



Innovation: designing for a sustainable future

Demonstrating renewable energy technology in Denmark.

Narrator

This is the Danish island of Samsø, located off the east coast of the Jutland peninsula.

It has around 4000 residents, and is a popular vacation spot for mainland Danes.

What's unique about it is that it generates almost all the energy it needs from renewable resources.

It's become Denmark's archetypal 'sustainable energy island', with a target of zero emissions by 2008.

It all started with an entry into a very unusual competition.

Søren Hermansen

Samsø became the energy island because of, you could say, old time development of the grass root organisations. They have for a long time longed for a test site, or a real, real full-scale project, where they could describe the development of renewable energy up till now. And what we wanted was a demonstration project where it was possible to see a complete Danish transition through 100% renewable energy.

And for that they needed an example like an island where you could measure everything imported and exported, and the Danish Energy Agency wrote out a competition, and luckily Samsø won this competition.

The aim was in ten years to develop 100% transition to 100% renewable energy.

I have to mention also that one of the things in the competition was we had to base the development on general laws, and proven technology so it's, it wouldn't be a test project, so much as a demonstration of what was on the market.

For electricity we established eleven 1-megawatt wind turbines and they produce now what is equivalent to a yearly consumption of energy in Samsø, so we could say we're 100% self-supplied by electricity.

When it comes to heating we say that we utilise whatever sources of biomass we have on the island, and we have established four district heating systems, and a number – we estimate about 250 private household plants or installations – and we are quite sure we are, have reached about 75% of the heating demand, is now transferred from oil, electricity, to renewable energy, solar or biomass.

Narrator

In Denmark, local self-sufficiency in energy is not exactly a new phenomenon.

Søren Hermansen

When electricity started we had small electricity companies all over the country. There were three or four villages around an electricity plant and it was owned by the local people. And before that small turbines was owned by local people, so it wasn't so far away from history that we could do these things.

Narrator

Local ownership was a key feature of Samsø's response to the energy competition.

Søren Hermansen

Denmark has a long history of creating co-operatives, so it's not so strange and new for us to think in co-operatives.

So when we established these new very big turbines we opened, you know, first for shares: everybody could come, and could come and claim to be interested in one share, or ten shares, or one hundred shares. And we ended up having two co-operative owned wind turbines at the island, and two co-operative wind turbines offshore.

Narrator

Over a thousand people have put their money into Samsø's offshore wind turbines.

Local farmer Jørgen Tranberg was one of the team involved in the tricky task of raising the money for the full set of ten turbines.

Jørgen Tranberg

It's big money and big contracts, and it was difficult to get the money in the bank, and some of the people who want to buy them, they drop it again. One month where we only have sold nine, DIFCO come and say oh, we want to buy one so we was going.

Narrator

A co-operative of Samsø islanders was amongst the earliest investors. Its 450 members now own the turbine closest to the shore.

The municipality of Samsø owns five more, on behalf of the entire community of the island.

Jørgen himself is co-owner of turbine number 8, as well as one of the eleven on the island itself. He's made a huge personal investment in helping Samsø meet its energy target.

Jørgen Tranberg

The wind turbines on the land cost six million crowns and the one on the sea cost twenty-four million crowns, so there I have put twelve million crowns,

Narrator

In all, that's getting on for two million pounds.

Jørgen Tranberg

And I could only get the money in the bank because I have the one on the land and that was a good one.

We have a good place down here and we are five farmers together who will build five wind turbines on each land. And that was quite easy to build them and get the money, and that was going very well.

Narrator

From the farmers' point of view wind turbines are a good investment.

Morgens Mahler

In Denmark a lot of farmers think it's a good idea for the windmills. They have look at their money and there's good money in it.

I own this windmill, this is mine, yes, and you can only have... you can only have one windmill by yourself, so is the rules now. Before you could have two windmills, you could have one on your SE number, that's your farming number, and you can have one on your person number, so you can have two windmills, but you can't I think it's eight or ten years they stopped that, but I can have this one, and then I can have part in the windmills on the sea and I have invested 2 million Danish crowns out there and this windmill cost be six million. So I have invested 8 million Danish crowns in windmills, which is a lot of money for my little farming.

