CLEAN ENERGY SOLUTIONS CENTER
ASSISTING COUNTRIES WITH CLEAN ENERGY POLICY

Energy Policy, Research and Innovation in Sweden

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Webinar Panelists

Robert Andrén	Ministry of the Environment and Energy, Sweden
Lars Guldbrand	Ministry of the Environment and Energy, Sweden
Rémy Kolessar	Swedish Energy Agency
Andreas Stubelius	Swedish Energy Agency

This Transcript

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Sean

Hello, everyone. I'm Sean Esterly with the National Renewable Energy Laboratory and welcome to today's webinar which is being hosted by the Clean Energy Solutions Center in partnership with Mission Innovation. And today's webinar is focused on the accelerating clean energy innovation in Sweden. And before we begin I just want to go over some of the webinar features. You do have two options for audio. You may either listen through your computer or over your telephone. If you choose to listen through your computer, please select the mic and speakers option in the audio pane. Doing so will eliminate the possibility of feedback and echo. And if you choose to dial in by phone, please select the telephone option and a box on the right side will display the telephone number and audio pin that you should use to dial in.

If anyone is having technical difficulties with the webinar you may contact the go to webinar's help desk at 888-259-3826. And we do encourage anyone from the audience to ask questions of our panelists at any point during the webinar. To ask a question simply type it into the questions pane and submit it there. And we will save those questions for the Q&A at the end of the presentations. And if you are having difficulty viewing the materials through the webinar portal you will find PDF copies of the presentations at cleanenergysolutions.org/training and you may follow along as our speakers present. Additionally, an audio recording of the presentations will be posted to the Clean Energy Solutions Center training page within a few days of the broadcast and will be added to the Solutions Center YouTube channel

where you will find other informative webinars as well as video interviews with thought leaders on clean energy policy topics.

One important note of mention before we begin our presentations is that the Clean Energy Solutions Center does not endorse or recommend specific products or services. Information provided in this webinar is featured in the Solutions Center's resource library as one of many best practices resources reviewed and selected by technical experts. Today's webinar agenda is centered around the presentations from our guest panelists Robert Andrén, Lars Guldbrand, Remy Kolessar and Andreas Stubelius who have joined us to discuss Sweden's approach t o accelerating clean energy innovation.

Before we jump into the presentations I'll provide a quick overview of the Clean Energy Solutions Center. And then following the presentations we will have a question and answer session where the panelists will address question submitted by the audience. And at the end of the webinar you will be automatically prompted to fill out a brief survey as well so we do thank you in advance for just taking a moment to respond to that.

The Solutions Center was launched in 2011 under the Clean Energy Ministerial. The Clean Energy Ministerial is a high level global forum to promote policies and programs that advance clean energy technology, to share lessons learned and best practices and to encourage the transition to a global clean energy economy. 24 countries and the European commission are members, covering 90 per cent of clean energy investment and 75 per cent of global greenhouse gas emissions. The Solutions Center is one of the nine initiatives of the Clean Energy Ministerial. Already initiatives include ISGAN, 21CPP and Global LEAP and all of the initiatives work towards the three overarching goals of improving energy efficiency worldwide, enhancing clean energy supply and expanding clean energy access.

Now a little overview of the Clean Energy Solutions Center. This webinar is being provided by the Solutions Center which focuses on helping government policy makers design and adopt policies and programs that support the deployment of clean energy technologies. This is accomplished through support and crafting and implementing policies relating to energy access, no cost expert policy assistance and peer to peer learning and training tools such as this webinar. The Clean Energy Solutions Center is cosponsored by the governments of Australia, Sweden and the United States with in kind support from the government of Mexico.

And there's five primary goals for the Solutions Center. First goal is to serve as a clearinghouse of clean energy policy resources. Second is to share policy best practices, data and analysis tools specific to clean energy policies and programs. Third is to deliver dynamic services that enable expert assistance, learning and peer to peer sharing of experiences. And fourth goal is to foster dialogue on emerging policy issues and innovation around the globe. And finally, the Solutions Center serves as a primary resource for project financing options and information to expand markets for clean energy. In this finance technical assistance service the Solutions Center announced last year at COP21.

Our primary audience is made up of energy policy makers and analysts from governments and technical organizations in all countries. We also strive to engage with the private sector, NGOs and civil society as well. Solutions Center is an international initiative that works with more than 35 international partners across its suite of different programs. And several of the partners are listed above and include research organizations like IRENA and the IEA, programs like SE4ALL and regionally focused entities such as the ECOWAS Center for Renewable Energy and Energy Efficiency.

