Linking Heat and Electricity Systems: Co-generation and District Heating and Cooling Solutions for a Clean Energy Future

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Webinar Panelists

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Sean — Hello everyone. I'm Sean Esterly with the National Renewable Energy Lab and welcome to today's webinar, which is being hosted by the Clean Energy Solutions Center and also the Clean Energy Agency. Today's webinar we'll be discussing Linking Heat and Electricity Systems, Co-generation d and District Heating and Cooling Solutions for a Clean Energy future. One important not of mention before we begin our presentation is that the Clean Energy Solutions Center does not endorse or recommend any products or services.

Information provided in this webinar is featured in the Solutions Center library, which is one of many resources best practices used and selected, by technical experts. For today's webinar, you have two options for your audience; you may either listen over your computer or your telephone. If you do choose to listen through your computer, please select the mic and features option in the audio pane display. That will help eliminate any feedback or echo.

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If you like to ask a question at any point during the webinar, which we encourage all attendees to do, you can simply type your question in the question pane, which is also in the go to webinar box, that will be submitted to the panelists, and I for the question and answer session letter in today's broadcast. If you have trouble viewing the webinar through the webinar portal we will be putting pdf copies on cleansolutionscenter.org/training and we'll also post an audio recording through that site within about a week of today's webinar.

In addition we will be adding the webinar to Clean Energy Solution YouTube channel where you'll find other informative webinars as well as video interviews with thought leaders on Clean Energy policy topic, now today's webinar agenda is centered around today's guest panelists; Didier Houssin, Jorge Javier Mandon Castro, Per Alex Sorenson, and Araceli Fernandez Palez and these expert panelists have been asked to joined us today to discuss the finding of new publication linking heat and electricity systems, co-generation and district heating and cooling systems for a clean energy future and the publication analyzes co-generation and district heating and cooling systems to identify barriers and other employment of these efficient systems and practical solutions to address logical, technical, economic, regulatory and strength.

Before the speakers begin their presentation, I'll provide a short informative overview of the Clean Energy Solutions Center initiative. Then following the presentation we'll have a question and answer session where panelist will address any question by you the audience. And then, we'll have some closing remarks and a brief survey. This slide provides a bit of background on how the Solutions Center came to be formed and the Solutions Center is an initiative of The Clean Energy Ministerial and it was launched in April 2011 it is Led by Australia, United States and other CEM partners.

That comes with this unique partnership includes supportive developing companies on policies relating to energy access, no cost energy and peer to peer training tools such as this webinar you're attending today. The four primary goals for the Solutions Center is serve as a clearinghouse of clean energy policy resources. Second is share policy best practices, data, and analysis tools specific to clean energy tools and programs. Thirdly is to deliver dynamic services that enable expert assistance, learning and peer to peer sharing of experiences. And then lastly the centers focus dialogue on policy issues and innovation around the globe.

Our primary audience is policy makers from governments and technical organizations from all countries but then we also strive to engage in

private sector NGO civil society. Now one of the market features that the Solutions Center is proud to offer is our policy assistance which is known as ask an expert and this ask an expert service has established a broad team of over thirty experts from around the globe and all five remote device analysis to all countries at no cost and for utility policies we're very pleased to have Rodney Allen a research director with the regulatory research project serving as our expert.

So if you have any policy assistance in regulatory utility policy or any other clean energy policy please use this service that is provided to you free of charge and to request assistance you may submit your request by registering through our ask an expert feature at cleanenergysolutions.org/expert. We also ask that you spread the word to your network and organizations. And so in summary we encourage you to explore and take advantage of the Solutions Center resources and services including the expert policy assistance, the database of clean energy policy and resources, and subscribe to our newsletter and participate in webinars like this.

Now I would like to provide introductions for today's distinguished panelists and our first speaker today will be Didier Houssin who is the director of Sustainable Energy Policy and Technologies at the International Agency. And our second speaker will be Jorge Javier Manon Castro who is the deputy Director of Benchmark and Indicant Permex and our third speaker today will be Per Alex Sorenson who is head of the department of strategy, planning of plan energy. Our final speaker will be Araceli Fernandez Pales who is a technology analyst at the international energy agency and so now with those introductions please welcome with me Didier Houssin to the webinar.

