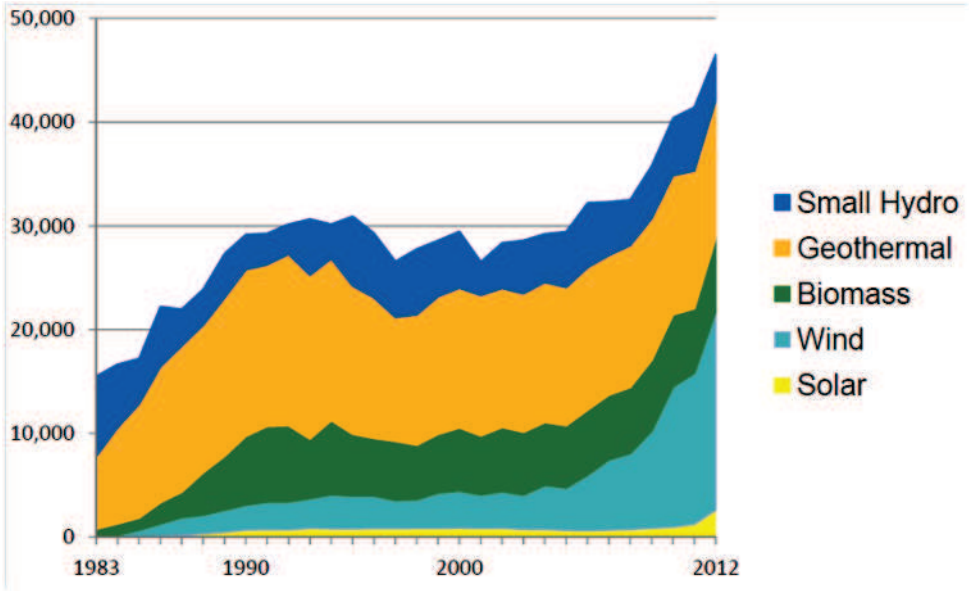
Source: California Energy Commission (2013)

FIGURE 6 - Electricity generation by source, California, GWh, 1983-2013



Source: California Energy Commission (2013)

FIGURE 7 - California renewable electricity generation by source type, GWh.



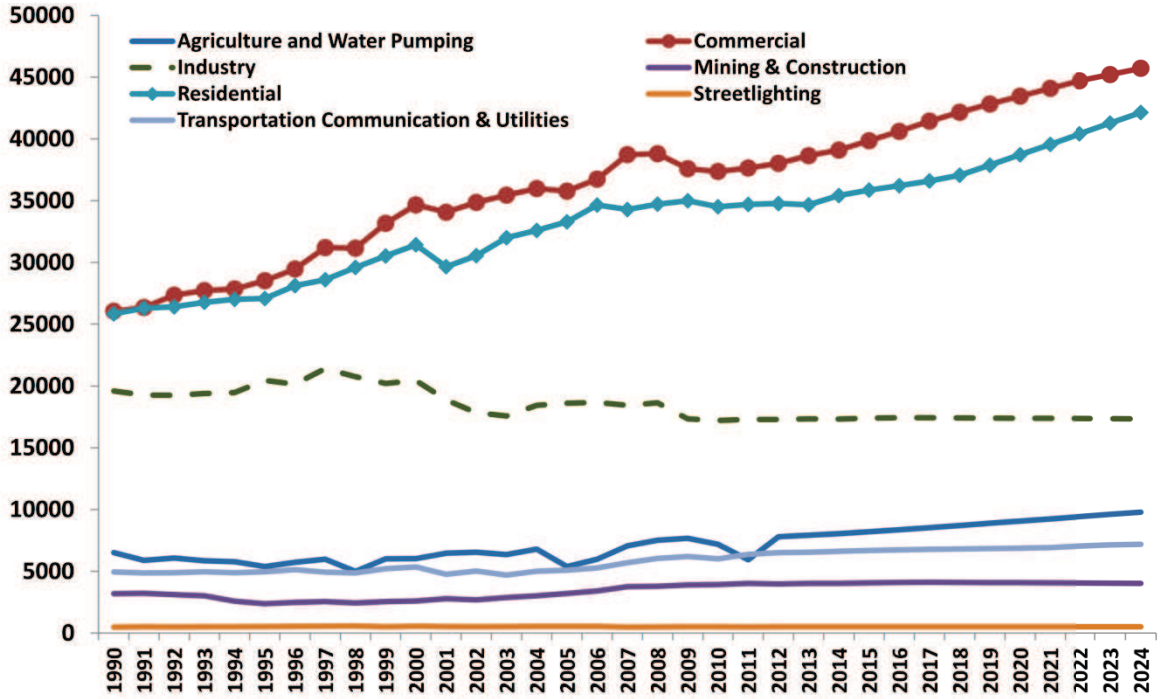
Source: California Energy Commission (2013)

In the Bay Area and surroundings (which largely overlaps with the service area of PG&E – Pacific Gas & Electric, one of the biggest electricity providers in the US; Figure 8; Box 1), electricity demand is primarily linked to commercial and residential uses, which have been rising over the years. Electricity demand from the industrial sector has been relatively stable over the last decade.

However, the picture is more nuanced for the different counties of the Bay Area (Figure 9). On the one hand, some counties have high shares of non-residential energy uses, linked with industrial activities (Santa Clara, Contra Costa and Alameda) or business and commercial uses (notably San Francisco). On the other hand, the share of residential electricity demand is much higher in the Northern Bay, which is mainly composed be residential areas (Marin, Sonoma and Napa); these counties also have the lowest electricity consumption levels in the Bay Area (Figure 10).

As we shall explore in Section 4, these features – lower and largely residential electricity demands – contribute to explain why it has been easier to start-up Community Choice Aggregation schemes in Northern Bay counties, notably in Marin.

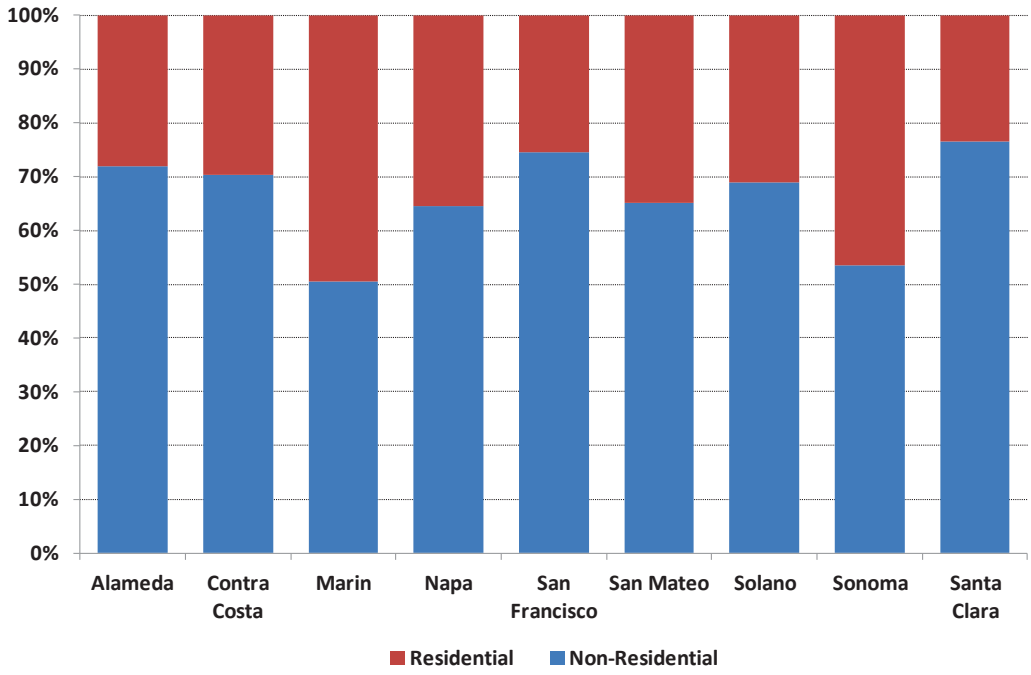
FIGURE 8 - Electricity demand by sector, PG&E service area, GWh



Note: Demand data from 1990-2012 are from estimates based on historical electricity consumption; data from 2013 to 2014 are forecasts based on Kavalec (2013).

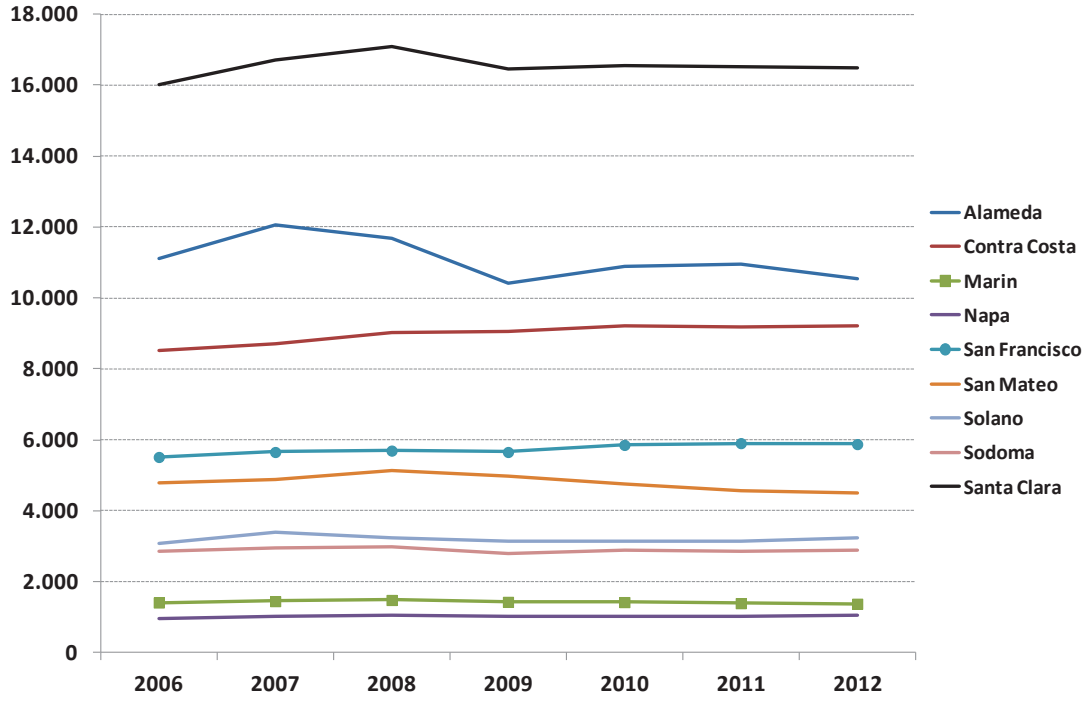
Source: California Energy Commission (2013)

FIGURE 9 - Electricity consumption by County and sector, %, 2012



Source: California Energy Commission (2013)

FIGURE 10 - Electricity consumption by County, total GWh, 2006-2012



Source: California Energy Commission (2013)

3.2 Key players and policies

3.2.1 Players

The functioning of energy markets in San Francisco Bay involves a complex fabric of players and regulators. The State of California has a pivotal role, setting policies, regulations and the overall playing field (e.g. for utilities). Among the key State-level players are:

- California´s Energy Commission (CEC), the main government executive agency tasked with energy policy and planning (e.g. forecasting needs, energy efficiency standards, renewable portfolios, guarantee supply, etc).