And then finally one of the marquee features that the Solutions Center provides is its no cost expert policy assistance known as Ask an Expert. The Ask an Expert service matches policy makers with one of the more than 50 global experts selected as authoritative leaders on specific clean energy finance and policy topics. For example, in the area of renewable electricity policy we're very pleased to have Paul _____ from the renewable and sustainable energy institute serving as one of our experts. So, if you have a need for policy assistance in a renewable electricity policy or any other clean energy sector we do encourage you to use this valuable service and again it's provided to you free of charge. So if you have a question for our experts, please submit it through our simple online form at cleanenergysolutions.org/expert. We also invite you and encourage you to spread the word about this service to those in your own networks and organizations.

And so now I'd like to provide brief introductions for today's panelists. First up today is Robert Andrén who has served in the government for 15 years in several different ministries and is currently the director general for energy at the ministry of the environment and energy. Following Robert, we will hear from Lars Guldbrand who has been working with the administration in funding of energy research in innovations since 1989 and is currently a senior advisor in the ministry of the environment and energy.

And after Lars, we will hear from Remy Kolessar who is the director of the department for research and innovation at the Swedish Energy Agency. He has a background in microelectronic industry and has more than 20 years' experience in the energy sector serving various positions within academia and government agencies. And our final speaker today will be Andreas Stubelius who brings 15 years' experience within the energy field to the Swedish Energy Agency where he's a senior project manager in the department of market development. And so, with those introductions I'd like to welcome Robert to the webinar.

Robert Thank you Sean and good morning, good day or good afternoon to all of you depending on where you are in the world at the moment. I will give you a short introduction to the overall policy objectives that we have on energy and climate in Sweden. And then my colleagues will take it deeply into our energy system and our energy related R&D and innovation system.

Sean And Robert, we can hear you just fine but we can't yet see your slides.

Robert I'm working on it. Now here it is. Like this? Ok.

Sean You'll need to select the show your—click on the show your slide prompt.

Robert Is this working?

Sean It doesn't seem to be. We'll go ahead and show them from our end.

Robert Ok. Are they up and running?

Sean Give us just one moment. Stephanie, can you show the slides for them please?

Robert Is it working now?

Sean Yes, it is working now.

Robert It's working now. Ok. I do apologize for the technical inconvenience here. Just let me start by giving you some words about Sweden as a country because it perhaps facilitates your understanding of our system and our solutions that we have chosen when it comes to energy and climates. As you can see Sweden is a fairly large country actually but with not so many people living in it. We're the third largest country in the European Union but we're the number 13 when it comes to people. We actually turned 10 million inhabitants just the other day. But we are as you can see our population density is very low particularly in the northern part of Sweden. Our GDP per capita is high and Sweden is ranked number seven in the world according to the GDP per capita indicator.

We are a very rich, forest rich country. We have a large biomass resource and more than half the country is covered by forests. And the annual growth of forest biomass succeeds by far the annual harvest and that is quite important in our system. It's also good to know that Sweden is and has for a very long time been a strong advocate for free trade due to our dependency on import and export for the economy. And important industrial sector in Sweden are engineering, automotive industry, IT and pharmaceuticals. But we still depend somewhat on traditional areas such as pulp and paper, iron and steel, wood products and chemicals.

Now the overall objectives that govern us. Now the prime priority of the present government as I guess is for most governments around the world is to create jobs. And one of the crucial ingredients to achieve this priority of creating jobs is the transition of our economy towards a more bio based and _____ economy where both energy and climate are seen as core fundaments in this transition. In June, this year, a broad framework agreement was agreed between the government parties and most of the oppositional parties in the parliament. And this is a very important framework and I will come back to it in just a few minutes. And it states that Sweden must have a robust electricity network with high security of supply and low environmental impact including climate change and offer electricity at competitive prices.

Now these are seen as safeguards for sustainable efficient robust and healthy and cost effective energy systems which in turn is a prerequisite for economic development, employment, our industry, trade and also research and

innovation. And as you can see, we are stressing security of supply, low negative environmental impact both locally and globally and also on the deliverance of electricity on the competitive prices. This policy we think is in very good agreement with the vision of the Mission Innovation to dramatically accelerate global clean energy innovation. And the objective is also underlining the need for long term perspective and clarity for the market and the market actors to generate new jobs and investments in Sweden as well as export possibilities for Swedish enterprises and solutions. And again, a robust and innovative energy system is also the core fundament for achieving the overall policy objective on climate which is that Sweden will be one of the world's first fossil fuel free wealthy nations.

