Energy Communique

March 2016
Issue 18

Editorial

Dear Reader,

Since the installation of the first solar PV plant in Nepal by the NTC in 1974, the solar energy market has come a long way. Especially in the last two decades where the Nepal government through its solar subsidy scheme has managed to deploy over 200,000 Solar Home system (SHS) to rural parts of Nepal, which has provided people an access to clean source of lighting and mobile charging services.

But, it is well established now that access to energy is much more than just basic lighting and mobile charging, people accessing energy for productive end use load is what makes difference to people's lives. As rural communities climb up the energy ladder and demand more energy for productive end use and community services, mini-grid technology has in certain contexts emerged as a more economical solution when compared to grid extension or such stand-alone systems.

One of such solar microgrids have been developed by Gham Power Nepal Pvt. Ltd, where private capital has been mobilized to initiate rural energy projects, rather than relying on subsidies alone. The equity investment for the project was made by the local communities and also by the company into a SPV (Special Purpose Vehicle). The rural communities view themselves as not just customers but also investors which provides the platform for longer-term economic growth and development.

There exists ample opportunities for rural entrepreneurs to innovate and come up with solutions that will help them generate revenue which in turn will help them pay for energy. The people in the community have already started setting up cyber centres, poultry farms, milling machines, gas-stations and water pumps which generate substantial revenue for the SPV. In addition to this, a couple of Ncell BTS stations are also purchasing power from the microgrid on a fixed PPA basis.

In the coming months, as more operational data on the microgrids are gathered, a better understanding could be developed regarding how microgrids could be better structured to facilitate private investment, provide opportunities for further innovation, achieve efficiency and growth.

There are still uncertainties in government policy regarding microgrids, especially concerning exit options for private investors in case grid arrives within the project period. High project development costs for the developers and high transaction costs for the investors have also been other deterrent for private investors to enter into this market. Uttar Pradesh recently came up with a microgrid policy of their own where clear emphasis has been provided on exit options in case of grid arrives, different business models developers could adopt, technical standards to be adhered to and safety measures. But, as the microgrid landscape grows in the near future in Nepal, the government needs to come up with clear policy framework to incentivize private investment.

There are also some, who argue that these approaches may just be a stop gap solution and diverts money from 'ideal' forms of grid electrification through large scale Hydropower projects, they overlook the fact that investment in such projects cost many times more than decentralized generation through microgrids and also has a long project development cycle. The microgrids bring immediate value to the users. Furthermore, savings from kerosene expenditure could be diverted to other use, revenue generated through appliances could reinvigorate the local economy and working hours are extended, which in turn increases productivity. These decentralized solutions, such as the microgrids incorporating productive end use have faster payback for the investors and provides safer, cleaner and cheaper source of energy for the people. This might be the right approach in moving forward as we try and provide energy access to rural Nepal.

Mr. Anjal Niraula

Gham Power Nepal Pvt. Ltd.
An EDC member organization

In this Issue

EDC Activities

Interview with Mr. Santa Rai, CEO of Dudhkoshi Power Co. Pvt. Ltd

1) Please, tell us about your organization?

Our organization, Dudhkoshi Power Company Pvt Ltd, established in April 2006, is a company devoted to promote energy production in Nepal with the primary purpose of contributing in reducing the energy crisis in the country. Having 400 million rupees authorized capital, the company has been constructing a very lucrative hydropower project: Rawa Khola Hydropower Project (6500 KW) in Khotang. The company's shareholders are comprised of investment companies and individual shareholders.

The company has adopted its strategy to contribute in energy production in Nepal by establishing cooperation with foreign investment companies and energy production companies. This will meet company's mission of contributing in energy supply in the country, which will be a milestone in industrial development and radical change in people's life since energy demand in Nepal will reach 8,000 MW by 2030.

2) Can you elaborate on the key current activities or projects that your company is executing?

Our company has been developing Rawa Khola Hydropower Project having 6500 KW installed capacity in Khotang district. Currently, we are doing main three jobs: finalizing land acquisition for the project, reviewing engineering design, and awarding civil contract. Camp facilities and access road have been completed in last year. We will begin civil construction by end of April.

3) What are the major challenges you have been facing during execution of your project?

Acquisition of land seems a little bit of a problem however; there is no big hurdle from local people. However, public and government forest land acquisition process is little bit lengthy process; the people's private land acquisition is not so much difficult in some like our project.

4) How do you propose such issues can be resolved?

Lobbying with government officials is only the way out for the moment.

5) Can you also suggest the key changes you think will help take the energy sector forward?

Answer to your question attracts three concepts in energy sector, which have been prominently discussed in Nepal. First; one is energy production for consumption and second is production for export.

I have some suggestions for overcoming the problems and obstacles in energy sector for consumption model. First; there should be *single - desk* to serve for land acquisition process whether the private land or public or government or forest area. The other main problem is lack of transmission line and substations. Second; there are few substations which on the one hand, have created problems of wasting power produced by Independent power producers (IPPs) like us on the other hand, IPPs are pessimistic with such situation. That is why, government should prioritize this sector. Thirdly, the local IPPs should be rewarded by financial incentives by the government for the certain time period until our energy production meets the total demand. Forth, the PPA concluded with IPPs should be revised as the NEA hike its selling rate in market. Fifth, government should develop this sector as the most lucrative sector for public by involving them in this sector.

In context with energy export, there should be concluded Power Trade Agreement, this should include transmission line as its annex. Power Purchase Agreement (PPA) should be provisioned to conclude in US dollar for a limit time period with stipulated terms and conditions, till the date of investment repayment. These provisions attract Foreign Direct Investment (FDI), which finally contribute to radical growth of IPPs and power production in Nepal. Mega projects should be built by internationally recognized companies in BT model. Then only, the concept of energy export comes into practice.

Third one is utilization of water resource. In general, many people are stereotyped to hydro power development. For them, water resource is just for hydro power and hydropower is sole project from a river. Water resource can be used in multiple ways in a single project. Therefore, project should be multi-purpose as far as practicable. Such concept will contribute in energy sector in higher stage of vision and development accordingly.

Interview of Mr. Uttar Kumar Shrestha, EDC Executive Committee Member and CEO of Butwal Power Company at Urja Bahas

On March 3rd, 2016, Mr. Gopal Basnet of Mountain TV took interview of Mr. Uttar Kumar Shretha and Er. Kumar Pandey at his renowned program “Urja Bahas”. The discussion was on the Concept paper on “The Energy Crisis Mitigation Bill and Electricity Development Decade Plan” recently declared by the government.

(The link of the interview is available at: ***www.youtube.com/watch?v=sxhMoNl7rEw&feature=youtu.be***)

Meeting with Vice-chairman of National Planning Commission

On 21st March, 2016, EDC visited Dr. Yubaraj Khatiwada, Vice- Chairman of National Planning Commission. The meeting was about the participation of NPC in the upcoming Nepal Power Investment Summit 2016 (31st May to 3rd June) organized by EDC and its partner Neoventure Corporation. Dr. Khatiwada has shown positive interest in participating in the Summit.

Announcement from Chhyangdi Hydropower Ltd, an EDC member organization

पूर्व लमजुङको फलेनी र बन्सार गाविसको बीचको छ्याङदै खोलामा निर्माण गरिएको छ्याङदी खोला जलविद्युत आयोजनाबाट विद्युत उत्पादन सुरु भएको छ ।

मुलुकमा जारी चरम विद्युत संकटकाबीच २ मेघावाट क्षेमताको सो आयोजनाले उत्पादन सुरु गरेको हो ।

घट्टे खोलो र छ्याङदी खालाको दोभानमा बाँधेर २२ सय मिटर लामो पेनस्टकमार्फत ल्याइएको पानीलाई फलेनी -१ दारिमबोटमा निर्माण गरेको विद्युत गृहमा पुऱ्याएर विद्यत उत्पादन सुरु भएको आयोजनाले जनाएको छ ।

छ्याङदी आयोजना र नेपाल विद्युत प्राधिकरणबीच सुख्खायाममा ८ रुपैयाँ ४० पैसा र बर्षयाममा ४ रुपैयाँ ८० पैसा दिने गरी विद्युत खरिद सम्झौता (पीपीए) भएको थियो ।

एक-एक मेगावाट क्षमताको २ वाटा टर्बाक्ष्नजडित यस आयोजनाको कुल ग्रस हेड १ सय ८५ मिटर छ ।

सोमबारवाट उत्पादन भएको विद्युत आयोजना आफैंले निर्माण गरेको ट्रान्समिसन लाईनमार्फत राष्ट्रिय प्रसारण लाईन उदीपुर सव-स्टेशनमा जोडिएको छ ।

आयोजनाबाट अहिले ६ सय किलेवाट विद्युत उत्पादन भएको प्रबद्धक कम्पनी छ्याङदी हाइड्रोपावरका कार्यकारी सञ्चालक लाल बहादुर थापाले बताए ।