- California´s Public Utilities Commission (CPUC), the regulator for privately-owned utilities, with the mission to protect consumers interests concerning the provision of safe and reliable services and infrastructure (e.g. tariffs and price levels).

- California´s Independent System Operator (CAISO), a not-for-profit corporation responsible for the operation and control of the State´s wholesale electricity transmission grid.

There are two main types of electric power utilities in San Francisco Bay (and in California, for that matter):

- Investor-owned utilities, i.e. private companies providing electricity (e.g. generation, procurement, distribution) to a monopoly service area, regulated by CPUC. Pacific Gas & Electric (PG&E) is by far the biggest in Northern California, including most of San Francisco Bay area (Box 1).

- Municipal-owned utilities (also known as "munis"), i.e. companies owned and operated by a local jurisdiction (which can also run the whole from-generation-to-distribution value chain). It is estimated that 25 percent of Californians are served by munis. Two examples from the San Francisco area are Palo Alto Municipal Utility and San Francisco´s Public Utilities Commission – SFPUC (Power enterprise division), the latter delivering electricity to large facilities in the city (e.g. public buildings, hospitals, port and airport) and sharing the market with PG&E.

BOX 1 - Pacific Gas & Electric (PG&E)

PG&E (the biggest subsidiary of PG&E Corporation) is one of the biggest utilities in the US. It is headquartered in San Francisco, delivering natural gas and electricity to most of Northern California, including San Francisco Bay Area. It serves roughly 5 million electricity customers.

PG&E is also one of the "cleanest" and progressive big electricity providers in the US. Over 60 percent of the electricity delivered by PG&E comes from a combination of renewable and GHG free resources (which include large hydro and nuclear). Roughly 20 percent of the power delivered by PG&E comes from "eligible" renewables, i.e. the ones included in California's renewable portfolio standard (RPS) (Section 3.1.), a law that PG&E strongly supported[22]. PG&E currently handles roughly 100.000 direct solar panels connections in their service area, which represents more that 35 percent of all the solar connections in the US.

The State of California and CPUC established a decoupling rule, meaning that PG&E is remunerated not by kWh sold but by the cost of the operations, which acts as benchmark for profits and amortizations. Hence, PG&E has no reason to incentivize higher consumption and is actively involved in several energy efficiency programmes. Despite selling many of their own plants in the late 1990s (with the de-regulation trends – see Box 2), PG&E still keeps some own generation facilities, complemented with other independent energy service providers and long-term procurement contracts (within California and in other States).

However, there are other relevant actors beyond State-level agencies, regulators and utilities in the energy turf.

First, there are a number of local authorities that recently joined forces to procure energy under so-called Community Choice Aggregation (CCA) schemes, like the Marin Clean Energy Authority (Section 4), challenging the dominance of investor-owned utilities. Second, there are a growing number of independent energy producers, both for wholesale distribution and for individual consumption, namely in the space of renewable sources. Third, San Francisco area has active communities of academic researchers, grassroots associations and organized lobbyist movements with action in the energy turf, influencing regulations, experiments, etc.

3.2.2 Policies

The abovementioned actors interact in a playing field of progressive policies and high-impact regulations. As mentioned before, California is considered as a "world apart" vis-à-vis the overall US energy framework, a result of historic environmental concerns, grassroots action

22 Asmus, 2009

(see Section 2) and industrial lobbying power (e.g. of technology providers). Most energy-related policies, regulations and incentives are pro-environment, cutting across interconnected domains (e.g. energy generation, procurement, distribution, electric vehicles, etc), including tax rebates, direct incentives, carbon trading schemes, laws curbing monopoly power, the right of association for energy procurement, etc.

Energy and electricity markets are liberalized but strongly regulated – namely after the Californian energy crisis of the late 1990s (Box 2). Moreover, emerging regulatory issues in other domains have growing impacts in the electricity field.

One example (explored in more detail in Section 5) relates with the incentives for the diffusion of electric vehicles in California. In order to be allowed selling regular (oil-powered) cars in California, car manufacturers and retailers have to first fulfill a quota of sold electric vehicles (called Zero-emission vehicle mandate). This results in a strong private incentive to promote the diffusion of electric vehicles and, thus, to nudge new electricity-related business and innovation models.

BOX 2 - Energy crisis in California

In 1996 the State of California passed the AB 1890, a law restructuring California's electricity market, separating the operations of electric monopolies in different business lines: generation, transmission and distribution (Asmus, 2009). This regulatory move was possible because, already in 1991, one third of California´s electric power was generated by non-utility companies or independent providers (Faulkner, 2010). As a result, PG&E sold most of its generation facilities and largely became a distribution utility; CAISO took over electricity transmission while power generation was planned to be handled to independent and liberalized power producers. The law also established an independent power purchase exchange (CalPX, California Power Exchange Corporation), to whom utilities had to purchase all externally generated power. From this moment onwards, PG&E could no longer establish in advance long-term contracts with external power providers. However, during 2000 the power markets in California collapsed. Natural phenomena (droughts) but essentially man-made delays in new power plants approval and market manipulation by power companies and traders sharply reduced power supply, causing a 800 percent electricity price increase during that year as well as several blackouts (Weare, 2003). Since CPUC had set a fixed cap on the rates to be charged to consumers, PG&E went into bankruptcy. The full origins of the crisis are still a contested issue (Congress of the United States, 2001; Joskow, 2008). In any case, it led to i) the bail out of utilities like PG&E, ii) the elimination of CalPX and short-term buying requirements and iii) giving CAISO more control over power plant outages and spot price purchases, moderating the previous liberalization model of California´s electricity sector. The ability of costumers to enter in direct contacts with energy generators was suspended.

Among the many Californian laws and regulations passed over the last decade, two Assembly Bills are particularly relevant to understand the initiatives analysed in this paper. First, the AB 117 (2002) legislation allowed for local communities to form agencies with the power to buy and sell electricity, using existing transmission and distribution grids and metering systems (e.g. of CAISO and investor-owned utilities). This law enabled the formation of Community Choice Aggregation schemes, namely Municipalities purchasing power on behalf of their citizens, but without the need to become fully-fledged Municipal utilities.

Second, with the AB 1078 (2002, amended in 2006), the State of California also established a so-called "Renewable Portfolio Standard" (RPS). It requires electricity retailers (both investor-owned and municipal utilities) to procure at least 33 percent of their electricity from eligible renewable sources by 2020 (i.e. excluding large hydro production). The RPS refers to people served, not to capacity installed. Moreover, the AB 32 (2006), also known as the Global Warming Solutions Act, requires California to cut its GHG emissions back down to 1990 levels by 2020. Other States in the US are only now starting to catch up to these regulatory standards.

Moreover, also cities and municipalities have an increasingly important and consequent role supporting energy transitions in the Bay Area. Besides, for instance, permitting renewable generation facilities, procuring electric vehicle fleets and charging stations, progressive municipalities and local communities traditionally engage in the development of new energy efficiency solutions. For example, the city of Berkley pioneered innovative approaches to finance solar energy through the property tax system (the so-called voluntary "Energy Assessment District"). Under this system, property owners can install solar systems and improve their buildings' energy efficiency up-front, repaying the costs through their property tax bills. This locally designed financial-energy innovation model is now widely called PACE (Property Assessed Clean Energy) and has made inroads beyond Berkeley; despite the recent mortgage crisis, many other States recently legislated to allow and incentivize PACE solutions[23]. Other related initiatives in the Bay area are called "community solar" schemes, through which local communities can jointly draw from single photovoltaic systems (e.g. Asmus, 2008; 2009). More recently, CPUC (under its 2013-2014 Portfolio Guidance Decision) invited local governments to design and implement new energy efficiency schemes by forming Regional Energy Networks. The Bay area was assigned with 25 million USD to prototype solutions in the fields of retrofit programmes and energy upgrades, marketing, new financial models, etc. (e.g. CPUC, 2013).

All in all, these schemes illustrate the power of local communities in steering innovation towards new energy business models, as well as complementing and expanding the conventional action of utilities in energy efficiency. Another example of bottom-up community action in this domain refers to the emergence of cooperation between municipalities to procure power for their residents, also called Community Choice Aggregation (CCA). This is the topic of the next section.

23 PACE Now, 2014

4 Community Choice Aggregation in Marin County

Marin County (250.000 inhabitants) is located to the North of San Francisco, directly linked to the city by the famous Golden Gate Bridge. It is composed by a number of relatively small cities and towns like San Rafael, Novato, Belvedere or Fairfax. Marin is well known for the natural landscape; the invention of mountain biking; the liberal politics, and it is the residence of some of the most affluent families and NIMBY communities in the US (e.g. Glaeser, 2011). During the last decade, Marin became also known as the first county to successfully implement Community Choice Aggregation (CCA) in California.