Dider Okay thank you very much and good morning or afternoon, everyone and I will like to welcome the participants on today as well as the speakers who will present in the discussion later. With energy systems becoming increasingly complex, the need in addition to technology networks is becoming more important. Co-generation and efficient district cooling solution can support and sustain energy solution by providing electrical length. Their doing thermal energy while at the same time delivering efficiency benefits and positive impact on target and security targets. Worldwide in 2011 co-generation plans had an average conversion efficiency that was more than one and five times more than that of conventional power plants.

DHC networks based on thermal heat recovered waste, heat and energy sources can be five to ten times more efficient than traditional electricity and equipment. Yet this is proven aptitude expect the implementation in some countries today although the climate has been quite limited. Some of the reasons behind the slow progress in the deployment and organizations of these technologies in terms of local energy market traditions. Lack of ability policy oppose to planning heating infrastructure.

We created the PHPV collaborating in 2007. Through this platform, the IA works with the government industry to promote cost effective deployment and is efficiency via technology. In 2013 we have also closely collaborate with the clean energy ministerial PHPV working group. We are releasing today the latest IA, PHPV collaborating publication, linking heat and electricity systems. These publications analyzes successful inventories of district heating and cooling systems to identify the areas of further deployment of these technologies and to outline particular solution to address technological and economical regulatory restraints. The IA works closely with energy partners to develop the companion case studies for co-generation in Mexico, in Spain, and Scotland for efficient heating and cooling systems making mark of friends in Saudi Arabia.

The reports analyzes policy recommendations in three major areas, supports a selection of co-generation district heating. And district heating and cooling technologies with enforcement of technology equability co-generation and DHT optimization of co-generation and DHT with an integrated sustainable energy system. And the three major areas the report highlights for long-term statement and environment that incentivizes energy efficiencies as a critical driver for the technologies as well as strategic planning to try to optimize the use of local energy resources.

Let me now conclude the introduction by thanking our speakers that have commuted to the work and will begin some of the case studies their self and the IT team. Thank you very much.

Jorge

Hi, my name is Jorge. I am from Permex and I am here to talk to you about co-generation in Permex. I'm just trying to show the bigger screen. Okay here we are. This is our work that made in Cogenera Mexico. That is the society promoting co-generation in Mexico and also in Permex that we're introducing the technology we're into. Just an overview, we're using before co-generation a steam generation which was a set low efficiency rated so by 2009 general management decided to implement co-generation in Permex south of the country is facility that handles natural gas and their decision was to build their first co generational plan to provide energy and to almost 200 sites within Permex.

So I just have to know is that we have the co-generation system providing 50 pounds per hour of steam to the plan and generating over 277 megawatts of electric power. Since then this site only based on terry tumedas have a lot of extra energy going to the great. This energy is being taken by various sites within Permex. Talking about efficiency or data indicates we're over 80 percent efficiency taking only of electric energy using nexergy we are around 51 percent efficiency and as I said before our operation agency previously was around 28 percent. So the efficiency gained is enormous and we'll also have shipped electric energy or power around sites.

Permex is only providing wire and fuel to third part, and pretty soon the steam and the power for us. Of course, we have to pay back this service but still we're making a profit. Of the profit, the reusing cost. The main driver of co-generation was the regulatory and let's says peoples that they are given us to the year 2006 where they recognize three types of co-generation. The very first is the generation of electricity together with steam, secondary thermal energy. This is where we're standing. We are generating steam and electricity. But still there are other types being allowed by the regulator.

The second we have an indirect generation of electricity for waste energy. Let's say like pressure units that we're not using the hot gasses. I think that is not yet quite developed in Mexico but it's already starting. It is direct or indirect production of energy by using fuels producing the processes and here we can see some of the digesters from wastewater plants and also from other kind of energies. Before co-generation, we were already sending some energy to the grids and lower efficiency of course and we were giving around 60 mega to 86 sites. This 60 megas were remaining eleven generation sites and the average efficiency of this site was around 28 percent. And we were buying to the grid. The national owned electricity company, as you can see anywhere from 99 to 180 megawatts. This is only due to the demand but we were buying too much energy from them. By the end of 2012, most of these 11 sites ceased their operation and since none of them fulfilled the conditions required for efficiency operations and we started a whole project in Permex by April 2013.

Here you can see the change in the energy we're providing with these 11 sites within the first few months that was still around 64 megawatts and we reach an aspiration of 650 megawatts being generated by co-generation planning of Permex. We invited some energy to take on electricity company but is quite small amount. We're taking advantage of capacities selling of Permex still. We want to reduce more business of buying energy to the electric company, by increasing the number of remote consumption centers.