'आयोजनाबाट' बर्षाको सिजनमा २ मेघावाट र सुख्खा सिजनमा उत्पादनमा केही कमी हुने उनले बताए । निर्माण थालेको डेढ वर्षमै आयोजन निर्माण सकिएपछि जिल्लाका अन्य जलविद्युत आयोजनाका प्रबद्धक पनि उत्साहित छन् ।

जिल्लामा निर्माण सम्पन्न भएको जलविद्युत आयोजना मध्ये तोकिएको समयमा सम्पन्न गर्ने जलविद्युत आयोजनामध्ये छ्याङदी दोस्रो भएको छ ।

यसअघि ४.४ मेघावाट राँधी जलविद्युत आयोजनापनि तोकिएकै समयमा सम्पन्न भएको थियो ।

छ्याङदी जलविद्युत आयोजनाले सामाजिक उत्तरदायित्व अन्तलत विद्यालय निर्माण, सडक र ग्रामिण विद्युतीकरणमा सहयोग गरेको सञ्थालक थापाले जानकारी दिए ।

जलविद्युत आयोजनाले परिक्षण प्रशारणको १५ दिन निःशुल्क रुपमा नेपाल विद्युत प्राधिकरणलाई उपलब्ध गराउनु पर्ने सरकारी प्राबधान छ ।

Announcement from Butwal Power Company, an EDC member organization

प्रेस बिज्ञप्ती

कावेली इनर्जी लिमिटेड र जलविद्युत लगानी तथा विकास कम्पनी लिमिटेड वीच विश्व बैंकको अन्तर्राष्ट्रिय विकास संस्थावाट प्राप्त हुने ऋणको लागि सहायक ऋण सम्झौता सम्पन्न

यस कम्पनीको ५३.५% लगानी रहेको कावेली इनर्जी लिमिटडले निर्माण गर्न लागेको ३७.६ मेगावाटको कावेली जलविद्युत आयोजनामा ४ करोड अमेरीकी डलर ऋण लगानी गर्ने सम्वन्धमा नेपाल सरकार र विश्व बैंक बीच मिति २०७१/०८/०८ मा Financing Agreement भएको र सो अनुसारको ऋण रकम कावेली इनर्जी लिमिटेडले प्राप्त गर्ने सम्वन्धमा नेपाल सरकारको स्वामित्वमा रहेको जलविद्युत लगानी तथा विकास कम्पनी लिमिटेड बीच मिति २०७२/१२/०४ मा KEL Subsidiary Agreement सम्पन्न भएको छ । उक्त आयोजनाको लागि अन्तर्राष्ट्रिय वित्त निगम ९ङ्क्ष० संग सम्पन्न भइसकेको ऋण सम्झौता अनुसार प्राप्त हुने ३ करोड ८६ लाख अमेरिकी डलर सहित विश्व बैंक समूहवाट उक्त आयोजनाको लागि प्राप्त हुने कुल ऋण लगानी ७ करोड ८६ लाख अमेरिकी डलर हुनेछ । यो सम्झौता सम्पन्न भएसंगै कावेली ँए' जलविद्युत आयोजनाको वित्तीय व्यवस्थापनको कार्य सम्पन्न भएको छ र निर्माण कार्य अगाडि बढाउन बाटो खुलेको छ । यस आयोजनाको लागत ९ करोड ९५ लाख अमेरिकी डलर रहेको छ । जसमा ऋण तथा स्वपूँजीको अनुपात ७७.५%:२२.५% रहेको छ ।

आयोजनाको विद्युत खरिद विक्री सम्झौता मिति २०७२/६/७ मा नेपाल विद्युत प्राधिकरणसंग सम्पन्न भैसकेको छ । आयोजना निर्माणको लागि सिभिल तथा हाइड्रोमेकानिकल ठेकेदार नियुक्ति भइसकेको छ भने इलेक्ट्रोमेकानिकल ठेकेदार नियुक्तिको प्रकृया अघि बढिरहेको छ । हालसम्म यस आयोजनामा करिब रु ६४ करोड लगानी भइसकेको छ ।

कावेली ँए' जलविद्युत आयोजना दैनिक उच्च माँग भएको समयमा चलाउन मिल्ने गरी खोलाको वहावमा आधारित आयोजना हो । यो आयोजना पूर्वी नेपालको ताप्लेजु▪ र पाँचथर जिल्लामा पर्दछ । जलाशयबाट पानीलाई ४ किलोमिटर लामो सुरु▪मार्ग मार्फत फर्काइ विद्युतगृहमा खसाली ३७.६ मेगावाटको विद्युत उत्पादन गरी पानीलाई पूनः तमोर नदीमा मिसाइने छ । उत्पादित विद्युतलाई विद्युतगृहको स्वीचयार्ड देखि करिब ८० किमि लामो १३२ केभी प्रसारण लाइनबाट दमक सवस्टेशनसम्म पुऱ्याइने छ । यसरी यो आयोजना राष्ट्रिय प्रशारण लाइनमा आवद्ध हुनेछ । यो आयोजना सन् २०१९ सम्ममा निर्माण सम्पन्न हुने र यसवाट देश विकासमा महत्वपूर्ण सहयोग पुग्ने र नेपाली जनतालाई चरम विद्युत अभावबाट मुक्त गर्न केहि सहयोग पुग्ने अपेक्षा गरिएको छ ।

नेपाल सरकारले सन् २००९ मा बुटवल पावर कम्पनी लि. नेतृत्वको जेभीलाई कावेली ँए' जलविद्युत आयोजना सार्वजनिक निजी साझेदारी ढाँचा अन्तर्गत निर्माण गर्नको लागि अन्तर्राष्ट्रिय प्रतिश्प्र्धाको माध्यमबाट जिम्मा दिएको थियो । सोही अनुसार सन् २०१० जनवरीमा ऊर्जा मन्त्रालय अन्तर्गतको विद्युत विकास विभागसँग आयोजना विकास सम्झौता सम्पन्न भएको थियो ।

निजी क्षेत्रबाट निर्माण हुने आयोजनामा विश्व बैक र अन्तर्राष्ट्रिय वित्त निगमले संगै लगानी गर्न लागिएको यो पहिलो जलविद्युत आयोजना हो ।

कावेली जलविद्युत आयोजनामा बुटवल पावर कम्पनी तथा क्ष्लाचबक्ष्य ब्कष्व एतभा ितमा को संयुक्त लगानीमा स्थापित गुराँश इनर्जी लिमिटेडको ६९% लगानी रहेको छ । यस आयोजनामा गुराँश इनर्जी लिमिटेड मार्फत २७.५% र प्रत्यक्ष रुपमा २६% गरी कुल ५३.५% लगानी बुटवल पावर कम्पनीको हुनेछ ।

साथै, यस कम्पनीले अघि बढाएको अर्को सहायक कम्पनी न्यादी हाइड्रोपावर लिमिटेडले ३० मेगावाट क्षमताको न्यादी जलविद्युत आयोजना निर्माण गर्न विद्युत खरिद बिक्री सम्झौता र वित्तीय व्यवस्थापन सम्पन्न गरी सकेर ठेकेदार नियूक्तिको प्रकृया अगाडि बढाएको छ ।

यो ऋण सम्झौतामा कावेली इनर्जी लिमिटेडका तर्फबाट संचालक श्री विवेक गुप्ता र जलविद्युत लगानी तथा विकास कम्पनी लिमिटेडको तर्फबाट सो कम्पनीका प्रमुख कार्यकारी अधिकृत श्री दिपक रौनियारले हस्ताक्षर गर्नु भएको छ ।

२०७२।१२।५
काठमाण्डौ

Nepal's Energy Scenario Page

Kathmandu: The third most polluted city in the world

By Gaurav Thapa and Anuj Kumar Adhikari

In a latest finding which may not surprise many, Kathmandu has been ranked the third most polluted city in the world, according to Pollution Index 2016.

According to latest pollution index published by Serbia-based research website Numbeo.com, Nepal's Capital city sits in the third position of the pollution ranking with a pollution index of 96.66. The last pollution ranking published in the middle of 2015 had also placed Kathmandu in the third position while in the beginning of 2015 Kathmandu was in the fifth position.

The rankings are based on perceptions of visitors to the website and includes some relevant data from World Health Organization and other institutions, Numbeo.com says about the pollution index. The index is an estimation of the overall pollution in the city with the biggest weight given to air pollution and then to water pollution.

The dismal performance in pollution index was expected as a 2014 report of the Ministry of Science, Technology and Environment shows that Kathmandu air contains 400 micrograms of particulate matter up to 10 micrometres in size per cubic metre or the PM10 is 400µg/m3. However, the maximum limit for PM10 set by the National Ambient Air Quality Standards is 120µg/m3. Likewise, another 2014 report by Clean Energy Nepal shows that Kathmandu air contains 260 micrograms of particles smaller than 2.5 micrometres in size per cubic metre or the PM2.5 is 260µg/m3 against maximum limit of 40µg/m3. The air quality samples for both results were taken from Putali Sadak.