CCA is a law-regulated system that allows local jurisdictions (e.g. cities, counties, or collections of both) to combine – "or aggregate" – the electricity demand of costumers within their borders and procure electricity to meet those demands, whether through the market or through own generation (e.g. CEC, 2006; Faulkner, 2010). Marin Clean Energy (MCE) was until very recently the only fully operative CCA in California . It is a leading example of bottom-up, local action to increase the share of renewable energy in the electricity mix.

Without claiming to be comprehensive, this section synthesizes the main purposes and history of MCE (4.1), its key features and achievements (4.2), the stakeholders involved (4.3), the critical success factors (4.4) and new developments and challenges ahead (4.5). The purpose is to illustrate new roles of cities and lower government layers steering change in broader energy systems and in the playing field of energy utilities.

4.1 Brief history and purposes of the CCA

Marin is the first CCA in California but not in the US. During the late 1990s, following the overall electricity liberalization trend, cities and towns in Massachusetts and Ohio launched pioneer power procurement and aggregation schemes. In California, the enabling law of CCA (AB 117) was passed in 2002, in the aftermath of the energy crisis (Box 2). After the de-regulation fiasco (see also Box 2), one of the purposes of the law was to allow for choice and diversity in the selection of the electricity provider, which had been limited during the crisis[24].

AB 117 allowed cities and counties to procure electricity for its constituents without the need to form a Municipal Utility. Moreover, the law covered two other important issues, namely i) the possibility for consumers to opt-out of the scheme (i.e. once a CCA becomes operative, costumers in the jurisdiction are automatically enrolled, being notified of their right to opt-out) and ii) the need for incumbent utilities to cooperate with the CCA by providing distribution, metering, billing and customer services (see Section 4.2).

There are a number of reasons why local authorities start a CCA. First, like in Massachusetts and Ohio, to get lower rates vis-à-vis regular investor-owned utilities; second, and related with the previous, to have more stability and control over electricity rates; third, the desire to

24 Faulkner, 2010

diversify generation supply portfolios (e.g. to increase and/or speed up renewables and/or lower GHG content); fourth, to reap local economic benefits (e.g. through local investments and job creation in renewable generation and energy efficiency programmes) and; fifth, because of political and idealistic stances (e.g. the belief on local community action versus centralized monopolies).

MCE was the first CCA in the US with the explicit ambition of providing cleaner energy, coupled with local job creation. Lowering energy rates was not a fundamental driver (even if that happened as well). MCE started with the aim of "moving faster than PG&E", enlarging and accelerating the renewable portfolio choices of Marin costumers. As explained:

"Marin wants to be a fast speed boat, while PG&E has to act as a tanker (...), PG&E cannot go as fast as it is responsible for an entire system, has to remunerate investors and cater for different supply preferences"

"In Marin, the way to become (even) greener had to be pursued through renewable energy procurement (...); local policies for reducing mobility would be unfeasible due to the significant wealth, the hilly geography and the car culture – most facilities have more than one car".

Starting a CCA is a rather challenging and complex process. First, CCA comes with financial hurdles and risks, associated with the start-up of the scheme (lack of credit ratings, need for loans), the knowledge to procure and establish long-term energy contracts, regulatory risks as well as commodity price volatility. Hence, many cities fear the risk of debt and bankruptcy, as well as the inability to keep low rates for the costumers/constituents.

Second, and linked to the previous, the process is likely to be blocked by local politics. CCA requires the formation of local constituency, agreements and alliances between city administrations, new formal entities and, ultimately, a local majority vote to get the CCA running. Moreover, the turnover of political representatives makes it difficult to achieve the necessary long-term commitment.

Third, as MCE demonstrates, CCAs can count with the resourceful opposition of incumbent investor-owned utilities. As explained,

"(...) in the beginning [2002], PG&E didn´t oppose it [AB117] as they had recently sold their generation facilities and were just being bailed out [of the energy crisis]. However, when the storm was gone [2005] PG&E started actively opposing CCAs as they thought it could be a first step toward municipalisation (like in Sacramento), and then they would lose everything [distribution]".

"PG&E spent a lot of money in the Bay area with several marketing and door-to-door campaigns against CCAs and in support of Proposition 16, which would make it very difficult to establish a CCA anywhere [as it would require 2/3 of the local votes for approval]".

Table 1 provides a synthetic chronology of facts and events involved in setting up the CCA in Marin, as well as other contextual features that co-evolved with it. Some of the abovementioned risks and hurdles have been recently removed, namely by the regulator CPUC. For example, a new law limited the liability of individual cities when jointly incurring in debts to procure energy. Moreover, after losing the ballot for Proposition 16, PG&E position towards CCA became neutral and campaigns officially stopped. Moreover, by acting as concept proof, Marin unveiled the many practical issues of the system, the challenges, the risk analysis, success factors, etc. (Section 4.4). Other cities recently joined Marin´s CCA (Richmond) and other counties are well ahead developing their own CCA (the County of Sonoma has just started a new CCA).

TABLE 1 - Short chronology and events around Marin CCA

Date	Events and developments
1991	A third of California´s electrical energy is supplied by non-utility companies ("qualifying facilities")
1996	AB 1890 legislates on electricity market de-regulation in California
1996-2000	PG&E sells parts of its generation business The States of Massachusetts and Ohio legislate for the first CCA experiments in the US
2000-2001	Draughts, blackouts, artificial power withholds and market manipulation lead to rampant rise in electricity prices (California energy crisis) PG&E fills for bankruptcy with USD 12 billion debt
2002	AB 117 legislates for Community Choice Aggregators in California Senate Bill 1078 establishes a Renewable Portfolio Standard (RPS) in California (20 percent renewables in 2017) Sustainable Fairfax, a local grassroots organization, brings AB117 to the attention of the Board of Supervisors at Marin County
2004	Marin County and 11 Marin cities start to investigate the formation of a CCA San Francisco City and County start exploring CCA possibilities (Ordinance 086-04)
2005	Navigant research conducts a feasibility study for Marin CCA
2006	Marin County starts a local task force to prepare a CCA
2007	About 40 local governments in California are studying the possibility to develop a CCA
2008	Berkeley and Oakland suspend CCA plans Marin Energy Authority (MEA) is formed by the County of Marin and seven cities

	State of California expands the RPS to 33 percent in 2020 A Senate law on Joint Power Authorities is issued, protecting individual cities from joint collective debts related with CCA
2009	San Joaquin suspends CCA plans MEA releases a call for proposals for power supply (900 GWh), receiving more than 400 offers
2010	CPUC approves the implementation plan for MEA Marin Clean Energy (MCE) launches all service in Marin and establishes a 5-year contract with Shell Energy North America CPUC threatens to levy fines on PG&E, for their campaigns against CCA and MCE PG&E sponsors Proposition 16, requiring 2/3 of local votes to form a CCA (vs. simple majority). Proposition is defeated
2011	MCE serves electricity to 14.000 costumers Remaining Marin cities join the MEA (Corte Madera, Larkspur, Novato, Ross)
2012	MCE starts offering "Deep Green" service in Richmond First feed-in tariff programme of MCE is implemented at San Rafael airport MCE serves electricity to 105.000 costumers
2013	The County of Sonoma (contiguous to Marin) forms Sonoma Clean Power CCA MCE offers "Light Green" service in Richmond (serving a total of 125.000 customers) MCE launches a new portfolio of energy efficiency programmes San Francisco´s CCA proposals remain "mired in politics"

Source: based on field work and on Bryer et al. (2011), Faulkner (2010), MCE (2013b) and Lagos and Baker (2013).

4.2 Key features and design

Marin CCA currently serves about 125.000 costumers (in Marin and Richmond), representing about 80 percent of the residential and commercial customers in the jurisdiction[25]. As explained, MCE follows a hybrid approach, combining elements of municipal and investor-owned utilities (Figure 11). Under CCA, power is procured and purchased by a public agency (MCE –Marin Clean Energy), but all the transmission, distribution and customer service is

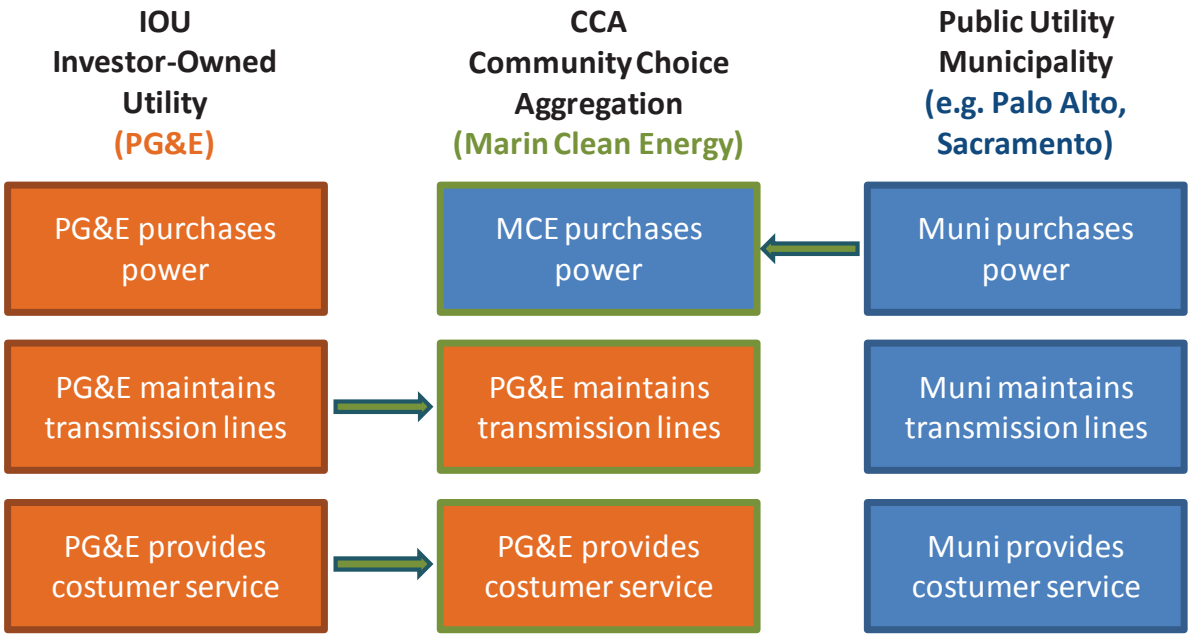
25 MCE, 2013a

provided by the incumbent investor-owned utility (PG&E). As expressed by Asmus[26], this hybrid system:

"...provides an easier way to change the content of the power supply without taking on the burden of managing the power lines, collecting bills and the divisive politics involved in the typically highly contested (and expensive) municipalization process".