Now in the shorter term, Sweden has done concrete decisive and quantitative goals corresponding to first of all the EU 2020 goals. And as you can see on the slide there is 50 per cent renewables in the gross final energy consumption. We are ten per cent renewable energy in the transport sector and a 40 per cent reduction in greenhouse gas emissions. Now in the longer terms the ambitions are higher of course. And in the framework agreement among between the government and the opposition as I mentioned earlier on, there has been [Break in audio] such as 100 per cent renewable electricity by 2040 and 50 per cent more efficient energy use by 2030. And also, again in another parliamentary committee it was agree among the parties that we should have a net zero emissions to the atmosphere by 2045. This was again endorsed in the framework agreement on energy.

Now steps that has been taken in Sweden if you look a while is that we has been that we have a carbon dioxide tax that was introduced in 1991. We also had an electricity certificate system that was introduced 2003. Then in 2012 this became a joint system with Norway so we have a Swedish Norwegian common system today. And we have also had investment support schemes for renewables. For instance, solar PVs and we also have initiated a climate investment program, the Climate Leap which is of course facilitating and strengthening our way towards achieving the goals and also the objectives.

Additional steps taken has been to the initiative Fossil Free Sweden which is launched in cooperation between the government and the private sector. And it has been both small, medium sized and large enterprises getting into this initiative in order to share experiences, put the spotlight on good examples, promote cooperation and also to see some concrete actions taken by other actors outside the government. We have also a special initiative on fossil free vehicle fleets because as we—our main challenge when it comes to fossil fuels is within the transport sector. So our intensified focus is on reducing emissions from transportation.

And we have also then introduced a number of new policies and public inquiries to reach that. And we have a bill, a new bill planned to put forward to the Swedish parliament in order to make, take even further steps towards reaching the goals and objectives. And I think I will stop there with this short introduction to our overall objectives and our interim goals set by our

political system. And I will now let my colleague Lars take you deeper into our system. Thank you for listening everyone.

Lars

Yes. Thank you. I will continue, Lars Guldbrand with a few words on the Swedish energy system and on the funding system for clean energy research and innovation. So I go a bit quickly over some of the pictures but they are there. You can look at them afterwards if you want. This is just a generic picture of an energy system and I just want to pop out the real importance for Sweden are domestic supply of hydropower and biofuels. Nuclear energy is also important but we import if you will. We have no domestic production of fossil fuels and no real deposits so coal, oil or natural gas. The use of imported fuel is actually quite low except for oil and the transport sector.

There are two other things about the Swedish system that might be of interest to point out. And one is that the electricity system was deregulated quite early and that we are part of a well-established Nordic market, electricity market. There are quite a lot of international connections and there is work being done to further connect us to our neighbors. The other thing that might be worth mentioning is that district heating is quite important. Sweden has a fairly cold climate and heating is a big consumption of energy but we have a lot of fairly efficient district heating and are getting more and more district cooling also. And actually in 2013, district hearing delivered 58 per cent of the total heating energy use in housing and premises in Sweden so that's quite a big share.

And this picture just shows you that things have been happening since the oil crisis in the '70s. We see to the left of the screen, we have very oil dependent supply system, the orange petroleum which is the majority of the supply. And this has decreased a lot over the years. Instead we have had an increase in the green wedge which is biofuels and in the yellow one which is nuclear power. It looks like energy consumption has gone up but we must note that nuclear power is giving us an input of nuclear fuel and not the use of the electricity. In fact, a lot of the energy in the nuclear fuel is lost as heat in the power station.

And this is the situation just 2013, the latest year we have full statistics for. The upper bar is the supply, big affairs of the biofuels, the crude oil and nuclear fuel. And the level one is consumption and you can see to the right that the heat loses in nuclear power are fairly big. They are almost as big as the entire electricity consumption. And also in the consumption we have biofuels, petroleum products for transport, heat and electricity. So what do we use this for? Well, the big three sectors of use, street transport and the buildings and service sector. And here we also see in the pie chart to the right that in the industry sector we have quite a lot of very energy intensive industry. Pulp and paper is almost half of the consumption. Steel and metals, chemicals and mechanical engineering, they are big users of energy and they are also big contributors to our economy so they are important for us.

This is a picture of the consumption. The black line at the top is the total consumption except for a blip in the middle here. It's decreasing slightly. The common bits are renewable consumption. And as you can see biofuels

and hydropower is the big part. Wind is increasing, heat pumps, the renewable part of the energy delivered by heat pumps are increasing, and solar is actually increasing but you can't see it in this picture. It contributes less than a tenth of a per cent of the electricity in Sweden.

Just to brag a little, this is the total renewable energy consumption in relation to the 50 per cent goal for 2020 and as you can see we have already reached that a few years ago. To the right, we see the emissions of greenhouse gasses, gross national product and per capita and you can see they are going in the right direction. But to reach a net zero emission in 2045 there is really a lot more to do so that is quite an ambitious goal. So this was short introduction to the energy system and I will continue with a few words on the funding of energy research and innovation before we get to the interesting bits that the Swedish Energy Agency will provide you with.