Rank	City	Pollution Index
1	Tetovo, Macedonia	99.24
2	Cairo, Egypt	99.10
3	Kathmandu, Nepal	96.66
4	Accra, Ghana	96.18
5	Manila, Philippines	96.08
6	Noida, India	95.55
7	Guangzhou, China	94.66
8	Delhi, India	94.14
9	Ho Chi Minh City, Vietnam	94.00
10	Alexandria, Egypt	93.99

The existing situation of water pollution is equally troubling. According to a research conducted by Bagmati Civilisation Integrated Development Committee in October last year, water in the Bagmati River at Minbhawan contains 0.53 milligrams of dissolved oxygen per litre or the DO is 0.53mg/l. Comparing this to the fact that any aquatic animal cannot survive in water with less than 3mg/l shows how polluted our rivers are. Likewise, chemical oxygen demand of water--total measurement of all chemicals in the water that can be oxidised--at the same place is 128.44mg/l and biochemical oxygen demand--the amount of dissolved oxygen needed by aerobic biological organisms--is 68.3mg/l. The effluent standard for industries for both COD and BOD is less than 30mg/l.

In the latest pollution index, Tetovo city of Macedonia has been ranked the most polluted city in the world followed by Egypt's capital city Cairo. Other Asian cities Philippines's capital Manila, Noida and Delhi of India, Guangzhou of China and Ho Chi Minh City of Vietnam also make the top 10.

In the Pollution Index for Country 2016, Nepal sits in the 17th place with Egypt as the most polluted country in the world.

(The article is derived from Kathmandu Post published on 19th March, 2016 and the link is available at: ***kathmandu-post.ekantipur.com/news/2016-03-19/kathmandu-the-third-most-polluted-city-in-the-world.html*** *).*

Guest Corner

A Lesson for Nepal from Bhutan
TED Talks: With World's Top 50 Global Leader- Tshering Tobgay, Prime Minister of Bhutan

This country isn't just carbon neutral — it's carbon negative

Interactive transcript

00:12 In case you are wondering, no, I'm not wearing a dress, and no, I'm not saying what I'm wearing underneath.

00:21 (Laughter)

00:24 This is a gho. This is my national dress. This is how all men dress in Bhutan. That is how our women dress. Like our women, we men get to wear pretty bright colors, but unlike our women, we get to show off our legs.

00:47 (Laughter)

00:49 Our national dress is unique, but this is not the only thing that's unique about my country. Our promise to remain carbon neutral is also unique, and this is what I'd like to speak about today, our promise to remain carbon neutral.

01:03 But before I proceed, I should set you the context. I should tell you our story.

01:10 Bhutan is a small country in the Himalayas. We've been called Shangri-La, even the last Shangri-La. But let me tell you right off the bat, we are not Shangri-La. My country is not one big monastery populated with happy monks.

01:27 (Laughter)

01:29 The reality is that there are barely 700,000 of us sandwiched between two of the most populated countries on earth, China and India. The reality is that we are a small, underdeveloped country doing our best to survive. But we are doing OK. We are surviving. In fact, we are thriving, and the reason we are thriving is because we've been blessed with extraordinary kings. Our enlightened monarchs have worked tirelessly to develop our country, balancing economic growth carefully with social development, environmental sustainability and cultural preservation, all within the framework of good governance. We call this holistic approach to development "Gross National Happiness," or GNH. Back in the 1970s, our fourth king famously pronounced that for Bhutan, Gross National Happiness is more important than Gross National Product.

02:38 (Applause)

02:43 Ever since, all development in Bhutan is driven by GNH, a pioneering vision that aims to improve the happiness and well-being of our people.

02:57 But that's easier said than done, especially when you are one of the smallest economies in the world. Our entire GDP is less than two billion dollars. I know that some of you here are worth more --

03:11 (Laughter)

03:12 individually than the entire economy of my country.

03:19 So our economy is small, but here is where it gets interesting. Education is completely free. All citizens are guaranteed free school education, and those that work hard are given free college education. Healthcare is also completely free. Medical consultation, medical treatment, medicines: they are all provided by the state. We manage this because we use our limited resources very carefully, and because we stay faithful to the core mission of GNH, which is development with values. Our economy is small, and we must strengthen it. Economic growth is important, but that economic growth must not come from undermining our unique culture or our pristine environment.

04:13 Today, our culture is flourishing. We continue to celebrate our art and architecture, food and festivals,monks and monasteries. And yes, we celebrate our national dress, too. This is why I can wear my gho with pride. Here's a fun fact: you're looking at the world's biggest pocket.

04:41 (Laughter)

04:44 It starts here, goes around the back, and comes out from inside here. In this pocket we store all manner of personal goods from phones and wallets to iPads, office files and books.

05:02 (Laughter)

05:03 (Applause)

05:05 But sometimes -- sometimes even precious cargo.

05:13 So our culture is flourishing, but so is our environment. 72 percent of my country is under forest cover. Our constitution demands that a minimum of 60 percent of Bhutan's total land shall remain under forest cover for all time.

05:32 (Applause)

05:38 Our constitution, this constitution, imposes forest cover on us. Incidentally, our king used this constitution to impose democracy on us. You see, we the people didn't want democracy. We didn't ask for it, we didn't demand it, and we certainly didn't fight for it. Instead, our king imposed democracy on us by insisting that he include it in the constitution. But he went further. He included provisions in the constitution that empower the people to impeach their kings, and included provisions in here that require all our kings to retire at the age of 65.

06:29 (Applause)

06:30 Fact is, we already have a king in retirement: our previous king, the Great Fourth, retired 10 years ago at the peak of his popularity. He was all of 51 years at that time.

06:50 So as I was saying, 72 percent of our country is under forest cover, and all that forest is pristine. That's why we are one of the few remaining global biodiversity hotspots in the world, and that's why we are a carbon neutral country. In a world that is threatened with climate change, we are a carbon neutral country.

07:14 Turns out, it's a big deal. Of the 200-odd countries in the world today, it looks like we are the only one that's carbon neutral. Actually, that's not quite accurate. Bhutan is not carbon neutral. Bhutan is carbon negative. Our entire country generates 2.2 million tons of carbon dioxide, but our forests, they sequester more than three times that amount, so we are a net carbon sink for more than four million tons of carbon dioxide each year. But that's not all.

07:55 (Applause)

07:57 We export most of the renewable electricity we generate from our fast-flowing rivers. So today, the clean energy that we export offsets about six million tons of carbon dioxide in our neighborhood. By 2020, we'll be exporting enough electricity to offset 17 million tons of carbon dioxide. And if we were to harness even half our hydropower potential, and that's exactly what we are working at, the clean, green energy that we export would offset something like 50 million tons of carbon dioxide a year. That is more CO2 than what the entire city of New York generates in one year.

08:44 So inside our country, we are a net carbon sink. Outside, we are offsetting carbon. And this is important stuff. You see, the world is getting warmer, and climate change is a reality. Climate change is affecting my country.

Our glaciers are melting, causing flash floods and landslides, which in turn are causing disaster and widespread destruction in our country. I was at that lake recently. It's stunning. That's how it looked 10 years ago, and that's how it looked 20 years ago. Just 20 years ago, that lake didn't exist. It was a solid glacier. A few years ago, a similar lake breached its dams and wreaked havoc in the valleys below. That destruction was caused by one glacier lake. We have 2,700 of them to contend with. The point is this: my country and my people have done nothing to contribute to global warming, but we are already bearing the brunt of its consequences. And for a small, poor country, one that is landlocked and mountainous, it is very difficult. But we are not going to sit on our hands doing nothing. We will fight climate change. That's why we have promised to remain carbon neutral.

10:21 We first made this promise in 2009 during COP 15 in Copenhagen, but nobody noticed. Governments were so busy arguing with one another and blaming each other for causing climate change, that when a small country raised our hands and announced, "We promise to remain carbon neutral for all time, “nobody heard us. Nobody cared.

10:50 Last December in Paris, at COP 21, we reiterated our promise to remain carbon neutral for all time to come. This time, we were heard. We were noticed, and everybody cared. What was different in Paris was that governments came round together to accept the realities of climate change, and were willing to come together and act together and work together. All countries, from the very small to the very large, committed to reduce the greenhouse gas emissions. The UN Framework Convention on Climate Change says that if these so-called intended commitments are kept, we'd be closer to containing global warming by two degrees Celsius.

11:45 By the way, I've requested the TED organizers here to turn up the heat in here by two degrees, so if some of you are feeling warmer than usual, you know who to blame.

12:02 It's crucial that all of us keep our commitments. As far as Bhutan is concerned, we will keep our promise to remain carbon neutral. Here are some of the ways we are doing it. We are providing free electricity to our rural farmers. The idea is that, with free electricity, they will no longer have to use firewood to cook their food. We are investing in sustainable transport and subsidizing the purchase of electric vehicles. Similarly, we are subsidizing the cost of LED lights, and our entire government is trying to go paperless. We are cleaning up our entire country through Clean Bhutan, a national program, and we are planting trees throughout our country through Green Bhutan, another national program.