As said, the CCA works as an opt-out system, meaning that local costumers become part of the system by default. During the first phases of the CCA, the opt-out rate was about 23 percent and about 15 percent in the latest expansion[27].

FIGURE 11 - CCA: a hybrid approach



Source: adapted from MEA – Marin Energy Authority (2012)

MCE´s procurement is neutral and market-based, not favouring a priori any particular renewable source, but excluding gas-fired, nuclear or coal generation (Figure 12). MCE opens regular call for tenders (i.e. on a yearly basis) in order to select independent providers for long-term power contracts[28]. Among others, tenders specify the amounts of power load to serve and the desired minimum share of renewables. Even if preference is given to local-regional generation (e.g. Northern California), the most of the power procured by MCE has been generated in other States (Oregon, Washington – see Figure 13), namely due to strong regulatory constraints on developing local generation facilities (e.g. wind, biogas and solar

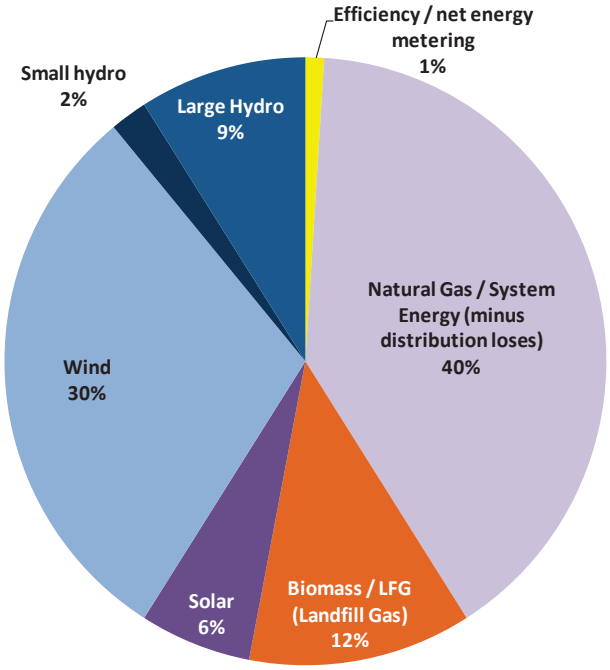
26 Asmus, 2009

27 The opt-outs have been mainly big clients, large businesses and other commercial facilities that can directly negotiate prices with PG&E, as well as previously bundled costumers, e.g. with distributed generation agreements (e.g. for solar panel connections); MEA, 2013a.

28 MEA, 2013b

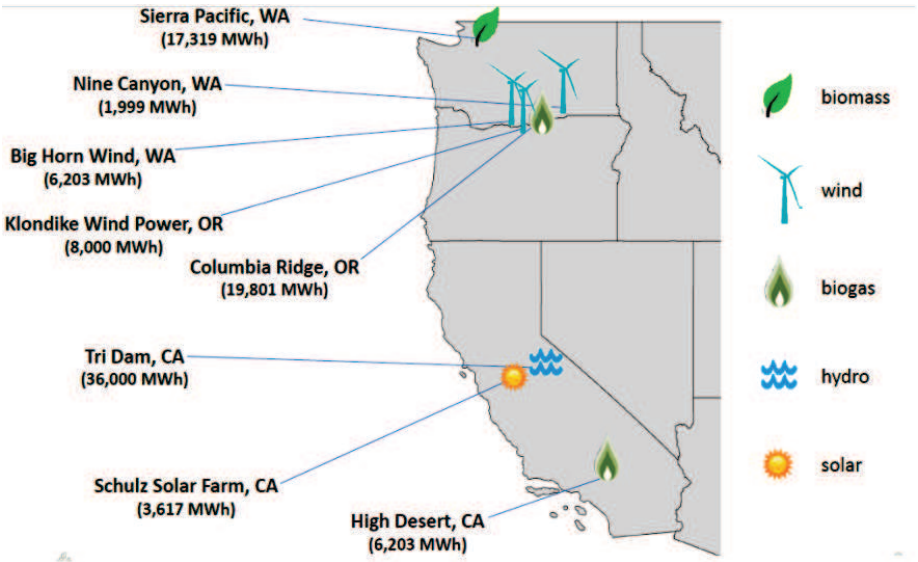
plants). More recently, a number of new providers will be generating electricity in California, namely from biomass and solar power (Figure 14). Moreover, besides market-based procurement, MCE established a premium feed-in tariff program, targeting exclusively local producers of renewable energy (Box 3).

FIGURE 12 - MCE 2013 resource mix (estimated)



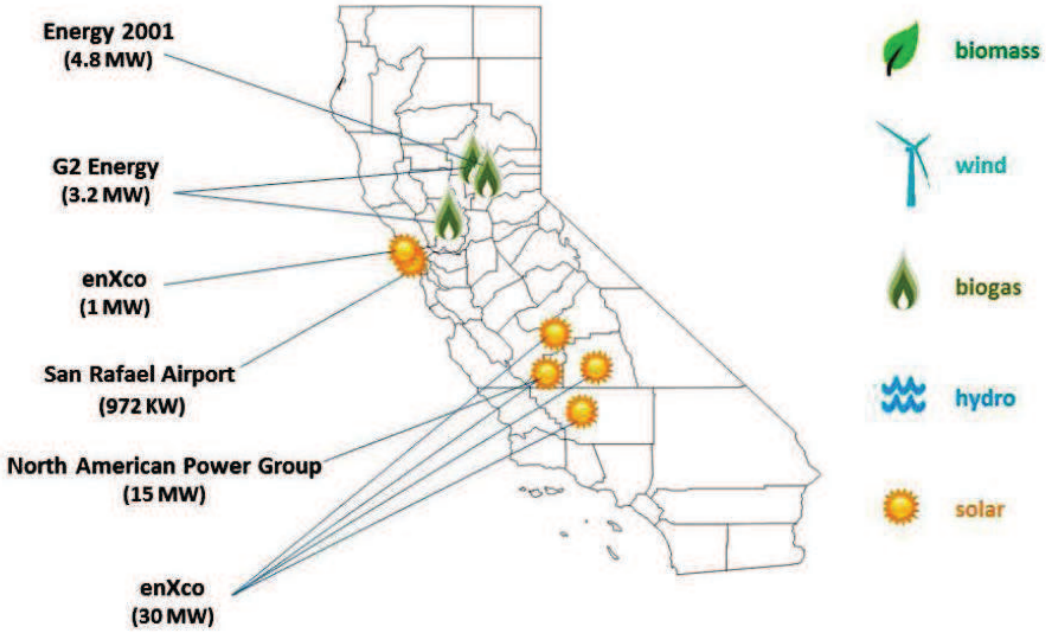
Source: MEA – Marin Energy Authority (2013)

FIGURE 13 - MCE´s 2011 contracted power supply



Source: MEA – Marin Energy Authority (2012)

FIGURE 14 - MCE contracts for new renewable power (2012)



Source: MEA – Marin Energy Authority (2012)

BOX 3 - Feed-in tariff programme

The Marin feed-in tariff programme consists in paying a fixed price per kWh sold to the grid out during a long-term period (e.g. 20 years), contracted out with local producers of renewable energy. It does not require open tendering but relies on the proposals of local producers. Currently, there is a cap of 10 MW capacity offer but only 1MW was committed to a rooftop solar generation project at San Rafael private airport (Eriksson and Prejean, 2013). It means that the monthly delivered electricity will vary (e.g. depending on whether the days are sunny), but the tariff is fixed for the long run. MCE pays a premium rate for local feed-in electricity produced by renewable energy sources. However, there are a number of preconditions: the proponent needs to have a PG&E interconnection agreement, the ability to build generation facilities within one year of signing the contract and a construction permit from the Municipality. Yet, these conditions are still major hurdles for the programme. First, there is a long bureaucratic process to get an interconnection agreement; second, strong environmental regulations in Marin make it difficult to get a construction permit and third, there is still a limited knowledge on how to successfully develop such a business model.

Currently, MCE provides two types of electricity packages, namely "Light Green" (with 50 percent renewable content) and Deep Green (with 100 percent of renewable content), the

latter for a small premium (Table 2) and with roughly two percent of subscribers in the area[29]. The procured electricity is certified by CAISO, who checks the generation loads powered into the grid. Moreover, besides purchasing "green" certificates, MCE also buys green energy credits (e.g. parcels of energy produced by other companies not supplying to the Marin CCA) in order to compose their portfolio.

TABLE 2 - Residential electric rate comparison

	PG&E (22% renewable)	Light Green (50% renewables)	Deep Green (100% renewable)
Electric generation rate (USD/ kWh)	0.092	0.079	0.089
PG&E Electric delivery rate (USD/ kWh)	0.115	0.115	0.115
Additional PG&E fees (USD/ kWh, MCE costumers only)*	0	0.012	0.012
Estimated monthly cost, USD (based on 508 kWh usage)	105.06	104.36	109.44

* including e.g. PG&E exit fees for costumers moving to MCE.

Source: adapted from MCE (2014). Rates as of June 11, 2014.

4.3 Stakeholder´s organization

Different stakeholders have been involved and contributing to Marin´s CCA initiative, linked through a mix of formal and informal networks and relationships.

A key player is Marin Energy Authority (MEA), the political "umbrella" organization responsible for setting the vision and strategy for the CCA. It is formed by 13 directors, which are elected representatives (mayors, aldermen) from the involved cities and the County of Marin. In order to launch the planning process, the County brought together a task force of elected representatives and technical staff from each city to investigate how to make it happen. The County was pivotal uniting the interests and perspectives of the different cities around a common vision for the CCA.