Just to start, this is in general research and innovation in total. We have 3.3 per cent of the gross domestic production is research and innovation. It's quite a big part. Almost two thirds is from the private sector and some funding also comes from the world like the European union. When it comes to who carries out the research, the private sector is even more dominant. Of course, universities provide quite a lot of research and innovation also. What we can note is that the institute sector is very small in Sweden. And this is because the Swedish universities are expected to provide three different tasks. It's education, it's research and it is collaboration with society and industry. So universities are expected to fill, fulfill part of their own but in other countries might perhaps be performed by institutes. And this provides universities with quite a lot of contacts with the users and industry and society and just in general a good thing that adds to the quality of the research being made.

Now here is a picture which will be incorrect fairly soon as ministers come and go. But at the moment it is the main ministries and ministers responsible for research and innovation that might be of interest for energy. The Ministry of Education and Research, they provide money directly to universities and also for basic science through the Swedish research council. Then we have the Ministry of Enterprise and Innovation which provides funding for research and innovation through the Swedish innovation agency called Vinnova. The Ministry of the Environment and the Energy also have agencies that provide funding. It is on the one hand the Swedish research counsels of sustainable development. They fund research of the environment of the forestry and farming and on city planning and stuff like that. But then to the right we have the Minister for Energy, Mr. Ibrahim Baylan and the Swedish Energy Agency that is the main actor in the field of energy research and innovation.

This is a fairly naïve picture of what the different founding agencies do and they are put on the screen in relation to the type of process in the innovation process that they generally found. And we see the research council at the basic research arrow, the Swedish Research Council in some sustainable development is more strategic and more targeted on environment and such.

And then we have the Vinnova research development demonstration and innovation. And to the right we also have some public companies that provide venture capital and the like. At the bottom, we see the Swedish Energy Agency which has a large role over the entire innovation system providing funding for everything from strategic basic research, research development demonstration and also business development, startups and so on. And they do this entirely from the energy relevance perspective. The other agencies they have also some energy relevant activities and they may have activities that are of interest for the Mission Innovation. But the main actor is actually the Swedish Energy Agency.

This is just an alternative picture showing the flows of funding directly to the universities, the public, about half the public funding goes directly to the universities. Then we have the research funding agencies and the expert agencies and the venture capital companies. And as you can see the big, the largest green arrow is from the Swedish Energy Agency and then it all collects in a nice pool of energy research development demonstration, product development and innovation. And that is in some extent caught in a bid strategically between the different funding providers.

And to finish up I just wanted to tell you that the Energy Agency has a rather large responsibility. The government and parliament, they state the goals of the energy policy as a whole, climate policy, they decide the appropriations, they give the instructions. But government and parliament does not do the choice of the different programs or areas where we're to invest. That is entirely the responsibility of the Energy Agency. The Energy Agency is to deliver the research and innovation results that will contribute to us reaching the energy and climate goals. And they will do this from _____ or whatever you say, from the overarching visions, goals and objectives they will do a strategic planning portfolio definition, acquisition and so on. And they will implement it and follow it up, review in evaluation, feedback and so on. So much of the responsibility of carrying out the tasks needed to get clean energy innovation in Sweden is the realm of the Energy Agency.

And I happened to lie I think because there is one picture left. And this is just some more bragging. We are very proud to have been ranked the second most innovative country in the world according to the global innovation index. Switzerland has the top, numbers three and four are the UK and the US respectively. And the European Union also does a ranking, the innovation scoreboard and last year we were actually number one followed by Denmark, Finland, Germany and the Netherlands. And I lied again because there's another picture. And this is just to look at later how to get to the webpage of the Swedish government in English and how to email me and Robert. And with that I will not take up any more time. I will hand the microphone over to Remy Kolessar who will tell you about the Swedish initiatives.

Remy

Thank you very much Lars and good morning all, good afternoon everybody. I will give you a deeper insight in the activities at the Swedish energy regarding energy research innovation funding. And later on, my colleague Andreas Stubelius will go more into details in the business development

activities we have at the Swedish Energy Agency. Just to start overall a few facts and figures about our activities. As Lars said in his introduction we are supporting and we have to support across the whole innovation chain. So from basic research to large scale demonstration, commercialization and market uptake within the energy sector. We have budgets today of roughly 150 million euro. That's today's figures.

And what is important is that the amount of money we put in research and development is actually doubled by private sector cofounding. And annually we're running right around 50 R&D programs and more than 3,000 project continuously running at the agency. Another thing is we do have not only funding but also responsibility for priority settings and strategy for public RD&D fundings in Sweden. And this strategy is actually articulated around five grand challenges we've identified for sustainable energy future.