12:55 But it is our protected areas that are at the core of our carbon neutral strategy. Our protected areas are our carbon sink. They are our lungs. Today, more than half our country is protected, as national parks, nature reserves and wildlife sanctuaries. But the beauty is that we've connected them all with one another through a network of biological corridors. Now, what this means is that our animals are free to roam throughout our country. Take this tiger, for example. It was spotted at 250 meters above sea level in the hot, subtropical jungles. Two years later, that same tiger was spotted near 4,000 meters in our cold alpine mountains. Isn't that awesome?

13:52 (Applause)

13:56 We must keep it that way. We must keep our parks awesome. So every year, we set aside resources to prevent poaching, hunting, mining and pollution in our parks, and resources to help communities who live in those parks manage their forests, adapt to climate change, and lead better lives while continuing to live in harmony with Mother Nature.

14:23 But that is expensive. Over the next few years, our small economy won't have the resources to cover all the costs that are required to protect our environment. In fact, when we run the numbers, it looks like it'll take us at least 15 years before we can fully finance all our conservation efforts. But neither Bhutan, nor the world can afford to spend 15 years going backwards.

14:55 This is why His Majesty the King started Bhutan For Life. Bhutan For Life gives us the time we need. It gives us breathing room. It is essentially a funding mechanism to look after our parks, to protect our parks, until our government can take over on our own fully. The idea is to raise a transition fund from individual donors, corporations and institutions, but the deal is closed only after predetermined conditions are met and all funds committed. So multiparty, single closing: an idea we borrowed from Wall Street. This means that individual donors can commit without having to worry that they'll be left supporting an underfunded plan. It's something like a Kick starter project, only with a 15-year time horizon and millions of tons of carbon dioxide at stake. Once the deal is closed, we use the transition fund to protect our parks, giving our government time to increase our own funding gradually until the end of the 15-year period. After that, our government guarantees full funding forever.

16:19 We are almost there. We expect to close later this year. Naturally, I'm pretty excited.

16:25 (Applause)

16:31 The World Wildlife Fund is our principle partner in this journey, and I want to give them a big shoutout for the excellent work they are doing in Bhutan and across the world.

16:44 (Applause)

16:48Whew, it is getting warm in here.

17:03 I thank you for listening to our story, a story of how we are keeping our promise to remain carbon neutral,a story of how we are keeping our country pristine, for ourselves, our children, for your children and for the world. But we are not here to tell stories, are we? We are here to dream together. So in closing, I'd like to share one more dream that I have. What if we could mobilize our leadership and our resources, our influence and our passion, to replicate the Bhutan For Life idea to other countries so that they too can conserve their protected areas for all time. After all, there are many other countries who face the same issues that we face. They too have natural resources that can help win the world's fight for sustainability, only they may not have the ability to invest in them now. So what if we set up Earth For Life, a global fund, to kickstart the Bhutan For Life throughout the world? I invite you to help me, to carry this dream beyond our borders to all those who care about our planet's future. After all, we're here to dream together, to work together, to fight climate change together, to protect our planet together. Because the reality is we are in it together. Some of us might dress differently, but we are in it together.

18:42 Thank you very much, and kadrin chhe la. Thank you.

18:46 (Applause)

18:47 Thank you, thank you, thank you.

(The talk was presented at an official TED conference, and was featured in the ted.com. It was filmed at February 2016 and is available at:
www.ted.com/talks/tshering_tobgay_this_country_isn_t_just_carbon_neutral_it_s_carbon_negative#t-25180)

Big solar is heading for boom times in the US, Riding three strengths, overcoming one weakness.

David Roberts

When people think of solar power, they tend to think of panels on rooftops. That kind of small-scale, distributed solar power is the most visible, gets the most press, and, from the consumer perspective, has the most sex appeal.

But the humble workhorse of solar power is the utility-scale solar power plant, usually defined as a solar array larger than 5 megawatts.

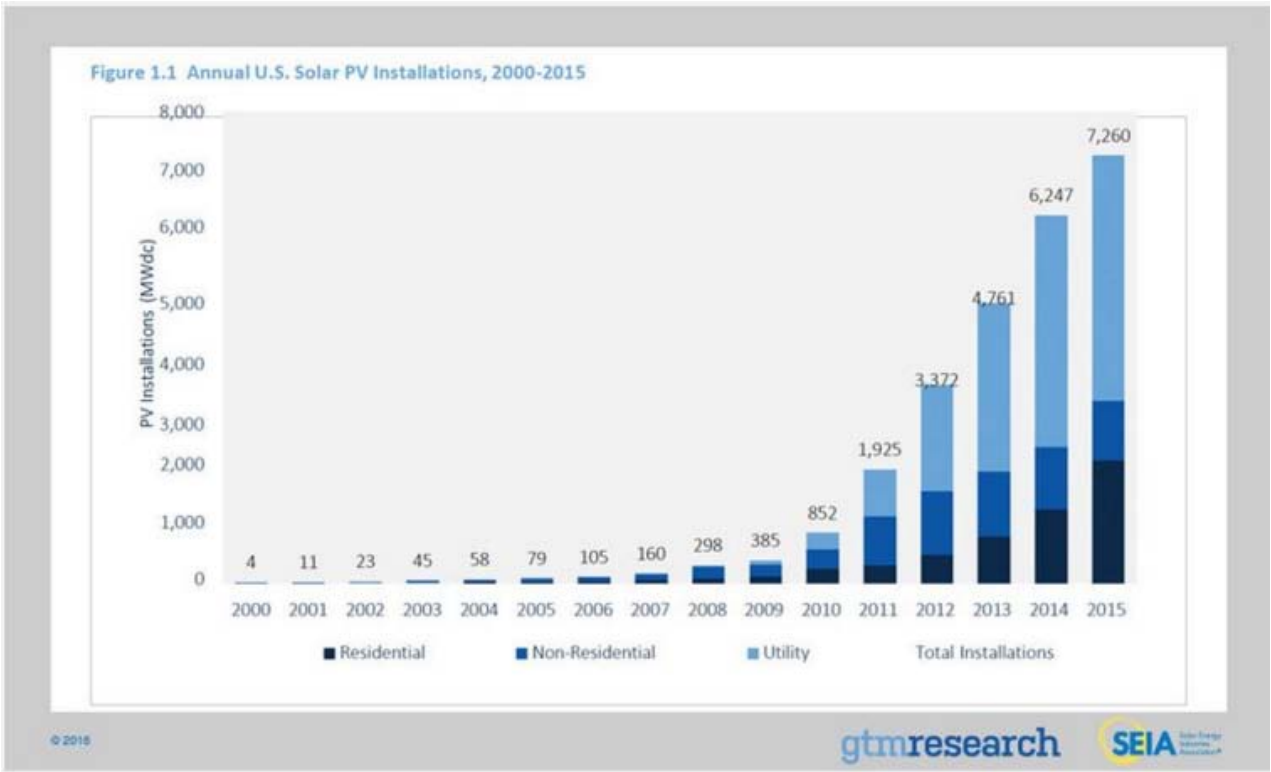
Solar power plants can consist in either photovoltaic (PV) panels or mirrors that focus sunlight on a fluid that boils and turns a turbine ("concentrating solar power," or CSP). In practice, most new solar plants these days use PV, which has gotten so cheap so fast that it's outcompeted CSP and every other solar segment, at least for now.

Nellis Solar Power Plant, in Nellis Air Force Base, northeast of Las Vegas. (U.S. Air Force Airman 1st Class Nadine Y. Barclay, via Wikipedia)

In 2007, there were zero utility-scale solar power plants in the US. Today there are hundreds, ranging from the 579 MW Solar Star project (the world's largest solar farm) in California down to dozens upon dozens of 10, 20, and 50 MW projects in communities across the country. (SEIA counts 2,100 solar PV projects over 1 MW.)

Big solar power plants still provide a measly 0.6 percent of overall US electricity. But they are headed up a steep growth curve.