The MEA is thus the governing body of Marin Clean Energy (MCE), the executive agency tasked with the daily management of the CCA, such as energy procurement, programme implementation, liaison with other partners and communication. MCE has a staff of 19 persons

29 MEA, 2013a

and it is supported by a number of consultants and external advisors. MCE has no interference in the cities or the County´s internal affairs, such as planning or permitting issues with impact on energy generation. This implies that the visions for the CCA and the land use planning actions may be sometimes at odds with each other, e.g. when new local renewable generation facilities cannot get the necessary permits due to stringent environmental regulations. Because of that, as expressed by an observer,

"CCA in Marin sometimes puts [pro clean energy] environmentalists fighting against [pro conservation] environmentalists".

MCE relies on the involvement of the private sector, namely large external electricity producers but also smaller local generators, like the ones involved in the feed-in tariff programme. On the one hand, big energy companies (e.g. Shell North America) have been essential assuring the lion´s share of the procured power, as well as moderate rates and reliability. On the other hand, small producers (e.g. San Rafael airport) are important to increase the amount of locally produced electricity, the share of renewables in the mix and local jobs, which are all part of MCE´s core strategy. Naturally, the relations between both types of power providers and MCE are based on long-term contracts.

As mentioned before (Section 4.1), also the incumbent investor-owned utility (PG&E) has a role in the CCA. That role has changed overtime from indifference (in the aftermath of the energy crisis) to fierce opposition (lobbying campaigns and explicit support to a ballot against CCA). The relation between PG&E and Marin´s CCA is nowadays formally neutral, even if the latter is increasingly seen as a partner, namely as PG&E provides the distribution network as well as all the metering and billing system to MCE´s costumers. The relation between MCE and PG&E is also strongly regulated by CPUC.

Besides regulated and formalized relationships, there are an additional number of relevant stakeholders involved, tied together through more informal relations. First, the whole planning and implementation process of the MCE involved several informal networks of influence between elected representatives at different scales (Senate, County, cities, etc), who worked together to champion the initiative and progressively removed its hurdles. Second, the role of local activists and grassroots organizations were important legitimating the initiative in an early stage, but also important to spearhead the advantages of the CCA model across California and the US. Third, the role of external advisers and consultants has been important not only due to their technical knowledge, but also to strengthen the initiative's legitimacy.

4.4 Critical implementation features

While Marin County succeeded bringing the first (renewable energy-oriented) CCA scheme to life, many other attempts failed or are taking a long time to start. Why was that the case? In this section we pinpoint a number of success factors beyond MCE.

To a large extent, the success of Marin has to do with the specific socio-economic features of the County: scale, homogeneity of preferences and green activism. Apart from the scale/size, these features are difficult to imitate and facilitated the start of CCA in Marin.

First, the County has an appropriate scale to start a CCA. With 250.000 inhabitants, it is not too big or too small, providing MCE with enough scale economies to make energy procurement viable and still manageable by a local agency. As seen in Section 2, the power demand in Marin is among the lowest in the whole Bay area and has been rather stable over time, making it easier to predict and plan in advance.

Second, the socio-economic and political bracket of Marin is considerably homogeneous (wealthy, liberal and "green"), making it easier to aggregate preferences. This is much more difficult in larger and more diverse cities and regions (e.g. San Francisco) in which different communities have nuanced preferences concerning energy supply (e.g. cheap vs. green), resulting in considerable infighting and lack of social and political constituency for CCA solutions. Moreover, the lack of industry and the wealthy inhabitants of Marin were relatively less sensitive to the threat of a potential rise in electricity rates.

Third, Marin has a strong tradition of grassroots movements and rallying environmental groups, favouring renewable energy yet potentially more sensitive to land conservation. This was important to preserve social and political support when contracting power to larger corporations from outside the State, like Shell. As explained:

"A deal with Shell would never pass in other cities like Berkeley, who are strong opponents of oil corporations. (...) In Marin, environmental preservation was more important, and if the energy is renewable the better".

However, and beyond the contextual features of Marin, also a number of key decisions and collective intelligence proved critical to launch and expand MCE.

First, MCE started "rough and dirty", being able to progressively prove the value of the initiative and increase the local renewable content. To make the start feasible, MCE had to rely on power providers from outside the State (vs. local generation) and loosen the renewable content of the electricity procured (below 100 percent renewable). Doing otherwise would have blocked the initiative due to much higher rates or simply because of the impossibility of developing local generation plants (e.g. due to regulatory features and other hurdles). The deal with Shell Power North America, although generating turbulence among local environmental supporters, contributed to enhance the credibility and the economics of the initiative, providing Marin with a good rates and considerable renewable content (not 100 percent "green" but much higher than PG&E). Box 4 illustrates how these and other dimensions have been playing in the case of San Francisco, hampering the city´s attempts to form a CCA.

Second, political will and the County leadership was essential to "walk the talk" and orchestrate the complex fabric of public and private stakeholders involved in the process

(Section 4.3). The role of key individuals – e.g. MEA´s Chairman Charles McGlashan, Executive Director Dawn Weisz and Mill Valley´s Councilwoman Shawn Marshall[30]– is often mentioned as pivotal coordinating these efforts and energizing the process of CCA formation along its ups and downs. Moreover, active leadership contributed to progressively remove key regulatory hurdles for the formation of CCAs in California (Section 4.2).

Third and related with the previous, societal support was also fundamental to drive the CCA. This goes way beyond the majority vote necessary to legally approve the CCA. Local grassroots organizations played a role raising awareness and political support for the complex process of CCA formation, and community groups and individuals contributed with loans and seed-funding to launch the process, raising about three million USD. Despite the decision to team up with Shell, Marin´s CCA managed to keep the support of such groups even if "(...) Shell was seen by many as less clean and "worse citizen" than PG&E, whom the new CCA scheme was actually fighting."

Fourth, MCE´s legitimacy and economics benefited from its fast expansion to other cities. After the removal of some hurdles (namely debt liability and PG&E opposition), all the remaining Marin cities joined the initiative, taking a seat at MEA. Particularly important was the expansion to Novato, an area in which most of the new residential developments will take place. Likewise, the recent expansion of MCE to Richmond (a city outside the administrative borders of Marin – see Section 2) makes it easier to procure more power for lower rates, while balancing the loads with industrial and commercial daytime uses. Moreover, the expansion to Richmond opens new possibilities for the development of local renewable generation facilities and legitimates CCA beyond wealthy communities. Despite being an overall impoverished city, the percentage of deep green users in Richmond is already higher than in Marin[31].

30 Bryer et. al, 2011
31 MEA, 2013a

BOX 4 - CleanPowerSF

CleanPowerSF is a CCA initiative set up by the San Francisco Public Utilities Commission (SFPUC) and adopted by the San Francisco Board of Supervisors in 2004. SFPUC is San Francisco's municipal utility company (see Section 3), covering power generation and distribution and has a share of 17 percent in the city's total energy generation (75 percent is generated by PG&E and the remaining 8 percent by direct access), mainly serving public buildings and infrastructure, including the port, airport and hospitals.

SFPUC's experience and facilities helped to set up the institutional backbone of CleanPowerSF. Like in Marin, the programme´s vision primary focuses on increasing clean energy in the mix. However, back in 2004, the original plan for CleanPowerSF targeted i) premium niche clients and ii) the highly ambitious shift towards 100 percent California-certificated renewable energy sources. A group of about 90,000 potential "early adopter" households were identified via surveys: wealthy young graduates, living in central areas and with high environmental awareness were identified as willing to pay a premium price; the expected increase in the energy tariffs was 10-15 percent, while the expected drop-out would be 70 percent. The target was to grow rapidly, from 30MW at the start of the programme to 100MW in five years time.

However, so far, CleanPowerSF has not started yet and has been facing a standstill (Lagos and Baker, 2013). In general, the programme has been perceived as too ambitious and difficult to implement – 100 percent California-produced green energy and low tariffs seem to be impossible to realize in just one step. As expressed by an interviewee, this would be like "sprinting the whole marathon". Moreover, and because of this, the programme has been lacking political and societal support. First, a potential contract with Shell (like in Marin) was seen as too controversial, making it impossible to obtain societal support. Second, the labour union for engineers advocated against the plan, due to the fear of losing jobs in the field of maintenance. Third, and related with the previous, there has been considerable political infighting in the City Hall, with the Mayor and board members of SFPUC opposing the plan, while the Board of Supervisors in favour of the initiative.

In order to overcome these barriers, the strategy and structure of CleanPowerSF has been adapting, based on critics of opponents. The new strategy tries to balance the interests of the various commissioners (e.g. job generation; lower tariffs) and loosen the initial ideas; in the meantime, the success of MCE and the availability of new suppliers in the market legitimated and offered new opportunities to the initiative. Nevertheless, as described by Lagos and Baker (2013), the initiative still needs to overcome societal and thus political opposition.

4.5 New developments, business models and challenges ahead

MCE is a recent development, and is still largely in a state of flux. Although many hurdles have been removed and its objectives are being accomplished (namely the provision of increasingly "greener" electricity portfolios), there are still challenges ahead for MCE and, indirectly, for new business models of investor-owned utilities.

On the one hand, although PG&E has now a neutral stance towards MCE, there are a number of remaining issues. First, PG&E currently asks exit fees to customers who move to MCE (see Table 2) in order to cover for long-term investments and electricity contracts for bundled costumers, levelling the playing field between bundled and MCE costumers. Second, under the same argument, PG&E currently asks unbundled MCE costumers to pay additional fees for the infrastructure (grid and metering) in case they want to use it to produce electricity and net metering (e.g. through solar panels). Finally, MCE expressed the ambition to access the smart-metering data from PG&E, which is currently not possible. All these issues will require further debate and ultimately, regulatory decisions by CPUC.

On the other hand, MCE is moving from simply procuring energy at wholesale towards establishing direct links and enhanced relationships with the costumers. In this way, MCE advances in the energy value chain and enters new business areas of investor-owned utilities. As explained,

"...MCE wants to get closer to the power grids and give back to the community by investing in local energy programmes".

To do so MCE – by selling renewable energy credits and the extra revenues collected from "Deep Green" electricity (one penny extra per kWh) – developed a cross-subsidization fund, with the objective to invest in a number of fields.