The benefits of efficient co-generation in Mexico are mainly the small commission cost the regulator recognizes to us and since we are providing high efficiency to the system and just as an example because we are having sites depending on the level of remote sites we're around 1 to 2 pesos of kilowatt-hour. With the project and low commission cost we are receiving as a benefit we are getting sites anywhere between .8 to .9 that's per kilowatt hour and the prices and the cost for us and also let me point out we have high demand on the energy level of course.

But still we have some consumption in the medium low levels and the difference is quite differentiated when we are reaching peak hours in Mexico seems to be alike in some of the countries between Mexico 9pm and 12pm. It changes depending on the season but we are talking about

nighttime. There's another benefit that the regulatory which is the capacity recognition. It seems like now that the national company is charging every user for capacity as well as the actual energy flowing, we are getting rid of the cost not entirely because we must have some energy set back up but we are getting rid of these cause of capacity. And these two benefits are providing us with cost efficient to us because efficiency by itself won't give us the right direction we were in getting back our money only by efficiency.

So we're taking advantage of this regulation benefits and just to give you an idea the corporation plan is taking about 80 million a day for gas we are generating 280 megawatts on average rush using the 64 percent of natural gas. The rest is used to generate steam and we are sending the energy to several sites that here listed five of them and also we are getting some energy to the bank. Of course, this bank is energy efficiency. We are giving the electric opportunity for them to sell and we get it back whenever we need it or we can sell it back at the end of the month for the price is right.

We'll talk about his price later. Since we are different the cost of this co-generation primarily gas is charging the rest of the subsidy areas for the natural gas and the cost is being translated to CFE that are quite low with the rest of the comparison costs. And just to make sure the right incentives are in place there are some penalties that came and applied to the party if they don't give us the energy their pay compromise it. And still when we have more than a year operating. These penalties have happened twice I believe for my officers up to today. The contract is operated well and we are getting a little more energy than we are expecting.

To give you an idea of this estimated savings in 2013, a little reminder the plant started back in April and this figure is in pesos we're still just to let you know how the main benefits reference are getting more than half of these benefits because they have more energy to the grid and that's an incentive to them to start buying this energy. If we receive these numbers by concept, we have the issue to fly and energy at lower efficiency that the efficiency was lower at home and the previous lock of generation that we are retiring generate also some savings.

But the night savings comes from us buying from the company and the steam generates a low value because the steam was already priced for us but it's giving us most of the benefits. We can see the subsidiary are has low savings. This is because they can lead our energy from this project and also they have some competitive cost in generating energy so for them the benefits are not that much. If we add the paying we have been having in September to December 2013 we can see the savings and we are adding another column that's CFE but what this company buys from us meet this is above or generating cost or below it.

We can see that our generation cost in August we didn't have any energy being sold to the CFE. From September to December, the price was low because we had an emergency in the system and the system had to operate mainly on water so most fuel efficient or high cost generation was stuck. And we were generating mainly on water so even then the bank the red columns was the value of the bank it was on the positive but steady a lot of liability when the CFE rises reduce the energy we are giving to the mex or we are selling to them.

We are increasing our number of sites getting these benefits, below this graph you can see a table of the numbers in us dollars for better recognition of what a million pesos mean. But as you see the numbers in US dollars, it gives you more sense. With this number, we are expecting to have more payout rate of five years maybe less. We can couple as many sites as we can we don't know yet it depends a lot on what are the actual CFE rates and of course the price of the natural gas because we are increasing efficiency but if the natural gas goes up the benefits go down.

For Permex there was a benefit for natural gas balance we were using before only for steam and energy purposes almost 77 million and now with the plan of Permex we are 50 million a day. Permex gas is saving almost sixteen million, petrochemical is saving almost 19 million and some other small amounts between the production under final choice, and the next saving is around 29 million. This means we are saving around 380 million tons of CO2 per year and some other number values as high as 460. We are being conservative and we relieve 380 we are saving to the system there are two numbers sorry. We're saving 430 million tons a year and if we are comparing the rest of the energy we are not saving efficiency of 41 percent 380 tons as I said before.