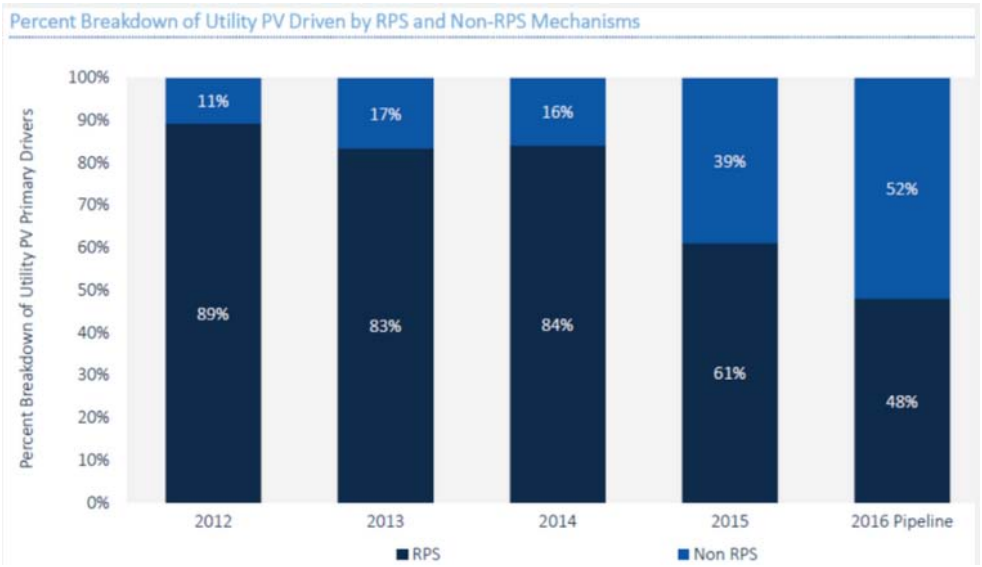
Residential rooftop solar is the fastest growing solar segment, but utility-scale solar is bigger. There's more installed, so even with its slower growth rate it adds more capacity each year — in 2015, it accounted for 57 percent of all new installed solar capacity.



(GTM Research)

("Non-residential" in this graph refers to rooftop solar on commercial buildings — parking garages, big-box stores, etc.)

What's more, there's a ton of utility solar in the pipeline. According to the Energy Information Administration, 9.5 GW of utility solar is scheduled for installation in 2016 — more than from any other single energy source, including natural gas.



That would make 2016 a banner year, with utility solar accounting for more than three-quarters of installed solar capacity, installing more in a year than in the past three combined.

That's serious growth. A new report from GTM Research is also optimistic about utility-scale solar passing something of a milestone in 2016.

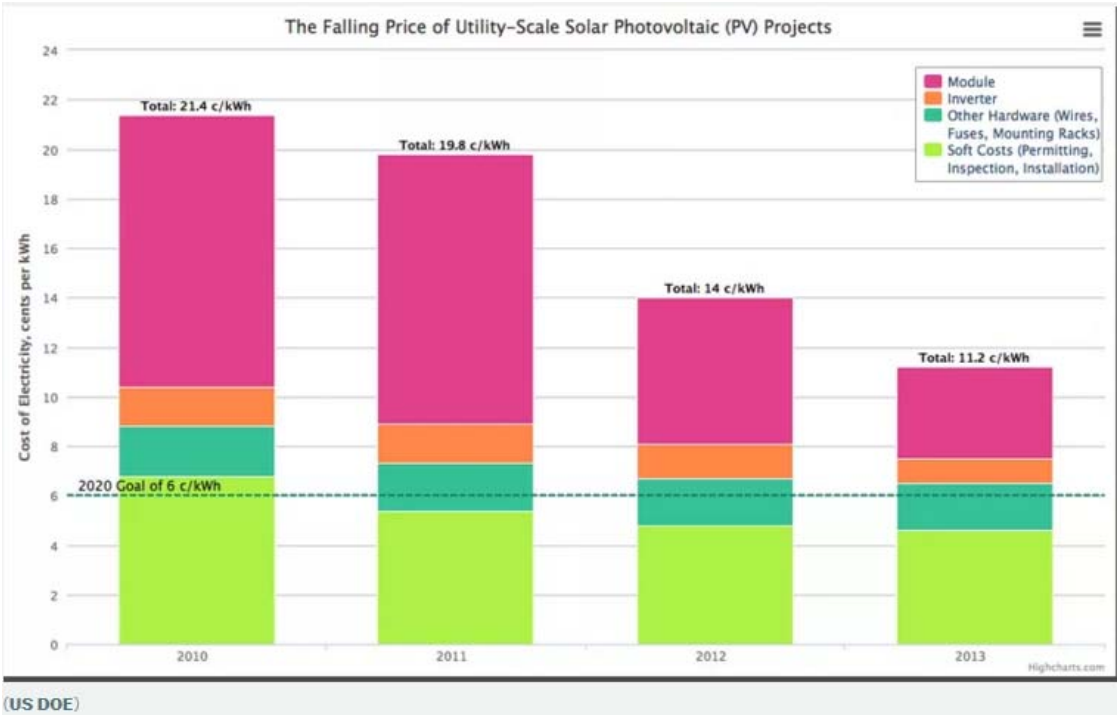
For years, the growth of big solar was driven by state-level renewable energy mandates; utilities had to build these plants. This coming year, GTM expects more than half the growth in big solar to come outside those mandates.

In other words, utilities are beginning to voluntarily opt for big solar.

Why is that? Utility solar is being boosted by three strengths — and it's making progress against its one weakness.

Strength #1: Price

The total installed cost of big solar, per watt of capacity, is rapidly getting cheaper:



(US DOE)

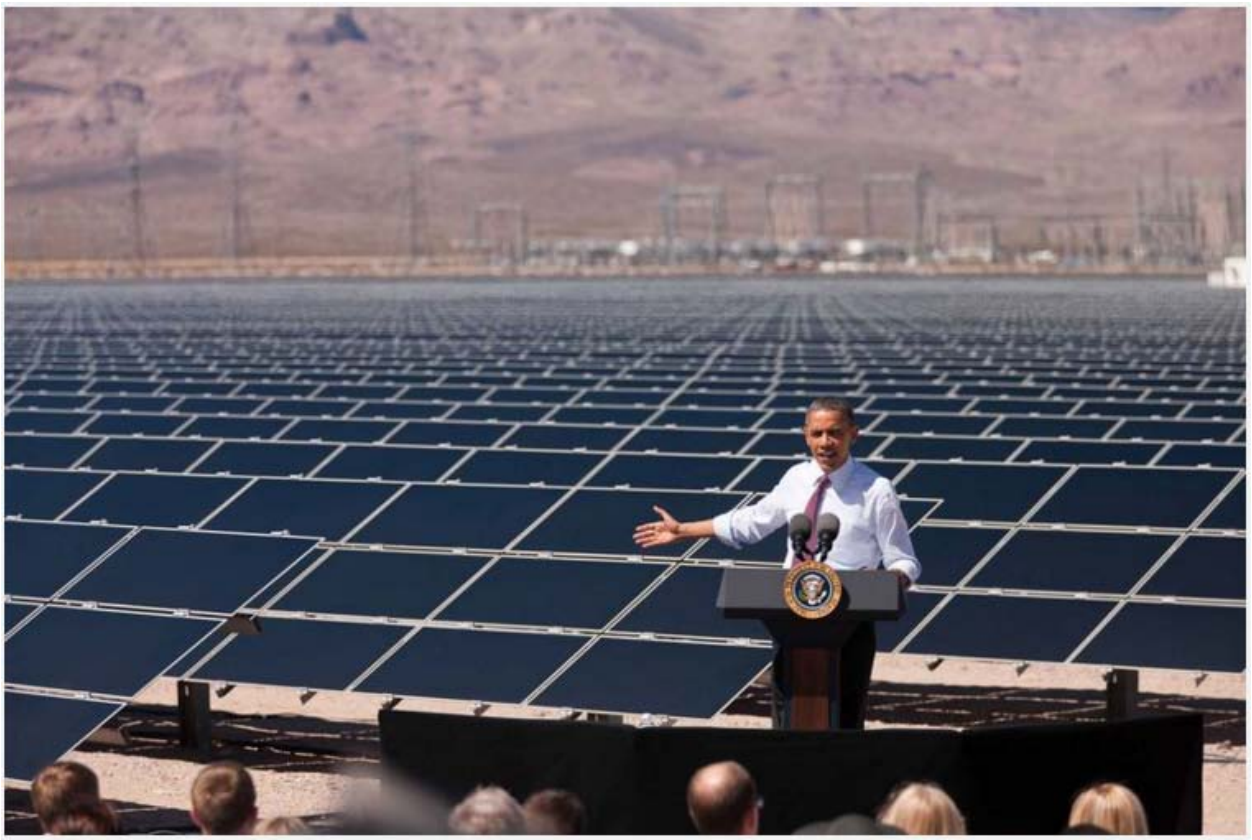
As you can see, most of the cost drop has been due to the falling cost of solar modules — and panels are only expected to get cheaper.

According to this 2015 Lawrence Berkeley National Laboratory report (the latest comprehensive data I could find), the installed cost of big solar has fallen 50 percent since 2009, from $6.30/W to around $3.10/W at the end of 2014.

Some projects were down as low as $2/W when LBNL released its report. And these days, solar projects in North Carolina and Georgia regularly report costs as low as $1.15/W.

The stretch goal of the Department of Energy's 2011 Sunshot Initiative is to drive installation costs down to $1/W, which it says "would make solar without additional subsidies competitive with the wholesale rate of electricity, nearly everywhere in the US."

The CEO of First Solar recently said that "by 2017, we'll be under $1.00 per watt fully installed on a tracker in the western United States." (More on trackers later.) It appears costs are falling faster than almost anyone predicted.



(**Official White House Photo by Lawrence Jackson**)
Obama, gesticulating at the Copper Mountain Solar 1 Facility in Boulder City, Nevada.