First, MCE is investing in expanding the local content of procured electricity. This includes i) a net-metering programme, with rebates to individual users who generate renewable electricity beyond their own consumption and ii) strengthening the feed-in tariff programme (see Box 3) and iii) the development of new, local owned generation projects. For example, a new solar plant is planned for Richmond over the next two years, and there are other projects planned for Novato. The idea is to apply MCE seed-money (as well as eventual loans and bonds) for developing joint ventures with investors willing to invest in local renewable generation (e.g. supporting pre-developments costs). Moreover, a new electricity product called "100% local option" is being devised to complement the current "Light Green" and "Deep Green" offers.

Second, MCE is starting to invest in local energy efficiency incentives, e.g. to support better insulation, home energy auditing, etc. To this effect, MCE teamed up with banks to provide loans for these investments, with the capital being repaid monthly through the electricity bill ("own bill repayment"). Moreover, MCE is also working on incentives to bundle solar producers to share their electricity, in new versions of "community solar" programmes (Section 2).

All in all, the new ambitions of MCE raise the bar on the intervention of local authorities fostering energy transitions. Moreover, they also heighten the need for closer work between local energy authorities (e.g. MCE) and stakeholders such as users, developers, utilities, and even with their own constituents: cities and counties. The ambition to invest in locally generated energy poses considerable challenges to overcome NIMBYism behaviours and stringent environmental regulations.

4.6 Overall assessment and shared value creation

Community Choice Aggregation (CCA) is a new way through which cities and counties can directly intervene in the world of energy, namely by procuring electricity and, through that, enhancing local control on rates and on its renewable content. CCA is still in its early infancy and, despite the progressive removal of financial and regulatory hurdles, the scheme still faces many challenges. Table 3 synthetizes some of the key features of the Marin experience with CCA, as well as the involved governance modes.

TABLE 3 - Key features of Marin CCA

Political economy framework (California)	Liberal market economy with strong State intervention and progressive regulation
External catalyst	California energy crisis
Key themes in the local agenda	Environmental conservation and renewable energy sources Increasing consumer choice
Technological dimension	Cleaner energy generation modes Business model innovation
Vision definition	Largely top-down (Marin County), but with strong local buy-in
Location of the pilot	Marin County and city of Richmond
Primary functions and social composition	Residential, wealthy residents (Marin) mixes with industrial, impoverished communities (Richmond)
Leadership	Marin County / Marin Clean energy (MCE) Key player defining, coordinating and largely executing the vision
Utility involvement	From indifference to fierce opposition to neutral partnership
Government / Public involvement	Marin county and Municipalities, State of California and utilities regulator (CPUC)
Role of industrial partners	Electricity generators (contractors) Joint ventures with feed-in tariff electricity providers
University involvement	Not directly involved, but active role of external experts and consultants (technical knowledge)

Governance modes/enforcement	Formal regulations and laws; long-term generation contracts
Societal support	Strong and lasting (active environmental and advocacy organizations)
Communication modes	Strong between MCE and regulators, facilitated by physical, social and institutional proximity

Source: own elaboration

Nevertheless, CCA is gaining traction in California and beyond, counting with new networks of advocates. Other cities in San Francisco Bay Area – including San Francisco itself – have long been planning a CCA while learning from the Marin experience (see Box 4). As CCA progresses, it challenges the playing field and business models of conventional investor-owned utilities. As the Marin case illustrates, CCA can move beyond the "simple" procurement of electricity to fulfil other roles in communities, like promoting energy efficiency or developing local renewable generation. Moreover, even if it is not possible to establish a causality nexus, as the CCA movement gained shape, PG&E increased their share of renewables in the mix, decreased the rates and offered new solutions for costumers (e.g. 100% green energy packages). Moreover, the developments incubated at Marin contributed to change regulations with impact on the businesses of utilities.

Despite the community involvement and "local" rationale associated with CCA, such initiatives still largely rely – and can benefit from – the involvement of private players to create "shared value". The case of Marin illustrates that the early involvement of Shell, even if criticized by many as a "bad citizen", was critical to launch the initiative by providing the necessary financial guarantees and a strong renewable mix from the onset. Likewise, Shell also benefited from its involvement with Marin ("the first CCA in California") as a way to improve its image of oil-driven, polluting company towards a community-supportive, renewable energy generator.

Yet, the case of Marin suggests that the close involvement of large private companies is likely to keep being problematic for the development of CCA. Paradoxically, if large private power companies are pivotal to increase the credibility of the initiative and increase its financial stability, the fact that they tend to be a traditionally fossil-fuel-based corporation can erode the social and political support for the initiative before its take-off. As explained, "[in Marin], Shell had to sell a lot of renewables for a low price, under exceptionally good contract clauses and only for 5 years as a way to convince the community and keep societal support".

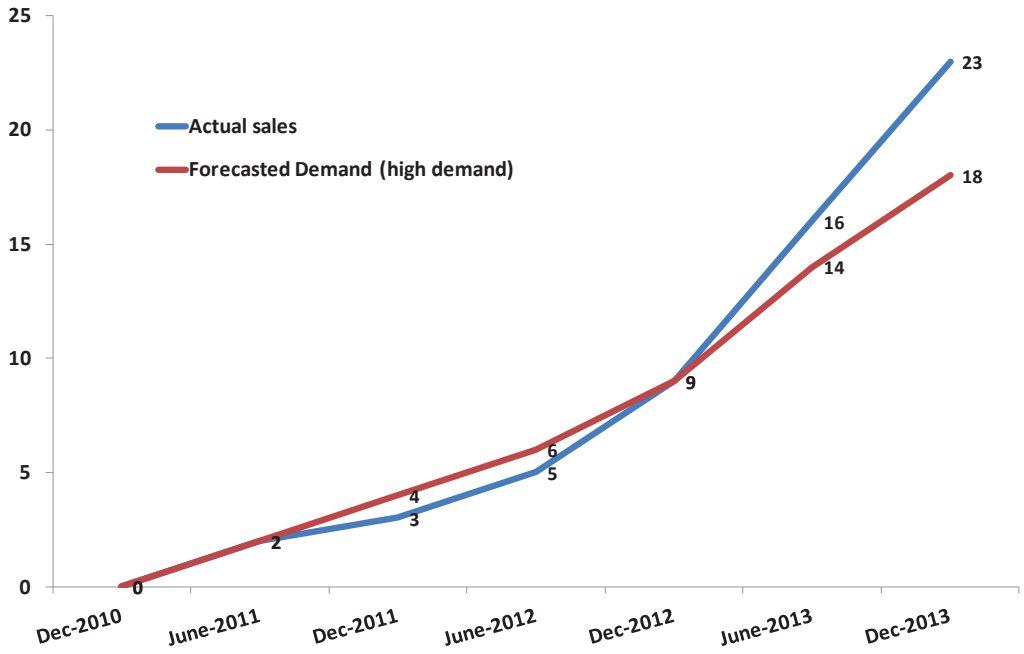
Nevertheless, as MCE progresses, the role of joint ventures and strategic partnerships between public and private players is likely to increase. This is the case e.g. for new renewable generation projects, but also for the relation with other leading firms involved in energy efficiency. Other domains in which new public-private partnerships are likely to increase, namely for the co-production of new business models, are in the fields of electric mobility. We explore that issue in the next section.

5 Electric vehicle diffusion in San Francisco Bay

This section focuses on the drivers and recent developments linked with the fast diffusion of electric cars (hereupon EVs) in San Francisco Bay. Since a high percentage of carbon emissions in the region are related with the use of oil for individual mobility (Section 3), this is also a pivotal domain for the region´s energy transition.

Currently, the rate of EV adoption has been exceeding expectations in San Francisco Bay, even when compared to the most optimistic forecasts (Figure 15). Moreover, the rate of adoption of plug-in EVs exceeded the one of hybrid vehicles; for example, it is estimated that EV adoption is tracking at two to three time the initial rate of Toyota Prius (PG&E, 2014)[32]. All in all, the Bay area has now about 80,000 to 90,000 plug-in EVs, the highest number in the US[33]. In order to shed light on this phenomenon, the next sub-sections explore the regulatory framework behind it (Section 5.1), as well as the turbulent and dynamic ecosystem of stakeholders involved and their actions to steer EV adoption further (Section 5.2).

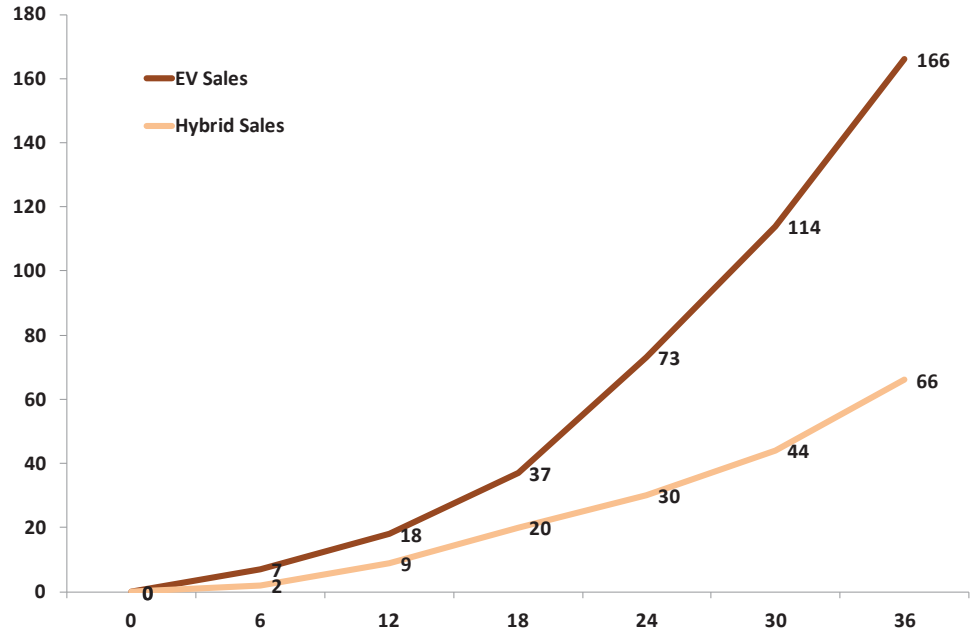
FIGURE 15 - Actual EV sales vs. Forecasted sales (high demand), PG&E customers in thousands



Source: PG&E (2014)

32 Naturally, as with other long-term transitions, it is difficult to identify in which development stage we might be now, but the fact remains that there has been a substantial acceleration of EV adoption over the last years.
33 The city of San Francisco has a relatively low number of EVs itself, which is related to the fact of having a general low rate of car ownership.