This means and I'm not an expert, this items but given the numbers in Mexico so official data with this project it will be for the environment will be the same as 63 thousand cars, this means a whole unity, small cities like Zacatecas or Guadalupe in terms of the whole country we are only providing that relief of 1.5 of the car sale nationwide right now. If we see it from the standpoint of the trees and forestation that are the amounts of 107,000 acres of trees and plants by year, this is only by Permex. We are projecting that Permex has the potential to generate 3.5 kilowatts of co-generation and follow of this big up but for this, we need to sell the excess energy to CFE. The Permex consumes around 1 kilowatts the selling to CFE will be quite big. So the rest of the potential but still we have two projects on the way it's not yet developed because the law changes in Mexico is not clear on the benefits it's giving co-generation to Permex. We'll stay in place or diminish not increase clear now so the other projects to develop co-generation are in a pulse for two or three months writing for this to lost cost and when they lost cost we can might be able to say if we are going to be able to pile up the potential or just a part of it.

Just to summarize Permex benefits for co-generation the third party generating this energies are also having benefits because they're having a revamped area they are increasing the capacity of their plan and starting a new generator and they are going to own the energy they are delivering the energy to other parties and for them it's going to be a good business process also. We are going to develop some more small projects two or three and then we are going to be in developed. There is my email. You can contact me anytime. And this will conclude my presentation. Thank you.

Sean Great thank you Jorge, now we will move along to Per Alex Sorenson and just want to remind the two remaining presenters to try to keep your presentation between ten and fifteen minutes. Alright thank and Alex, to you now.

Per Alex Thank you very much, I will present Marstal District Heating it's based on an island in Denmark and they have 100 percent Renewable District Energy System with last year's summit. This is just one of the employers for all of my employees its cutting grass and I come from Plan Energi it's an energy company. We have worked with renewable energy for seven years and all kinds of renewable are mixed. Marstal district heating is in Denmark like already in 9000 of solar collectors in 2002 they got another 8000 meters of solar collectors.

And 10000 cubic meters water storage. The small heat pump so they have been on us for the next project. This was how it looked in 2010 you can see that they have 18000 meters of solar collectors and you can see the wide spread in the background. They were designing a new project and wanted it to go from 35 percent up to 50 percent to go for the rest so they can find the plant and they will extend the solar collector to 15000 and 75000 cubic meters of getting started with water storage and then reduce compressor heat pump, fortunately which organic ranging inside of it. Pride support and they got it in 2010 the acceptance and in 2011, the billing started so next.

This is the principle diagram of the new part of the program. On the left, you can see the 50000 square meters and water from solar collectors can be delivered as forward temperature from the district heating customers or to the storage. The storage you can see at the bottom right. If it's summer maybe only one fifth part will go to the customers and the four fifths parts of the eight percent will go the storage collecting the solar. Then that's a heat pump so when we reach wintertime and the temperature is not high enough to use the storage directly as a forward temperature then we can use the storage as a heat source for the heat pump.

So the size of the heat pump reaches the heater for district heating for forward temperature. It heats up to forty degrees and in the forward temperature, it heats up to eighty degrees. On the cold side, it cools down the storage to ten degrees. And that will be released in the beginning of

February and then the solar starts to heat up the storage and in winter period run and also runs in organic side of energy process. Next, I will show you some pictures from the building process. This is the beginning of the process. Solely we dig a hole in the ground and used the earth to digging as banks so that we don't have to add a rest to removers and in the background, you can see the grounds.

Sean Alex I think you actually muted yourself, its showing you as muted.

Per Alex Sorry, has that been for a long time?

Sean For the last fifteen seconds I believe.

Per Alex Yeah okay. So this picture from winter 2011, 12 and the water is being filled in two to three months, so next. And this is summer 2012 and the picture is hard to see that's a white area in the middle and some meters have been implemented. So that's how it looks today, next. Now this being a monitoring program, the goal is to design production of the plan at the top you can see the actual production in different parts in 2013 and the solar collector is a little more than the sorbent and the last of the stories is calculated that production from the work ship parlor is a little less because it was not fully in function in 2013 so therefore it was not as expected.

As a main thing we can say, it works as it's designed. Next, this concept, Sunstore concept is made because in Denmark we have a lot of fluctuating electricity from wind power and it goes up to electricity power to wind power fifty percent average electricity production in 2020 and when it comes to that we want to learn a lot success you can say a lot of wind power and electricity areas and other areas. So when the windmills are running we use the heat pump to heat up the storage and when the windmills are not running we will use the power plant and use electricity to reduce the solar to heat up the storage. So that's the irony in Sunstore.