The cornerstone is of course 100 per cent renewable energy systems. But sustainable future is not only renewable energy systems. The system has to be also flexible and robust, resilient and also take into account resource efficiency both for society and also from a sustainable point of view. Also, we do not only have transitions that need to be done from a technology point of view or from infrastructure point of view. Even the system actually includes markets, regulation, development of new business models, behavioral changes and so on. So interaction between the systems and all actors in society is also very important to study and develop. And finally, of course these new challenges means that we have also opportunities and we have to look at the opportunities through innovation creating, addressing challenges for climates but also creating jobs of course.

Our research is organized around nine thematic research areas covering everything from policy assistance, smart grids, renewable energy sources, bioenergy, very important for Sweden as let's say before in the introduction transport system, industrial processes we have a lot of industry, large energy users in Sweden and efficiency and energy processes is very important. Building as part of the energy system. Energy system studies, more general sustainable society development, business development and commercialization and more globally development of international partnership.

When it comes to the different tools we are using across the innovation chain, we are dealing with everything from research grants and research program, industrial cofounded research programs, large scale, small scale demonstration project but also development of prototypes, proof of concepts for large and small actors. We also have tools concerning the support for startups and SMEs and my colleague Andreas will be talking later on on these particular kind of tools. We even have innovation challenges and prizes as tools to introduce and accelerate introduction of new innovations and even diffusion in terms of information campaigns, for instance in energy efficiency. So tools across the whole innovation chain.

Just to give you some highlights [Break in Audio] applications of our activities on the upper left corner you have the total R&D spending, net

spending from, for energy research and a strong correlation with application of patent applications related to energy during the last years. And looking more specifically in different areas we see also a strong correlation with areas we've been focusing on, especially renewable energy resources, efficiency in the transport sector, electrical vehicles. Yeah. And biofuels for instance. There's a strong correlation with our activities and the impact on patent applications as we can see.

Just to give you also other example of what we're doing and result of what we're doing, here are examples of activities that's actually started by support of more early research support and lead to business development at some point. We have in Sweden a couple of very interesting companies developing solar cells for the third-generation solar cells like took some of the few examples here with Exeger and similar integration of indoor solar cells. _____ we are _____ that increase efficiency of commission of solar cells. Midsummer with high efficiency flexible thin film solar cells. So all of these companies were supported at various stages of the research and innovation are a good example of the kind of result we can obtain. We also have dedicated support for solar fuse for more long term and long range applications with the solar fuse institute.

Ocean energy is also an interesting area we've been supporting from basic research, early research at university level and resulting in a couple of Swedish companies active in these, in the area of solar energy. Give you also an example of other type of support when it comes to pilots and demonstrations at more industrial levels. We have a couple of projects with the larger important groups in Sweden when it comes to transportation, the Volvo group and Scania. With Volvo group we have two projects that could be highlighted. One is electrified and autonomous query, Volvo electric site, Volvo construction equipment. So both autonomous vehicles and machinery and electrified query that aim to reduce dramatically CO_2 emission for this sector.

Have also project with electric buses running today in Gothenburg. With Scania, we have wireless charging EV bus running today in _____ Stockholm just to give you some examples of the kinds of projects we're also supporting. When it comes to biofuels we have large amounts of biomass in Sweden and of course this is a very interesting in areas to develop. And so, biofuels just to give you an example, we have testing facilities falling in biofuels project between _____ and Nordic Paper we've been supporting just to give you an example.

Area of smart grids, we have several large project smart grids demonstrators for ranging from smart cities, the Stockholm royal seaport, city in the southern part of Sweden in _____ involving traditional utilities and equipment suppliers in those projects. And we have also another project in the island of Gotland, a more rural area. So smart grids for integration of renewable energy in rural areas. Other type of example we have is innovation challenges and prices. We run a challenge oriented toward intelligent management, energy management locally produce energy, solar roof and

storage and energy management as a system and currently are now after the result of the challenge are running the project for companies that are listed in here.

As you can see there is even not only Swedish companies, there is also actually from Greece and the US. And we are planning a new challenge related to sustainable mobility as a service which is under preparation actually. So that was all I wanted to tell you for now about our activities and I'll let some of the results and example of our support. And I would like to give the floor to my colleague Andreas Stubelius running from San Francisco actually.

Andreas Yes. So can you see my slides?

Lars Yes, we can.

Andreas Ok. Perfect. Yeah. So good morning from sunny San Francisco, California and I'm going to speak to you about how we work with business development of clean tech companies and technologies. And my first slide is more of like the history. And we have this quite famous Swedish guy called Alfred Nobel. Maybe some of you have heard of the Nobel Prize that he's giving out. That he was an inventor, an innovator and an entrepreneur. He held more than 355 patents and I mean the people of Sweden is more or less living in his spirit of innovation. And when we get that together with the our sense of resources and living with the nature, I mean we have to carbon tax on carbon dioxide since the '90s. So we live in the polluter pays principle. And if you marry the spirit of innovation together with the carbon efficiency that we live in, we can create some really interesting clean tech solutions actually.