FIGURE 16 - Actual EV sales vs. hybrid sales (thousands, Nationwide, months after introduction)



Source: PG&E (2014)

5.1 Policy framework in a nutshell: the playing field

As in other energy and environmental-related domains (Section 3), the regulatory framework that sets the playing field for EVs in California is considered to be highly progressive, in many ways. To some extent, the progressive regulation can be seen as a result of the large air pollution problems that started to emerge during the 1970s in the region. Since then, California has set stricter vehicle and pollution standards vis-à-vis the ones enforced at the federal level by the Environmental Protection Agency.

More recently, beyond general vehicle environmental standards, the State of California has set many specific, high-impact incentives to nudge the adoption of EVs[34]. First, there is a low carbon fuel standard regulation, working as a cap-and-trade carbon credit programme to reward cleaner transportation fuels. Second, complementing Federal tax credits (up to USD 7.500), the State provides upfront rebates to EV buyers (USD 2.500). Third, already since the 1990s, the California Air Resources Board (CARB) passed the so-called Zero Emission Vehicle (ZEV) production requirement, obliging manufactures with annual sales greater than 60.000 vehicles to produce and deliver for sale in California a minimum percentage of ZEVs. This percentage is currently 12 percent but it is set to increase progressively every two years (e.g. 14 percent for 2015-17[35]), placing strong requirements on automakers to nudge local EV sales.

34 Elkind, 2012
35 CARB, 2014

Moreover, beyond regulations and in order to remove remaining hurdles, the State of California recently created a zero emission vehicle action plan through joint efforts of multiple government agencies.

Over the last years, also many Municipalities in the Bay area have been actively supporting the adoption of EVs, namely through the deployment of charging stations in public places and the procurement of EV municipal fleets[36]. Moreover, EVs are granted access to bus and taxi lanes, allowing users to avoid traffic jams. These actions have been backed by the State, who has been indirectly supporting the installation of charging stations, e.g. through local funds for air quality improvement. Many Municipalities have also been investing in education and campaigns to inform the population about the benefits of EVs, charging procedures, etc., often involving not-for-profit organizations in those efforts. Within the Bay Area, Palo Alto and San Jose are considered among the most proactive EV-supportive municipalities, with the deployment of several charging stations and other initiatives. The same goes for San Francisco, despite its lower car usage rate and overall efforts to reduce it further[37]. Marin County is currently launching a number of test beds of electric battery resistance together with Tesla, a leading EV automaker (see below).

5.2 Stakeholder´s ecosystem and the role of localized action

The fast diffusion of EVs in San Francisco can thus be largely linked with the distinctive, high-impact set of incentives and government action. However, that is not the whole story. Although State-level incentives are the same for the whole California, it is widely acknowledged that the adoption dynamics in San Francisco are different than in e.g. Los Angeles or Sacramento. Moreover, the reasons why such regulatory framework is in place have to be explained as well. The distinctive tradition of environmental activism, the entrepreneurial culture in the area and the presence of wealthy and advanced users are good candidates. For example, according to PG&E (2014), the early EV adopters in their service area are disproportionally wealthy, tech savvy, high incomes and frequent app users; the EV is frequently their second or third car. Moreover, beyond the governmental action, the Bay Area concentrates an ecosystem of leading stakeholders, with direct influence in the buoyant development of the EV-industry, such as car makers, venture capitalists, battery providers, charging station companies, utility and several grassroots movements and advocacy organizations. It is very likely the most dynamic EV innovation ecosystem in the US. As explained:

"…Many people and different players are trying to bring different pieces of the puzzle together, but it [EV industry] is still fragmented; the local industry is shaking up a lot, new players are

36 See for example State of Califiornia (2013), for more details.

37 The priority of San Francisco´s transport policy is on the 'transit first principle', meaning reduction of miles driven by single occupied personal vehicles (e.g. car sharing, public transport, bike, walk). As it will not be possible to abandon personal cars, the second priority is to promote the use of cleaner cars, e.g. EVs.

emerging, others bankrupting and new solutions are coming in…the [Silicon] Valley is becoming the new early days Detroit for the EV industry".

Many carmakers have been settling business and R&D antennas in the Valley in order to benefit from this ecosystem´s dynamics and user behaviours. Moreover, the leading EV carmaker – Tesla Motors – is based there, championing new innovation and business models that promise to revolutionize the industry (Box 5).

BOX 5 - Tesla Motors: the symbolic dimensions of electric mobility

Tesla is one of the world's leading (and exclusive) EV manufacturers, headquartered in Palo Alto. Tesla focuses on the high-end car segment (luxury and sports) and beyond cars, also produces and delivers other components like batteries e.g. to Toyota or Daimler – the companies invest in Tesla and use their powertrain components in some models. Among others, the case of Tesla illustrates the emerging symbolic dimensions that become associated with electric mobility.

First, Tesla cars combine top-notch technology with a strong focus on design, usability and exclusivity, largely resembling the strategy of Apple – another leading company in the Valley, to which Tesla hired a number of engineers and designers. For the sake of exclusivity, Tesla sells directly to the consumer (online or in company-owned dealers/showrooms), with no intermediation.

Second, Tesla extended the EV value chain to encompass charging as well. The idea is to make electrical charging an exclusive experience in its own right. To this effect, Tesla developed their own network of fast charging "Supercharger" stations spread from coast-to-coast, taking roughly 45 minutes to charge the full battery . Access to Supercharger stations is reserved to Tesla owners, who automatically join the Tesla Club and have the right to recharge their cars for free. Moreover, many charging stations in the West Coast corridor are sun-powered by SolarCity (Box 6) and, in the future, all Supercharger stations are to be supplied by solar energy. In addition to this, Tesla promotes a programme of battery replacement/swapping in certain points.

All in all, the case of Tesla illustrates that commodities like electricity and charging can start to have symbolic value and become true status symbols, with 'clubs of aficionados', making competition by differentiation increasingly relevant for utilities.

A number of companies are increasingly active in the battery and storage business, tapping on the EV opportunities but also on the rising solar energy market. Tesla´s CEO Elon Musk is chairman of the board of a solar panel´s company (SolarCity) and Tesla is developing a large battery factory, allowing new value chain expansions of the automaker and promising a boost in the EV market through the creation of a number of scale economies (e.g. selling batteries to

other car makers, utility companies, etc.). Moreover, it is expected to boost the market for battery-backed solar systems (see Box 6).

BOX 6 - Tesla-SolarCity batteries and energy storage

SolarCity is a provider of energy services founded and based in Silicon Valley. It primary focuses on the design, financing, installation and maintenance of solar energy systems, energy efficiency audits and charging stations for EVs. Due to the increasing competition in the field of solar energy (e.g. low cost solar panels from Asia), the company is further developing and implementing battery storage capacity in solar systems (including software for digital control and real-time communication systems). There are a number of on-going R&D and prototyping projects between the company, Tesla, the University of Berkeley and residential users (Bullis, 2013).

The company already offers Tesla batteries in its solar systems that consumers can use as emergency back up in case of blackouts. In the near future, it expects to use the battery storage capacity also to lower consumer bills by charging from the battery in peak hours and using times with low rates to recharge the battery. Currently, this is not yet possible on a large scale due the high prices of batteries, resistance of energy utilities (who need time to install and test batteries in the grid) and uncertainties about energy rates (e.g. feed-in tariffs). However, the model is being already tested in California.

When it comes to electric vehicles, PG&E is also an active player, with a large interest in the EV market, seen as the biggest electrification opportunity ahead. In general, EVs require little extra investments and can allow flattening demand peaks, improving the grid metabolism. Moreover, it creates new demand, improving the economics for long-term power procurement contracts, while allowing getting closer to the user. To this effect PG&E created many pilot programmes with an eye to address the EV costumer needs, including, among others, i) a dealership information and rate analysis pilot, to provide customized rate analysis at the point of sale, ii) an EV specific rate to encourage night charging and iii) a 100 per cent green rate ("carbon free riding"). Furthermore, PG&E is heading a number of new battery-related business models associated with battery swapping and the use of old EV batteries as storage capacity for the grid (Box 7).

BOX 7 - New leading business models between utilities, carmakers and users

The State of California and CPUC passed a regulation in 2010 obliging utilities to have extra electricity storage capacity in their grids. Since then, PG&E has been developing a number of new business models that can simultaneously allow coping with that regulation while supporting the diffusion of EVs in society.

One current state-of-the-art business model pilot from PG&E consists in paying carmakers to provide upfront rebates to their costumers (USD 2000-5000), in exchange of old batteries for PG&E use in their own grid. Under this model, the carmaker "sells" their client´s used batteries to PG&E, so that it can be used as extra grid storage capacity. In this way, a new use for the battery is created, users don't have to concern about recycling and the costumer gets an additional upfront rebate, providing an extra incentive to the EV market. Batteries remain with the carmakers, but they simultaneously become an asset of PG&E. The storage capacity of PG&E is therefore distributed among different locations and clients. Moreover, PG&E benefits from both the relationship between carmakers and users and their knowledge on batteries.

At the time of writing, there were already a number of ten-year contracts with carmakers committing to provide electricity storage in exchange of rebates for their costumers. The pilot was designed by PG&E in interaction with carmakers and the regulator CPUC. At the beginning, it will run with 500 costumers and the idea is to scale it up at a later stage, with new supportive legislation. In this way, cars and carmakers behave like power generation companies, rendering services and storage capacity to the utility. Moreover, the involvement of multinational carmakers is essential in order to spread the business model to other parts of the world, steering broader EV transitions at the global scale.

Also battery and charging station providers are increasingly relevant players. Over the last years, many moved to the Bay Area and to the Valley to tap into the ongoing EV-related dynamics and competences (e.g. advanced users and State-Local policies, venture capital).

The market for charging station is exclusively in the hand of private companies. In order to avoid accumulation of power and potential monopolies, CPUC doesn't allow energy utilities like PG&E to own or deploy charging stations), letting this to individual market providers. Yet, over the last years, a number of charging stations providers went bankrupt in San Francisco due to the still difficult economics of charging services (Box 8).