Next, so this idea is of course the topic of today, the integration between power and heat production where we can make the power to heating periods and also in other heating periods. This has other flexible possibilities we can provide with the heating cooling system or reduce and even the operation according to what's necessary in the region and also it's flexible in the area of solar, biomass energy, excess heat and you can use electricity also related to the resources in the area. The special work ship solar you can use in work ships also. So that's the idea of the concept, next. That's all and you can find more information.

Sean Great thank you so much Alex and now we'll be moving on to the last presentation today. Before we do, I just want to remind our audience if you have any questions on these presentations you can submit those questions in the pane in the go to webinar and with that let's turn it over to Araceli for her presentation.

Araceli Thank Sean, in this co-generation, district and cooling parts of the sustainable solution of course they can provide their hand in efficiency in terms of conversion train we compare the heat and electricity systems we can see that commercial electricity plans has an average commission in specific in 2011 plan they had 50 persons. The IA balance and so those benefits are theirs. Also, the district heating and cooling systems of course can provide efficient platforms in the energy efficient technologies or local energy sources. However, assisting areas prevent a stent of employment of these technologies.

In the co-generation share of the power production in 2011, we could see that there is a different level of co-generation in different countries. But if we look at an average since 1990 we can see that customer reviews from persons in 2000 so specific areas we find basically related to thermal and electricity planning also minor conditions rewarding energy efficiencies lacking energy policy. So this report in electricity systems the only thing we've followed is to develop case studies within approaches making the heating and cooling systems. Making a whole analysis lesson learned on experience from three different access of project development technology information perspective also from a financial analysis perspective in terms of business case studies, mechanisms like overcoming existing barriers.

The summary of the studies is included in the case study. **[inaudible] [00:48:44]** energy also in a different location, to the analysis they look at the factor with deployment of this type of projects for the technologies. From a project development perspective the technology stage so have to make sure the amount of energy was selected and how we finance them are given the existing market situation, given the assistance market operation perspective and business is identified in the areas. The development stage is where they taught in terms of technology selection phase the key factors we are to look at to understand very well the efficiency that we are trying to make so for instance trying to understand which capacity is required it's real difficult from the energy perspective or, from the energy efficiency measures have been considered or are they planning to be considered in the near future so in the end we can find capacity which one optimal point in the project lifetime. Also when we discussed about thermal things is really important to take the temperature and one validity in factors to remain sure that in the local framework we don't miss any opportunities to link these points but also from the district heating cooling perspective operating minimizing the temperature is important in the perspective of achieving energy savings but also allowing low rate available systems in the region to incorporate it in the system through organic sites really. Then of course we need to understand what is the relationship between heat and electricity demands overtime which is partial that we need to meet to be sure that we have technology to fulfill those requirements also these states to cause interconnection possibilities between demand and supply so make sure that we end up with a system that can bridge effectively with demands plus with generation points. It is

important to make sure at this stage the flexibility is valued so we select the right technology to add another value to the system later on economical terms.

From the energy perspective, it's very important to understand a lot of systems by reaching thermal and electricity systems can help by balancing the renewable levels by national greed adjusting the salvation as well. Playing with the turn out rates on the operational parameters, from the district heating and cooling systems perspective it is important to understand all the energy sources that are available and created in the system. Also all the other natural resources natural cooling for instance, implementing other technologies in the system can provide conditions of flexibility by reaching thermal energy.

An example that Per Alex was presenting before, how this, how integrated the system by balancing heating and electricity systems through CHP. Once technologies set up and the project is engineered we need to answer the question of how the system is going to be final. And of course CHP technologies and DHC networks are capital intensive because they require a significant equipment training that is why it's so difficult including economic terms of benefits in terms of energy efficiency and flexibility and in terms of high information levels that we make sure that all the possible technologies are integrated within the system. Of course, in this assessment having a long-term view can have a risk making it attractive.

When it comes to the operation the consistence of the energy and comes in rated energy systems. I know that energy systems when we come integrate in different technologies we'll have a lot of interaction between demand and supply that will come by directional and not unidirectional technologies business structures will have to be smart and be developed so that the energy efficiency and the flexibility benefits were identified and the technologies were able to divide can be realized with this small business structure so when it comes to policy and market conditions, how these strategies can help with overcoming these barriers and making sure that all of these benefits of project development can really be realized.

The first thing you can identify is the need to have a long term stability in regulatory framework which is relevant for the technology to make sure that the investments belong in investments portion I should say. Through the technology selection perspective one of the critical areas is to ensure that the energy market should be rewarding energy efficiency by making sure the energy market are reflective of the generation cost also it would be useful for the countries to benefit co generational energy efficiency and renewable policy. For instance, we need to make sure we use the renewable policy in the most efficient way. Also, a clear and streamline of connection can help co-generation to be proven of the value being able to work with energy green.