And so, a little bit about how we started. We started out in 2006 and the question from the government was like ok. We're spending a lot of money in research and development. Can we work a bit further with creating growth, jobs and getting these technologies out of the markets so people actually could use them? And so, we structured a team more or less like a venture capital team. And we are currently using the department that the [Break in Audio] is head of as a backbone to do the technical due diligence in all these companies or technologies. I mean one of the big issues here is that it's really high technically advanced and it's really hard to really understand the technologies and how you can apply them. So I think that is really one of the big backbones in our team.

But we're also—we're a governmental agency and we don't want to invest with equity because we can't really take ownership in all these companies. So our lawyers have been quite innovative I would like to say. So we have created a tool which is a grant with a limited royalty. I won't go into the details but it's working really good. And yeah. Also, one of the big, big issues is that I mean Sweden is a really small country and our industry is quite efficient so most of the technologies don't really have their main market in Sweden. So we use the Swedish market as a leverage to get these companies, test the technology and then get out on the main markets.

And so, that's one of the reasons I am in San Francisco today. I have brought seven of the companies in our portfolio to meet with the investors and I can say we created quite a buzz yesterday. My companies were in at least 35 investor meetings and the buzz was around Swedish clean tech and how we can really, really apply more technologies. And when it comes to what we do then, we have identified two valleys of death. I should say two financial valleys of death. I'd say there are at least 100 more valleys of death when you're creating a technology company but the first one is when you're, you're about to test your technology. You need to test your technology in the first commercial scale. There is a lack of capital so we have a tool for that. And the other valley of death is when you need to scale up. You get your first big order and you need the liquidity in your company to scale up. So that is the two main targets that we have working with these companies.

A little bit about the portfolio. We have—ok, now my slides are not—ok. There is works. And we have financed 84 companies since 2006 and 71 of them are still alive which gives us survival degree of more than 80 per cent. And I mean this is early, really early seed stages so I think that is a quite remarkable results so far. And note that I call it survival degree. I won't call it success degree because I mean creating companies takes a long time. But so far, I think we're doing really good. Our team have invested $63 million into these 84 companies and our six top companies have a market value of more than $400 million so far. So I mean then the rest of the 65 companies are not included in these $400 million. So in terms of financial we're also creating quite remarkable values here. But of course, our main mission is not to make money. It is more to get the technologies out on the markets where they're needed.

We have eight of our companies have went public to the public stock markets. We've had three big M&As where one of the companies was actually bought by a big American company called Fairchild. And in terms of climate effects we have actually had the World Wide Fund, WWF to make some calculations of the innovations in the portfolio. And they have concluded that the innovations in our portfolio have the possibility to save some 750 million tons of carbon dioxide equivalents every year. And I mean how much is that? Well, if you put it in reference to the total emissions of Sweden this is 15 times of the total country of Sweden every year. So I definitely say we have some positive climate impact from these technologies.

And I mean in our agency we are around 300 people and there's more than 470 people working in these portfolio companies. So Lars spoke earlier about getting really high in innovation ranks. So there's also a global clean tech innovation index where Sweden also comes really high. And I also want to show you this map because one of the big, big issues for us is to get these technology companies out of Sweden quite early. And based from the needs of the companies in the portfolio we have identified four different markets. And that is Germany, UK, the US and China. So we have four different programs of helping the companies to go into those markets.

And well, I mean the small country of Sweden we have seen some really, really amazing companies the last years. We create more unicorns than Ge rmany and for instance two real exciting companies is Skype and Spotify which if I try really hard I can get them to be sort of clean tech companies. I mean Skype makes possible meetings without travel and I mean Spotify can give you music without yeah, having to see the records. But I mean we have a landscape of technologies in Sweden and this is an example around Stockholm that is—I mean it's awesome and I think we have some really great possibilities here.

So this is my last slide. This is where you can download these publications and you can see more of the portfolio companies and you can also find them on our website. And I am in San Francisco and I will be here for like two more days. And if you want a more detailed description about how we do these things or interest in the companies please email me and we'll book a meeting. So thank you.

Sean Great. Thank you very much Andreas and the rest of the presenters. We very much appreciate those presentations and the information that you conveyed there. We will now move ahead to the question and answer session. I would just like to remind our attendees if you have any questions for the panelists, please go ahead and submit those at this time using the question pane. We will also keep several links up on the screen throughout the question and answer for quick reference that point to where the, where to find information about other upcoming and previously held webinars and how to take advantage of the ask an expert program. So we'll jump right in now to questions from the audience. First one is how can nonprofit incubators and accelerators work with Sweden to pursue Mission Innovation initiatives?