Strength #2: Predictability

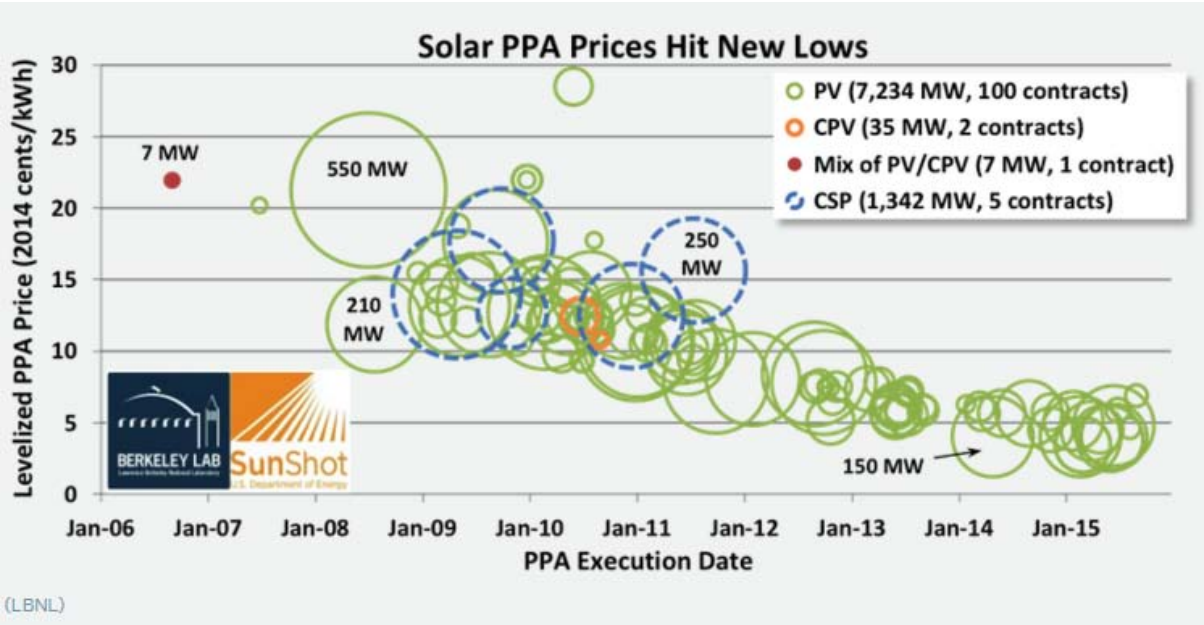
The thing about solar power is you know exactly how much it's going to cost, forever. (At least for the life of a solar PV installation.)

Coal and natural gas have highly volatile prices. The price of sunlight is zero. There is no fuel cost.

That means the costs of the produced electricity can be calculated in advance, based on capital and operation and maintenance costs. It's more like building infrastructure than like operating a commodity-based asset.

This allows solar developers to offer utilities extremely stable, long-term power purchase agreements, or PPAs. For a utility in these turbulent times, knowing exactly how much power is going to cost for the next 20 (or more) years is a great comfort. That kind of risk hedging is worth money.

Here's a plot of PPA prices over the past several years:



This graph makes two things clear. First, almost all new big solar plants in the past few years are PV. And second, power prices are getting extremely low, now regularly falling below $0.05/kWh, or $50/MWh, sometimes as low as $40/MWh.

The city of Palo Alto, California, is on the verge of signing a 25-year solar PPA at about $37/MWh, which could well be the cheapest PPA ever signed for solar. The city has the option to extend the PPA to 40 years, which might also make it the longest PPA ever signed.

Imagine the peace of mind that comes with knowing you've locked in extremely cheap wholesale electricity, at $0.037/kWh, for 40 years. With a stroke, a big source of volatility is eliminated from the budget.

(Photo by Marcus Yam/Los Angeles Times via Getty Images)
Pretty reliable.

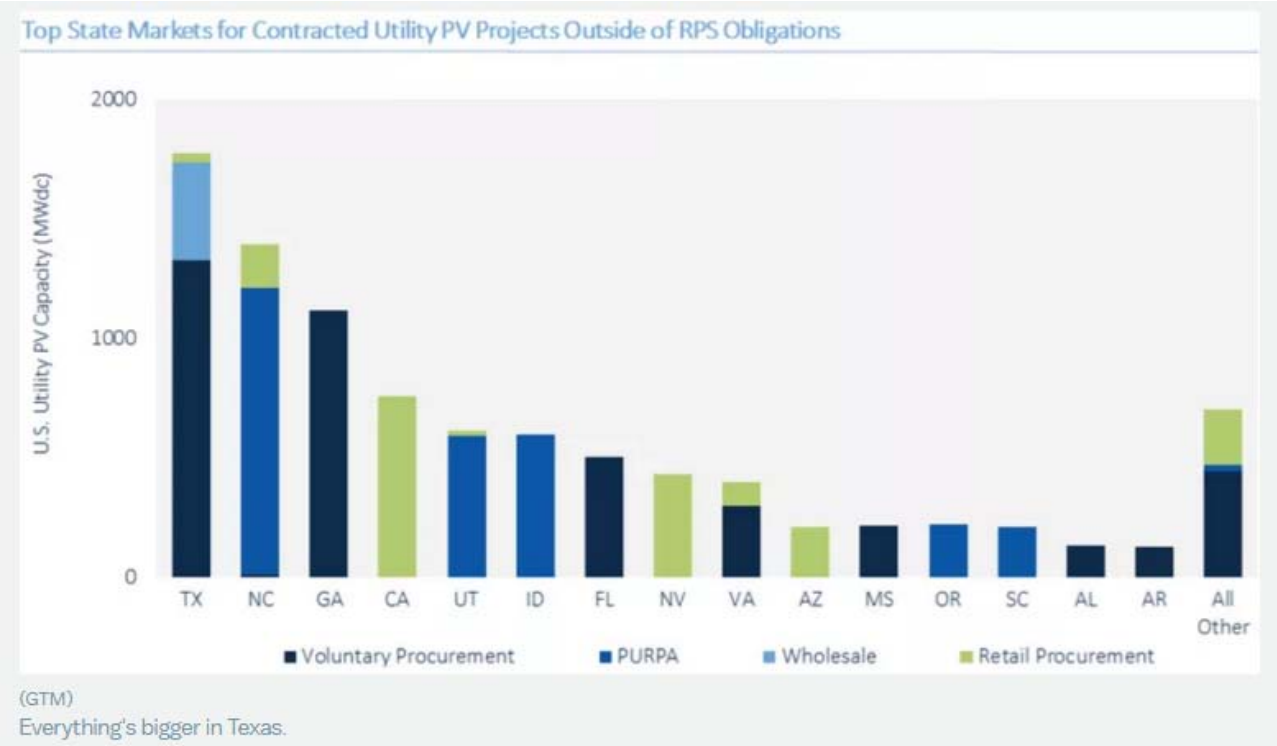
One reason big solar PPAs are so cheap is that the federal solar investment tax credit (the ITC) is still in effect and was recently extended, set to phase out over five years. That gives the industry a clear runway to grow past the need for subsidies.

And it's already looking past them. First Solar's CEO also said, "I fully believe that within 10 years we'll be talking about low-3-cent power on a peak basis," without subsidies. That would make big solar the cheapest source of power, period.

Strength #3: More states have plants

The market for big solar used to be fairly concentrated in a few states, particularly states where it was required by mandates. But now that growth is expanding outside those mandates, the industry is starting to spread out.