BOX 8 - Charging stations in the Bay Area

Many municipalities in the Bay Area have procured charging (and fast charging) stations to private companies, installing them in public places and parking lots, free of charge. As explained,

"…in the beginning nobody thought they would be used, but now they are always completely crowded".

Beyond municipalities, also large private companies have been procuring charging stations for their parking lots, an example being Google.

However, the economics of installing charging stations in other spots is still fraught with problems. For example, contrarily to a gas pump, consumers do not necessarily have to use it (they can charge at home). Moreover, beyond the cost, it represents a complex collective action problem, with many players and different interests involved, making it difficult to provide the chargers in the market. Site owners (e.g. supermarkets) see limited value in investing in the sector and the costs and permitting process is still hard to overcome. Moreover, in multiple family buildings, the building owner may raise issues about liability and payment of the charging station itself and the electricity. Currently, the City of San Francisco teamed up with ChargePoint, a private company, to develop a number of demonstration projects in multiple-owner buildings.

Grassroots movements and not-for-profit organizations are actively championing the adoption of EVs and electric mobility in society. These movements have several supporters with interest in leveraging the EV market – car makers, charging station companies, utilities, the government, etc. – providing a bridge between public and private interests and the consumer. Their core actions encompass lobbying and educational campaigns, namely as information has been considered one major hurdle still hampering more widespread diffusion of EVs[38]. One example of such initiatives is the so-called "EV week", an initiative to demonstrate the benefits and potentials of EV mobility with consumers (Box 9).

38 Elkind, 2012

BOX 9 - EV week

The EV week is a one-week event promoted by "Charge across Town", a not-for-profit advocacy organization in favour of EVs. It consist in a "moving circus" across different cities in the Bay Area (in 2013, it went through Palo Alto, San Jose and San Francisco), composed by EV-related expositions, test-drives, discussion forums among others. In 2013, more than 2.500 test-drives took place during the EV week.

The event is targeted to consumers and general society, but counts with the close involvement and financial support of many public and private organization, including PG&E, car dealers, charging station companies, etc. For example, PG&E held a large seminar in the event on "debunking EV myths" (expensive, for rich people, distance freight, high electricity rates, etc. while showcasing their discounted electricity programmes, phone and home assistance, etc.).

Beyond large players, the event organizers also try to involve smaller companies and organizations in the fair, even if they are not (high-paying) sponsors (e.g. smaller EV sharing companies). The idea is also to connect different industry players. The event is pre-competitive, focusing on raising the profile of the EV industry as a whole.

6 Conclusions, business models and implications for energy utilities

This case study explored two streams of on-going energy transitions in San Francisco Bay:

- the implementation of Community Choice Aggregation (CCA) schemes, i.e. municipalities (and groups of municipalities) procuring electricity on behalf of their constituents, with the ambition to increase its renewable content. We explored the case of Marin Clean Energy, a pioneer experiment championed by Marin County, a wealthy community in San Francisco´s Northern Bay;

- the drivers and recent developments linked with the fast diffusion of electric cars in the region, namely the ecosystem of actors involved and the formation of new business models.

These dimensions are part and parcel of current energy transitions in San Francisco, and respond to fundamental changes and challenges. On the one hand, Marin Clean Energy illustrates the growing relevance of community-level action in the world of energy, challenging incumbent investor-owned utilities; on the other hand, the market development for electric vehicles can be seen as a reaction to the need to de-carbonize mobility, one of the most critical energy and environmental challenges in the Bay Area. Moreover, the case depicts how associated energy-related innovations have been finding fertile ground to develop in the region, widely recognised as a global "lighthouse" when it comes to new energy thinking[39].

This case study highlights the link between energy transitions and State-level regulatory framework. San Francisco clearly benefits from a number of (environmentally) progressive, high-impact Californian laws and regulations, which have been enabling experimentation, nudging new business models and fostering the adoption of new technologies. However, such a progressive regulatory framework has to be explained as well, and San Francisco´s Bay actors and institutions play a key role on that – the region's famous "tech" and entrepreneurial culture and rooted environmental concerns provide ample room for energy experimentation and change.

6.1 New business models and the changing playing field of energy utilities

Both the rollout of CCA schemes and electric mobility are in a still relatively early stage (see Section 4.6), and a lot of uncertainty remains. However, the progress observed in San Francisco hints toward relevant challenges ahead for the business models of energy utilities, as well as to new opportunities for city-utility engagement.

39 Asmus, 2009

First, the case illustrates the power of local communities advocating for more control over the content of energy supply, even when utilities (like PG&E) are already considered highly progressive and "green". The emergence of hybrid CCA models (between investor-owned and municipal utilities) unbundle costumers and aggregate electricity demands locally, thus progressively turning incumbent utilities into distribution companies. Despite being still fraught with challenges, the recent diffusion of CCA models beyond Marin (e.g. a similar model is under discussion for San Francisco city itself) suggests that change can tip off relatively fast as remaining hurdles become progressively removed.

Second, and related with the previous, the case of San Francisco suggests that local authorities are progressively entering the new business spaces of energy utilities. We observed different ESCO-like models, energy efficiency programmes and financial solutions designed and implemented by local authorities. One example are the Energy Assessments Districts and Property Assessed Clean Energy (PACE), developed in Berkeley and then diffused to many other parts of the US (Section 3.2), but other energy-savings models are under development in Marin as well (Section 4.5). Moreover, centralized and "distant" generation models are being actively challenged. For example, beyond procuring electricity from large external producers, Marin Clean Energy is now increasingly supporting local feed-in tariff programmes and developing joint ventures with local renewable generators. These investments rely on a new local fund – created out of the "100% green" additional revenues (section 4.5) – also used to promote energy efficiency programmes. In this way, even if conventional investor-owned utilities are still responsible for distribution and billing, local authorities are becoming closer to the costumers in energy-related issues.

Third, the case study shows an increasingly symbolic dimension attached to energy consumption, which companies bring into their business models. For example, Marin Clean Energy (but also PG&E) offer "premium" electricity packages such as "100% green" or "100% local-generated", showing possibilities for differentiation in utility markets. The same is happening in the field of electric mobility. Tesla provides a good example: the company developed an exclusive system of car chargers, based on proprietary fast-charging stations for Tesla owners; moreover, access to those chargers is included in the (high) price of the car. Other charging station companies are developing charging "clubs", reflecting the fact that electrical charging is also increasingly about symbols, status, aesthetics and experience.

Fourth, the case of San Francisco illustrates the emergence of new cross-sectorial business models and diagonal integration: energy businesses getting combined with other sectors, such as finance, real estate development or car dealing. With distributed generation, real estate developers become increasingly involved in energy production (e.g. through the installation of solar roofs, such as in San Rafael airport) and energy becomes part of their product. Moreover, as the diffusion of electric mobility suggests, cars become moveable power storage units. Currently, PG&E is developing a pilot business models with car manufacturers through which the utility buys long-term storage capacity to car dealers (who make use of old car batteries), simultaneously providing financial rebates for new electric cars owners (see Box 7).

Fifth, as the electricity value chains and business models keep changing, so do the types of actors involved, with many new entrants. As we have seen in the previous sections, beyond regulators, government and utilities, considerable change is being driven by local governments, car companies, charging station industrialists, advocacy organizations, app developers, etc. This calls for new governance models and ways of engagement between utilities and society.

6.2 Final thoughts on cities and the geography of energy transitions

From a more conceptual perspective, this case study illustrates the reasons why it can be relevant for utilities – and other energy players – to look at cities as key places to steer energy transitions.

First, the literatures in economic geography clear posits that cities and dense urban regions are good innovation "nurseries", namely in the early development stages of new technologies and industries[40]. This is so because dense cities provide for face-to-face contacts, ecologies of exchange, learning and matching that are pivotal when new domains and solutions are not stable yet. Currently, San Francisco Bay plays a nursery role for most of the new energy solutions explored in this case study, as they require interactions among many players and involve unstable designs and business models. For example, the new CCA schemes emerging in the Bay Area (Sonoma) learned from close interaction with the Marin pioneer proponents; or the "energy assessment districts" innovation developed in Berkeley before being rolled out the US. Another example relates to electric cars, whose turbulent business models and innovations rely on close interactions between actors in proximity. In this respect, San Francisco is now playing the nursery role of Detroit in the early years of car making. It is illustrative, that established carmakers like Daimler and Toyota have invested in Tesla, giving them direct access to new EV technologies.

Second, the current energy transitions unfolding in San Francisco do not operate on "virgin land" but rely on a previous set of specific and highly localized institutions, such as the region´s entrepreneurial culture, innovation and experimentation routines, venture capital organization and liberal-environmental prone politics. This makes the region particularly "ready" for the types of transitions under analysis. These institutions are hard to imitate across places, although they can, to some extent, travel with individuals to other contexts – see e.g. Carvalho et al. (2013), for an example of linkages between the Silicon Valley and Shanghai, bridged by transnational entrepreneurs. At the same time, although San Francisco and Los Angeles largely share the same regulatory framework (California), the specificities of the first make it more ready to host innovation-driven transitions.

At the same time, the case of Marin´s CCA suggests that, in some circumstances, smaller places may be equally apt to steer energy transitions. This is so because these places make it easier to aggregate individual preferences (e.g. for "green" energy) avoiding early

40 Duranton and Puga, 2001; Storper, 2013

experimentation to come to a standstill due to very different social and political stances. The case of the city of San Francisco illustrates some of these difficulties in getting social and political support to implement a CCA (Lagos and Baker, 2013). Moreover, the case illustrates that smaller cities can compensate their lack of hard resources with political clout, influencing higher-level regulations over time.

Finally, the case study shows that energy transitions, experimentation and "green" energy are not only for wealthy communities like Martin. The fact that the working-class city of Richmond joined Marin´s CCA demonstrates that environmental concerns are increasingly cutting across rich-poor divides, yet for different reasons. While Marin cities have a preservation-oriented drive, Richmond communities are more sensitive to the link between environment and health of their families in addition to possibilities for new job generation. This suggests that the types of transitions observed in Marin and in San Francisco may be more general, transposing any type of socio-spatial delimitation.

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