Lars Yes. Andreas is that a question for you?

Andreas Yeah. Well, I mean the one of the issues for clean tech companies in Sweden is that we really—we really need to get these companies out of Sweden a bit earlier than the normal innovation system is used to. I mean normally we—you grow your company strong enough in your home market and then you get out of that market and go into exports. But I mean since the main market here in Sweden is so small, we really need to get these companies out of Sweden earlier. And I think that accelerators and incubators all around the world can take really good part in that work. So I mean we are really interested in cooperating with many, many incubators.

Sean Thank you, Andreas. Moving ahead to the next question now. How do you see the funding flow for this type of work changing in the upcoming years?

Andreas Yes. The funding is increasing in general. I mean the different sources and the way that research is funded may perhaps not be changed that much but we have continuous increase in the funding of the energy research and innovation. And we also have an increasing interest in the wider aspects of clean energy, sustainable development and the interfaces between energy technologies and other parts of the economic system, the industrial system, the way people behave and want their needs fulfilled. So in one way we are

facing increasing funding. And in the other we are looking at broader system system-oriented activities and collaborations with the other areas not least social sciences, humanities and economic research.

Sean Thank you.

Robert And I can here I mean from a venture capital point of view and for more private capital I definitely can increase in capital and interest for clean tech and we're seeing like a second wave of venture capital starting up. The pension funds are gaining a lot of interest in putting their money into more environmental friendly technologies and so we definitely see an increase in the public, in the private money sector for clean tech.

Sean Thank you both. Moving on to the next question it asks, can you speak to whether Sweden has plans to specifically resource any international RD&D collaboration for instance by building upon existing partnerships through for example MOUs with international partners.

Andreas Yes. The second part of this question is really relevant because we have a few collaborations through bilateral or more MOUs and we really see these as interesting starting points, nuclei to build broader and more engage more partners in areas where the Mission Innovation has also for instance the certain challenges. And this might be we have some collaboration with Indian smart grids. We have some collaboration with the UK on district heating. We have some collaboration with the state of Minnesota on biomass and bioenergy and so on.

So these collaborations are very much seen as starting points for broader Mission Innovation collaboration which is not to say that we wouldn't look around and see if there are initiatives from other countries in the Mission Innovation that we can join. But we have not sort of set aside a specific budget for each Mission Innovation challenge or something like that. But we really see that there are lots of opportunities out there to be upon.

Sean Great. Thank you. And next question says to achieve Sweden's ambitious and laudable 2045 net zero emissions goal, has the government developed sector specific pathways in support programs for energy intensive manufacturing such as steel and chemicals?

Andreas Yes. There is something called I don't know how to translate this collaborative programs that one of them is for in, for industry, to develop industry and we are looking into that with the industry, with the other funding agencies and so on. So there are five of these. It's an industry. It's in transport. It is the bio-economy. It is the I forgot. It is sustainable _____ and then there is a fifth one, life science. This is fifth one. And these are areas of priorities where there will be a lot of effort focused. And there are also some private initiatives from the different paper and the metal, steel and iron industries to try to do this. Remy, do you have anything to add?

Remy Well, maybe the—maybe we can name also the upcoming strategy for different sectors for terms of energy efficiency, the result of the political

agreement that was introduced before. And so, there are some sector, strategies for different sectors including electricity intensive industry would be covered by those strategies.

Sean Ok. Thank you, Remy. And the question from our next attendee. They want to thank you for your excellent presentations and they noted that in the introduction you mentioned the role and industry in Sweden. Does the country have policies and programs to address emissions leakage?

Andreas I'm not really sure how to respond to that. But as you saw in the introductory slides there is a lot of effort focused on competitive prices for energy and to provide a system that is robust and works and underpins our industry. So there is of course policy and politics to make sure that the Swedish industry energy intensive industry can continue to be competitive that we combined the sustainability and the decrease of emissions with the economics so that we don't kill our economy. It's not really my area, this bit of the energy policy but it's a very, very important concern for us and it was a very important concern for the oil party energy commission that resulted in the goals and the direction of Swedish energy policy that Robert mentioned in the beginning. So emission leakage and the moving out of industry is in focus that I can say.

Sean Great. Thanks again. The next question that came in notes that—or asks. And you already touched on this but perhaps we should reiterate for the attendees since the question did come in again. Does Sweden having national strategy for energy related research and innovation or how do you coordinate the different agencies and programs in order to cover the value chain.