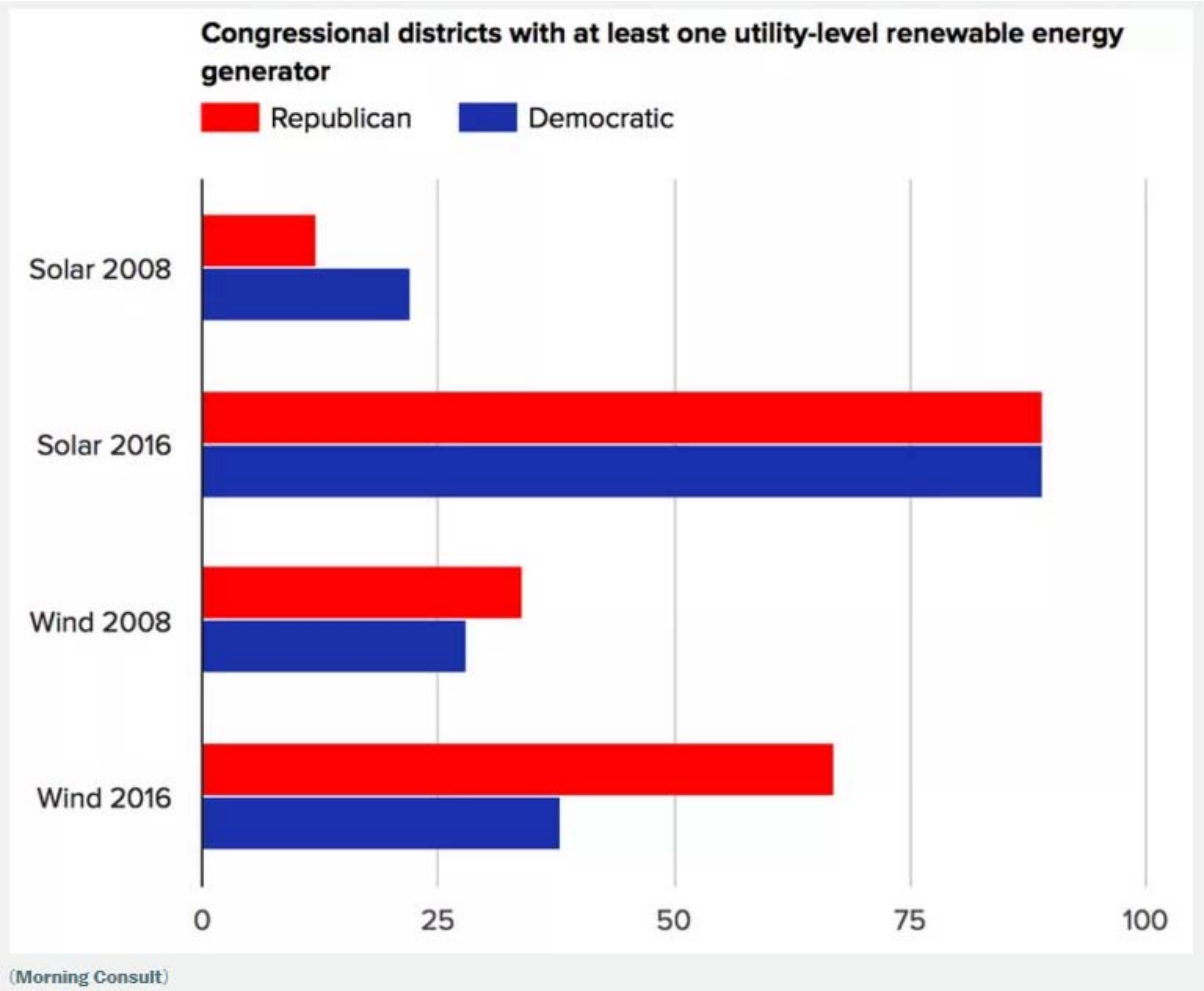
"To date," writes GTM, "19 state markets have at least 50 megawatts of non-RPS utility-scale solar in development."



Why is this geographic spread a strength? Politics.

The more states where large-scale solar is a business interest, the more respect and assistance it will get from state politicians.

As Jack Fitzpatrick notes in Morning Consult, "The number of U.S. House Republicans representing districts where there are utility-scale solar facilities increased from a measly 12 in 2008 to 88 in 2016."



There are now as many Republicans as Democrats with solar power plants in their districts (and more Republicans with wind farms). The reason red districts are catching up (and pulling ahead) so fast is that they are more likely to be rural and have open, cheap land to attract developers. (Rural North Carolina, for instance, is going nuts over solar, in all kinds of ways.)

As Fitzpatrick says, this geographic spread helps explain why (to everyone's surprise) the renewable energy tax credits were extended last year. Despite the GOP's notional opposition to energy subsidies, and a state-level fight against solar funded by the Koch brothers and carried out by state-level organizations like the American Legislative Exchange Council, local and state-level Republicans welcome the economic benefits that renewable energy brings.

This is especially true for big solar, which dodges many of the thorny issues being raised by customer-owned rooftop solar.

Weakness: capacity factor

Here's an important distinction to understand: The capacity of a power plant refers to how much power it is theoretically capable of producing if it generated maximum output, around the clock. The capacity factor (CF) of a power plant refers to how often it actually runs, producing power.

Here's a hypothetical example. Say you build two power plants, one nuclear, one solar. They both have 1 GW of capacity, which means if they both produced maximum output, they would generate a GWh in an hour.

But they don't always produce maximum output, or run year-round.

(Shutterstock)
Nuclear, always runnin'.

Averaged over time, the nuclear plant's output is about 90 percent of its maximum capability, i.e., has a CF of 90 percent. It will generate 900 MWh (90 percent of its capacity) in an average hour.

The solar plant only "runs" when the sun is shining and only reaches maximum output at the sun's peak. Averaged over time, its output is about 20 percent of its capacity; it has a CF of 20 percent. It will generate 200 MWh (20 percent of its capacity) in an average hour.

In other words, to get the same amount of MWh, you need to build four to five times as much solar capacity as nuclear capacity.

So how are big solar plants doing in terms of CF? Let's put it in context.

Based on EIA data (thanks to Jesse Jenkins for sorting through it), the current CF of the US nuclear fleet is around 88 percent — nuclear plants are typically expensive and unwieldy to shut down and restart, so they are almost always running, except when they are offline for maintenance.

The current CF of the US coal fleet is around 55 percent. Individual coal plants are capable of much higher, but old coal plants are being idled more and more often.

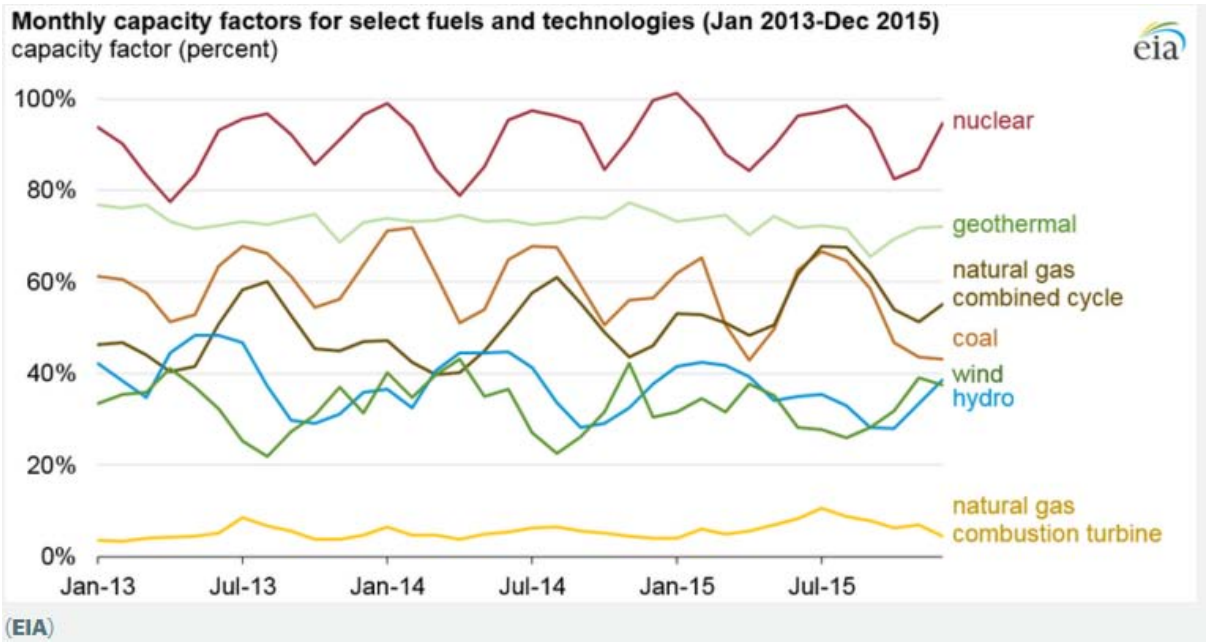
The US wind fleet averages out at about 33 percent CF, where it's been more or less stuck for years. Turbines are getting taller, which improves CF, but they're being installed in more and more suboptimal sites, which lower CF; for now, it's balancing out.

(Shutterstock)
Wind, sometimes runnin'.

The natural gas fleet is at about 26 percent CF. Note that this lumps together combined-cycle plants, which tend to have CFs up toward 57 percent, and open-cycle plants that are used primarily for "peaking," which have CFs down around 7 percent.