Also, extensive planning in terms of several infrastructures can help to identify energy efficient opportunities. To identify this luck of assistance can add added value to the international energy assistance but then in some conditions market conditions fail to reward efficiency and there is no clear option to have this technology to be seen in a different option in terms of financial and fiscal incentives to correct this imbalance of the market. Another interesting aspect of this is that in some countries they have cooling and networking existing which in huge investments to be modernize and make sure they reach good energy efficiency levels. They need to lock investments to furbish these huge investments, then from the systems operation perspective that I mentioned has a need to demonstrate to develop energy and flexibility in high-integrated complex systems we see another value in having co-generation in developers of this business models also with planners.

Also, to make sure lesson learned when applied the expansion systems or new systems so that these costs are minimized and the system can operate on additional energy sources that would be used from the luckily available resources. These are the very resources a part of the analysis of the different case studies and this is the summary of the market strategies that co-exist and included but of course I would be happy to answer any question now either if it's from the case studies or the technology of the case itself I would be happy to have that discussion. Thanks.

Sean Thank you Araceli and thank you to the rest of the panelist for the great presentations today and we will move on to the question and you can submit any questions to the question pane by typing those in and then I will present those to the panelist. I did receive a couple of questions. The first question I received was directed towards Alex. Alex the question asked if you could talk a little bit more about the information on the lessons learned from the Sunstore project. What worked and what did not work?

Per Alex Yes thank you for the question well in the, as it is now I think it works all of the parts as expected. But we had a lot of lessons learned during the process. Most the lessons were with the storage it's a very particular storage it was a lot of rain in the construction period and that caused a lot of troubles and after that we learned we had to treat the water like district heating water to prevent corrosion also there was a leakage in the storage despite of tests of the welding. There was leakage but it was found and tied into its possible to send down a diver in two three periods in the end of January the beginning of February so we did that we found the leakage and repaired. There are a lot of new things and it's a small district heating company so we're learning all the time. As overall, it's functioning as expected.

Sean Great thank you Alex and the next question that I have is for Araceli and it asks, can you please explain the business model selection model.

Araceli Thanks Sean. Yeah sure, on the business model selection the idea was really to understand which financial agreements were existing at the moment between generation, co-generation in energy. Since we understand that they are flexible enough to understand energy efficiency caused it, for instance, we find that most of these structures aren't flexible enough and they tend to be more financial. So they're going to allow energy users to have networks, so most of these flexibility energy that we identify in the systems cannot really realize in reality when it comes to an operation it's not reflected in agreement factor perspective.

For instance, nearly you will recall call back four, it's a case study it's demonstrated in the [inaudible] [01:01:36] and it's basically called district heating and cooling. The existence of this idea business model is really to provide a flexible network and uses of this network which gears back to the network and if they can help an extra piece with the competitive price. So of course the different users and generators which the network needs to satisfy energy efficiency level so with this kind of system you can have an added value of being more flexible or being more efficient because you can be rewarded with the efficient energy you reduce so it's this type of system that provides a difference to making this flexibility systems more attractive economically. Then there was a need for Australia to develop this type of structures more wisely so that we can share more lessons learned indeed.

Sean Thank you Araceli. Now we have another question for Alex. Alex the question is, is it realistic to assume the same sort of concept can be replicated in other countries in implication if so what do you think will be needed?

Per Alex Well as it is now, we have a very high taxes on natural gases in Denmark and that means we can implement such hybrid systems without support actually, but if we look at the neighbor countries in Germany for instance in the future Germany energy system this kind of concept would be very efficient and needed but to come to that there has to be more district heating and that's a discussion taking time and also I think maybe the structure for district heating is not so efficient as it is in Denmark where it consumes its own cooperatives. So I think the beginning of those kind of grants will be district heating and more district heating excess heat and then there will be an add on maybe with the heat pumps and solar and so the step will be district heating and combining power with excess heat. The next step will be maybe heat pumps and solar and the last storage and the storage doesn't have to be seasonal storage, it can also be storage like we have, all it is to make the systems flexible but I think the flexibility will be needed with the more fluctuating you will have.

Sean Great and Alex another question for you did you use nearby seawater for cooling purposes as well as to make the system more efficient?