Andreas Yes. That is an important question. And the answer has several components. In one way, the majority of the really primarily energy relevant research is done by the Swedish Energy Agency and they have an overall strategy that they renew periodically and that they follow. So that strategy exists. Then there is also from the government and from parliament there are instructions that when the energy research or the energy agency touches upon areas of responsibility for other funding agencies like the _____ that for instance funds their research on industrial processes and so on. There is a coordination and there is discussions on synergies and overlaps and so on. And this is very important because if you look at the energy aspects on pulp and paper industry for instance or you might look at the paper industry and the quality of products they produce and have research on that. And at some point, these areas connect and you have to have coordination and collaboration between the industrial product research and the research on the energy aspects. So there is a history of coordination. Do you have anything to add, Remy?

Remy It's a very difficult task but it's very necessary. Get the most out of the limited resources that we have and avoid double work or perhaps more importantly avoid things that escape from the radar and are not addressed. So yes. There is one strategy for the energy agency and there is a system of coordination with the other funding agencies.

Sean Great. Thank you. I think anyone that works in this field can agree that is always an issue and an important topic to tackle as well. Moving along to the

next question, what role is regional integration with other Nordic and European countries expected to play in the post-2020 clean electricity goals.

Lars Well, there is a Nordic collaboration. There is a Nordic council of ministers. There is a Nordic parliament and there is a Nordic institution on energy research which also runs a number of different collaborative efforts between the five Nordic countries, Finland, Sweden, Norway, Denmark and Iceland. So this focuses on the Nordic countries as a region with the common missions and ghosts and common ways of doing things and good channels for collaboration both between industry and researchers. So we are looking at the Nordic system as a unit also and looking at how this might develop in synergy with the other Nordic countries and also how it might fit with the greater European energy system.

And that is—that is a very important aspect because the different Nordic countries have different areas of excellence. They have different resources and so on. And together it's a much stronger region than the countries are individually. I'm feeling I'm just waffling a bit. But the short answer to the question is that the Nordic countries are in some ways a block trying to develop solutions that benefit us all.

Sean Thank you, Lars.

Robert Just to add if you are interested, there is a publication jointly from the IEA and from the Nordic energy research that is called Nordic energy technology perspectives. This is a special part of the IEA series of energy technology perspectives and this can be downloaded from the IEA website. And this shows in some detail how one could see the future of the Nordic countries as a region with working towards net zero emissions.

Sean Great. Thank you. And perhaps this question is for Andreas. To promote the global growth of the clean tech companies, for example match making with potential investors, does the Swedish Energy Agency work with other Swedish government agencies such as Business Sweden?

Andreas Yes. I mean we work a lot with Business Sweden. I mean they are out—they are posted all over the world. So I mean it's quite natural to work with them. And we also work with some of the other agencies around us in Sweden. For instance, Lars mentioned _____. We also have the agency for regional growth and development. So yeah. We need to—I mean Sweden is such a small country we really need to focus on our agencies and get help from all of them. It's really important actually.

Sean Thank you, Andreas. That is the last question we've received up to this point. So with that I just want to thank the panelists again for the Q&A session and the presentations. And if any other questions come in we can always come back to them or we can send them to our panelists after the webinar so that they can respond. Before I wrap up the webinar I'd just like to give the panelists a final opportunity for any additional or closing remarks that you'd like to make. Lars, why don't we start with you and your group?

Lars Well, the final remark is just if you have questions, suggestions or ideas for collaborations or initiatives within the Mission Innovation, just drop us an email to me or to Remy or to Andreas. And I will be watching my mailbox and hoping for lots of suggestions.

Sean Great. Thank you, Lars. And so, with that on behalf of the Clean Energy Solutions Center, I'd just like to again thank everyone in our attendees for taking the time to participate in today's webinar. We very much appreciate everyone's time and hope in return that you gathered some valuable insights that you can take back to your ministries departments and/or organizations. We also invite you, the attendees, to inform your colleagues and those in your networks about Solutions Center resources and services including the no cost policy support through our ask an expert service. I also invite you to check the Solutions Center website if you would like to view and download the slides from today's webinar. And also, within about a week we'll be posting a recording of the webinar to the Solutions Center page.

Additionally, you can find other information on upcoming webinars and training events on the Solutions Center website. And just a reminder, we're now also posting webinar recordings to the Clean Energy Solutions Center YouTube channel. If you haven't yet, I do encourage you to check that out. A lot of very useful and helpful recordings out there all in one spot for easy access. Finally, I would like to kindly ask you to just take a moment after the conclusion of the webinar to complete the short survey that will automatically appear on your screen. Your feedback is very much appreciated. And so, with that I hope everyone enjoys the rest of your day and we hope to see you again at future Clean Energy Solutions Center events. And this concludes our webinar.