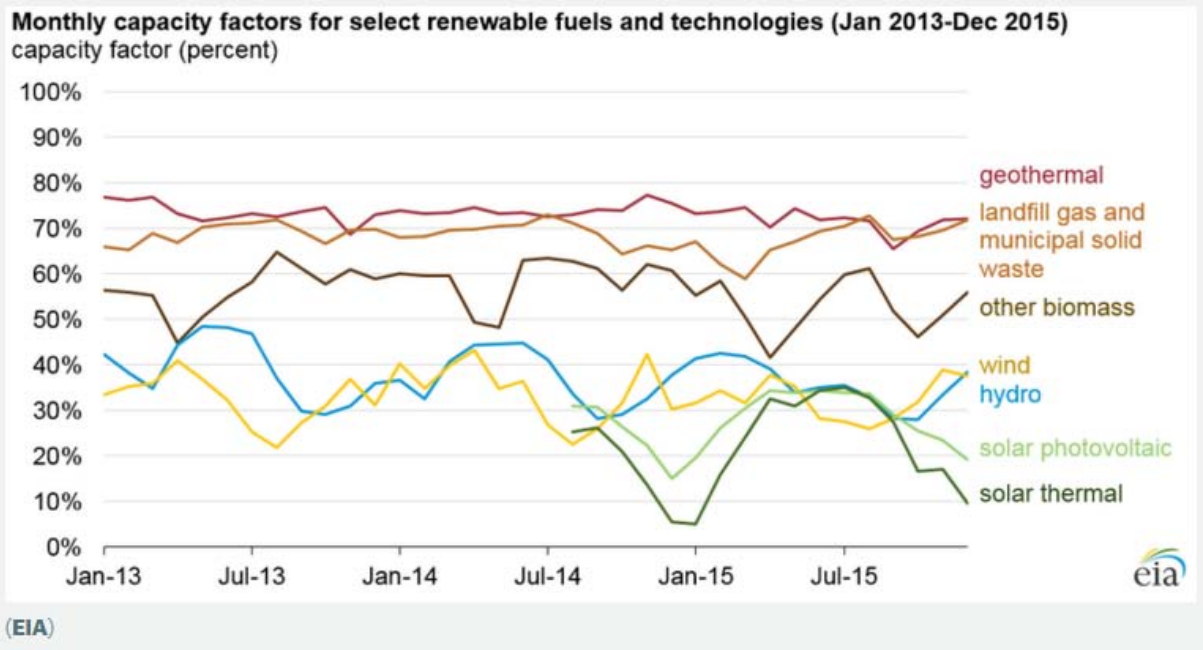
The average CF of all utility-scale solar (including PV and CSP) is about 19 percent.

Here's an EIA graph showing capacity factors over time:



(EIA)

And here's another that focuses on renewable energy capacity factors:



(EIA)

Not exactly the upward sloping lines one might like.

A new report from LBNL takes a deep dive into the CFs of new utility-scale solar PV plants (installed in 2014). The report finds that the average CF across all new PV plants is 27.5 percent, but the range among individual projects is crazy wide, from 14.8 to 34.9 percent. (Though they did find that most solar PV plants produce roughly what investors forecast.)

The high end of that range, flirting with 35 percent, is really impressive — way better than what was possible even a few years ago.

What makes for higher CFs for solar PV plants? The intensity of sunlight is the biggest factor, obviously. Beyond that, trackers, which change the orientation of panels throughout the day to follow the sun, are a big boost. Keeping the panels clean is important. And "inverter load" is important, though I won't bore you by explaining it.

Long story short, solar PV plants are performing predictably and improving their capacity factors over time.

(Photo by Brian Lawdermilk/NASCAR via Getty Images)
Solar CFs are nothing to be sheepish about.

Big solar is about to get unstoppable

Big solar used to be almost entirely driven by policy, mainly state renewable energy standards and federal tax credits. It has all but outgrown the first and will outgrow the latter over the next five years.

It's about to stand on its own two feet, outcompeting even rivals that are allowed to dump carbon emissions into the atmosphere for free. It won't be long before the discussion about environmental benefits is moot — utilities will demand solar because it's the cheapest power available.

(The article is derived from Kathmandu Post published on 19th March, 2016 and the link is available at: ***www.vox.com/2016/3/10/11192022/big-solar-boom-times*** *).*

When Swachh Bharat met Digital India: Now solar-powered trash cans to send alerts when full

Aman Sharma

The Swachh Bharat campaign could soon get a digital accessory. The Centre may use its Digital India project in conjunction with the Swachh Bharat Abhiyan to have solar-powered trash cans like in many US cities which send alerts to sanitation crew once they are full. If this happens, the question on when to empty trash cans will not remain a guessing game.

Such a solution, which combines solar energy and information technology was launched in the US and 47 other countries by a firm named Big Belly, which was named the 'Top Smart City' application in the 2015 Internet of Things Awards. Waste management is an integral part of India's biggest cleanliness campaign, Swachh Bharat, but the reality is stinking and open dustbins compounded by lack of a smart waste management solution for efficient sorting of waste or identifying recyclable disposed products.

The government has asked for citizens' suggestions to come up with such a waste management solution.
The idea being floated is to use Internet of Things (IoT) — an integration of small devices linked by a web-based system which can send signals through sensors and interact with an online system.

Basically, the government plans a solution for installing such devices on specially-designed trash cans in major urban centres across the country which will be solar-powered to emit signals to the online system once full so that sanitation crews are dispatched to the spot. Big Belly has installed such fully-covered and solar-powered trash receptacles and trash compactors in many cities abroad like New York, Boston, Chicago, Amsterdam, Hamburg and Stockholm.

"Waste management is an important requirement for ecologically sustainable development. Efficient sorting of waste is a major issue in today's society," the government has said in a post on the prime minister's MyGov portal asking for citizen suggestions for such a project. "To assist the Swachh Bharat Abhiyan initiative, projects may be set up to create products which are solar-powered trash receptacle and trash compactor that alerts sanitation crews of municipal authorities, when it is full," the post under Digital India project says, asking for atechnology-based solution to ensure wastes are properly disposed and collected.

"We would like to welcome your ideas on how a smart waste management system using IoT can be implemented in order to achieve the target of Swachh Bharat Abhiyan," the government has said.

The trash cans installed by Big Belly abroad communicate with a cloud-based web application for constant updates on their waste levels - they come with an attached bin for recyclable waste. The Indian government is also concerned over an e-waste management solution. "E-Waste (electrical and electronic devices) is of immediate and long term concern as the industry is unregulated and recycling can lead to major environmental degradation posing a major threat to human health," the government post says.

The Prime Minister had launched the Swachh Bharat Abhiyan on October 2, 2014 on the eve of Gandhi Jayanti.

(The article is derived from The Times of India published on 18th March, 2016. The link is available at: ***timesofindia.indiatimes.com/india/When-Swachh-Bharat-met-Digital-India-Now-solar-powered-trash-cans-to-send-alerts-when-full/articleshow/51451754.cms***).

Welcoming new EDC member

Established in 2009, High Himalaya Hydro Construction Pvt. Ltd. has already carved a niche in the hydro construction sector of Nepal. The aim of the company is to meet Nepals construction demand in the field of hydropower & infrastructure works. The company has been able to contribute significantly in nation building by construction of hydropower projects using modern and highly efficient resources with a sustainable approach.

High Himalaya Hydro Construction Pvt. Ltd. (3HC) offers complete design and construction services for Hydropower, Tunnelling, Transmission Line, Irrigation, Water and Wastewater Management, Ropeway/Cable Car, Road and Bridges, Building and Fabrication Works.

List of EDC members

S. No.	Name of the Organization	Organization logo
1.	Nepal Electricity Authority	
2.	Alternative Energy Promotion Center	
3.	Chilime Hydropower Company Ltd.	
4.	Madhya Bhotekoshi Jalvidyut Company Ltd.	
5.	Rasuwagadhi Hydropower Company Ltd.	
6.	Sanjen Jalavidhyut Co. Ltd.	

S. No.	Name of the Organization	Organization logo
7.	Butwal Power Company Ltd.	
8.	Hydroelecticity Investment and Development Company Ltd.	
9.	IDS Energy Pvt. Ltd.	
10.	Arun Valley Hydropower Development Co. Ltd	
11.	Dantakali Hydropower Pvt. Ltd.	
12.	Reliable Hydropower Pvt. Ltd.	
13.	Himalayan Infrastructure Fund	
14.	Sanvi Energy Pvt. Ltd.	
15.	Dibyashwari Hydropower Ltd.	
16.	Shiva Shree Hydropower Co. Ltd	
17.	Chhyandi Hydropower Ltd	
18.	Saral Urja Nepal	
19.	Rara Hydropower Development Co. P. Ltd	

S. No	Name of the Organization	Organization logo
20.	Wind Power Nepal	
21.	Gham Power Pvt. Ltd.	
22.	Lotus Energy Pvt. Ltd.	
23.	Sun Farmer Nepal Pvt. Ltd	

S. No.	Name of the Organization	Organization logo
24.	CEDB Hydro Fund	
25.	Nabil Bank Limited	
26.	NMB Bank Limited	
27.	Global IME Bank Limited	
28.	Prime Commercial Bank Ltd.	
29.	Century Bank Limited	

S. No	Name of the Organization	Organization logo
30.	Transweld Pvt. Ltd.	
31.	TSN Energy Pvt. Ltd.	
32.	Waiba Infratech Pvt. Ltd.	
33.	North Hydro & Engineering Pvt. Ltd	
34.	Nepal Hydro & Electric Ltd.	

S.No.	Name of the Organization	Organization logo
35.	Nepal Hydropower Association	
36.	National Association of Community Electricity Users Nepal	
37.	Dudhkoshi Power Pvt. Co. Ltd	
38.	ICTC Energy Pvt. Ltd	
39	High Himalayan Hydro Construction Pvt. Ltd	

ENERGY DEVELOPMENT COUNCIL

Energy Development Council

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