Per Alex Well actually we don't do the cooling if we have a requirement for cooling we could use seawater but what we do is we use when we come to the winter we cannot empty the storage to less and certify forty degrees because of the return temperature. And then we use the rest as a heat source for the heat pump. We only need heat and not cooling action.

Araceli If I could jump in on this just to highlight that there is a district cooling case study in the report for parties and in that size they incorporate free cooling in 2009 and that implementation was increased by 34 persons and so there is some more information about participants point.

Sean Thank you Alex and Araceli, the next question is for Jorge and Jorge the question is, at what level could be the extended co-generation attendance. What is the potential for this source of energy?

Jorge Just like I said we have around 3.5 kilowatts of potential so it is ten times of what we already have. That's the potential we are taking about the5 fineries left because one is already being built with CFE conjunction it's a staple electrical company so there's five fineries remaining. Another two gas centers and two petrochemical centers, these have main, the gross of the capacity we also have efficiency recovery from waste, heat and compression stations and around five sites and all together that is around 3,500 megawatts.

Sean Great thank you Jorge and now we do have another question for Alex. Alex the question is the integration of technology will be the supported for small locations predominantly? Is that correct?

Per Alex No I think it's we start at the small locations but actually we develop the systems for a lot of and very often in the Danish systems we have cooling parts between cities and if we have that we can place solar collector. We can place stars along the translation parts. Also, it's easier if you have those translation parts to heat the industries and gas pumps. So this is only the beginning it's also a concept that can be used for lots of cities.

Sean Great thank you and the next question I have asks, if IA can elaborate on experiences with two different heating systems. First is the non-based profit, where profit goes back to consumers as in Denmark and two the liberalize systems where companies operate on market conditions such as some places in Sweden. So could you just elaborate with your experience on those two different district heating systems?

Araceli Yes thank you Sean. Actually, I think it's really, this question goes to the local market commissions and is it really reflecting the generation cost. For instance, the seed worth mentioning and most of these companies mentioning the similar distribution network is actually on a similar basis. So in this case with the consumer has a direct view of generation cost has more ability to have a better understanding on which technologies and the energies that have been used. But I guess in the end the question really

comes to whether the national framework, the final time is reflective of real generation cost, whether this is the case, technologies will say I prove their added value in terms of energy efficiency amount. So I don't know if that was really the point but maybe we could generate more if we have potential.

Sean Great thank you Araceli. And again back to Alex for the question about Sunstore , the mentioned the land usage of some sort and ask if there's an innovative solution to reduce land loss and to increase peoples acceptance of projects.

Per Alex Is the question about the land use for solar collectors and storage?

Sean I believe so.

Per Alex Yeah in Moscow I think we used something like ten hectors for solar collectors but if we should have used energy crops in exiles, we actually used 180 in exiles so we don't think that the land use is that high. But of course if you are in new cities and you have discussion where you have places but not normally for the small is so difficult process you can afford the entire transmission pipe. So of course as the land use—yes it's less use for energy crops and so it's discussed of course yes and normally exceptive.

Sean Thank you Alex and the next question from the audience asked a general question. what are the main barriers to the deployment of co-generation **and efficient DHC system? And why don't we start with IEA for this one.**

Araceli Thanks Sean, yeah sure I mean with this on the presentation I mean the most important area that we can identify and can receive from experts participating in the project that the lack of the long term view in the efficiency in energy crisis models and regulation so it ended up that most of the technologies were not attractive from an economic perspective because of the high risk. They were so dependent on the electricity crisis. Those are changing the regulations in the business case and that's why the high risk perception of investors in technologies one of the other important barriers we're discussing is market and not only being stable but not being that very moment in time, not being cost generation effective, basically rewarding energy efficiency so there was not a value for energy for the final energy ties were not considering benefits that were cross subsidies made the tides are low and surely compared to the tides some cost of the heat generation rather than split equity. So those were the main barriers of course there's other aspects for instance in terms of preventing seeing the flexibility solution most of the barriers were interconnection. So understanding the reason to be assigned choice and national read and most cases they are not very clear and not transpiring and makes a process for industries to make sure that they can sell electricity back to the green. And at the end I think the main challenge was energy efficiency as a first rank

and many flexibility options I think it's more of a long term view of the systems can be operated in an operable manner and so it's a mixture of both.

Sean Great thanks again Araceli. We did receive another question for you Araceli and it asks, in one of the parts it is shown that Russia has doubled the size compared to the US in co-generation use. Can you just talk about the factors that explains it?

Araceli Yeah I think they may be referring to the share of electricity from co-generation. I think one of the differences is that there is a big component in the co-generation being implemented in Russia. I think there's been a greater push in the US. The regulation so they were expecting I believe last year from the president of the United States to incorporate more industry capacity in the country portfolio so there's a slight push there. It will be coming to see this capacity in the upcoming years. But I think overall in Russia there's such a long history of district heating as well and there is such an infrastructure in place which makes that solution liquidation capacity with the system that share the CHC capacity also by importance but as I mentioned there's a very different situation there's also some information about the reports systems for heat and electricity systems in Russia and some cases where subsidies are existing so there's no characteristics of high cost prices of generation in the heat ties in Russia. It's going to a level situation where there is quite a significant capacity in infrastructure in Seoul there's some investments to be made in capacities in an energy efficiency level.

Sean Great thank you. And next question is are there any existing national platforms for the exchange of practices and experiences pulling these technologies and whoever likes to jump in and handle this one first please go ahead.

Per Alex Alex speaking, there's a European platform with a hidden power and there's also district heating and cooling platform for Europe.

Araceli Yes this is Araceli and one of the platforms since it's the IEA conditioning and cooling platform that was mentioned at the beginning of the session where we incorporate industries and I can say discussing these technologies, within the IEA technology there is an implement on agreement that it's cooling parts of that platform incorporate various government industries and also within the IEA collaborative work we ran a series of publication which provide an analysis more in a specific basis to provide target policy recommendations that can be applied by different countries it's all available on our website. But in terms of other social applications that we work with there's also ways for centralize energy application and also the [inaudible] [01:19:49] which is currently controlled by Finland we work in close collaboration with them.

Jorge Just to say most of the countries have a co-generation association down in Mexico but the U.S. and Spain have their own association and there is a lot of information that can be useful also.

Sean Great thank you everyone. And I have one final question for the audience for you and it's not directed towards anyone specifically. The question is available co-generation and DHC systems are limited, do you feel like this is an opportunity to get a better understanding of the full potential of the technologies?

Araceli I can jump in constantly I think in the day time in studies especially on the thermal side is quite limited when it comes to co-generation especially studies are like submitted as well so we made it a key issue and we work with governments to make sure that based the added value of having a more gathering structures in place so that we can have proof of analysis and make sure we have more or less objections in analysis energy efficiency levels of course the available information varies from country to country. But I think this is something that we should definitely promote.

Sean Great thanks again Araceli.

Jorge I just want to…

Sean Go ahead Jorge

Jorge Thank you I will like to add that also with the lack of information in some cases the first thing to do is to look at your heat consumption and if you can reduce your heat consumption your co-generation potential uses will also use your juice of energy and that's more efficient so and some potentials and some capacities are showing the whole heat needed at some point of view, but if you do the tail analysis or what are you doing with it, you can come up even without a lower capacity of potential but a higher efficiency you aren't burning anything or juicing anything to generate that heat.

Sean Great. Thank you ‚Jorge.

Per Alex Alex speaking.

Sean Go ahead Alex.

Per Alex just one last remark, because I think this is very important it's a very large potential for co-generation and district heating and cooling. There's one study in Europe that shows the huge reduction potential for that kind of system is very large and I think its estimate in the debate so I'm very happy that I've taken up this topic.

Sean Great thanks again to everybody for the great presentations and question and answer session. And I haven't received any additional questions from the audience so I'll go ahead to wrapping up the webinar and I do have a

short survey for the attendees that tells us how we did today and to help us improve for future webinars. Heather if you could go ahead and display that first question for us please, that question is the webinar content provided ne with useful information and insight. You can respond directly by clicking in the poll. Great and the next question please Heather. The webinar's presenters were effective. And the final question is overall the webinar met my expectations. Great thank you for answering our survey and on behalf of the Clean Energy Solutions Center we will like to extend a very hearty thank you for each of our panelists for joining today for the presentation and also for the attendees for participating in today's webinar we've had a great audience and I appreciate your time and I do invite our attendees to check the Solutions Center website over the next few weeks if you'd like to view the slides and listen to a recording of today's discussion as well as previously held webinars.

Additionally you'll find on upcoming webinars and other training events and we also invite you to inform your colleagues and networks about Solutions Center services and resources including the ask an expert no cost policy support. Hope everyone has a great rest of your day and we hope to see you at future Clean Energy Solutions Center events. This concludes our webinar.