Narrator

That's about £700,000. The return on the money comes from the sale of the electricity generated by the turbines.

Morgens Mahler

This windmill here gives the profit it has promised and a little bit more, so I can only be satisfied with this, working like they have promised it to do. There's no trouble with it and if there is, Bonus, the company I buy the windmill off, is very quick to be here to get it repaired.

The windmill I have on the sea is also a Bonus mill.... and we hope the money out there will be good also.

Narrator

Mogens is not alone in his views - nearly all of the island's adults have money invested in the wind turbines.

For the community as a whole, the turbines play a crucial role in reducing carbon emissions and giving the island a self-sufficient source of electrical energy.

The offshore turbines export electricity to other parts of Denmark, providing an emissions surplus that can be offset against CO2 emissions from the ongoing, but diminishing, use of fossil fuels on the island.

Self-sufficiency in energy for heating has proved a slightly harder problem to solve.

Once again, the strategy involves both co-operative and individual ownership - a mix of district and individual heating systems.

This is Samsø's biggest single investment in heating technology - a combined solar woodchip district heating system. It uses mainly local woodchip waste and is fully automated. The human operator of the system comes in every second day to check everything is working well. Water is first heated as it flows through the 2500 square metres of solar panels. It's heated further as it passes through the woodchip-fired boiler. The hot water is pumped around the main town to heat work places and domestic dwellings. The solar thermal panels make a major contribution in the summer months. During the rest of the year, the plant relies much more on wood chip waste.

Other communities get their energy from district plants which burn biomass such as straw, wood, and potato tops, or biogas from landfill, animal manure and organic waste.

Burning biomass is carbon-neutral. It all comes from renewable sources, and does not impact on the island's net emissions of CO2.

Away from the district heating zones, islanders are turning to a variety of new technologies to replace their traditional oil burning boilers and stoves.

This small scale heating system is based around 19 square metres of solar thermal panels. It's connected to a large hot water tank under the floor in the central part of the house.

Malene Lunden

We get the water heated inside and when the water tank is heat enough we have 250 litres, then the rest of the heat, because that's sometimes a problem when you get a lot of heat and you cannot use it. In our house the first room you come into is the heart of the house and it's where we protect the heat, because it's the middle, the middle room in the house so the heat will go up and to the other rooms.

When the sun has warmed our 250 litres tank up then, you know, there's also heat for the feet, for the foot, and also for the wet clothes because sometimes it's raining in Denmark, you know, and we have a lot of wet clothes coming in and suddenly there's also, you know, room for that – the sun delivering that kind of heat, that's totally luxurious for me.

Narrator

Other people on the island are choosing to make use of locally available biomass resources, and are installing wood and straw-fired heating plants, or farm-based biogas units.

All of this means new, and rather different, work for people like the island's plumber.

Søren Hermansen

He has been forced to rethink his business.-He used to sell oil furnaces and the customers relied on this guy – when he came out with his things for selling, as a salesman - they would ask him for advice and say to him; “How do you think we should develop these things, what about solar energy?” And he would say in the old times; “Solar energy, well, some people say it's good but I mean that oil furnaces are reliable and we know how to handle them.” And the customer would say; “Yes, that's what we'll do then” because they relied on the plumber more than they relied on me because they knew I was in favour of renewable energy, that was my job.

But when the plumber, he got used to this and could see that he had a new product in his factory, then he would of course be interested in selling a furnace of some kind: I prefer a wood furnace, or a wood-pillared furnace, and a solar panel, and do both. So he'd recommend for the consumer and the customers now, well, many people have now a double installation, because then in the summertime you can shut off your traditional furnace and only supply your house from solar energy – and so people will do that.

So we have to prove that there's a business potential in it, that it pays to do these things, and that the community will back it, back up the idea. So now I think you could go round asking in the streets and most people will say it has been good for Samsø to have the renewable energy island, good for development, good for business, and good for jobs.

Narrator

The generally positive attitude of the population, plus individual and community investment, means the island is well on the way to meeting all of its sustainability targets for heat and power.

Emissions from transport are proving a much tougher nut to crack. The island is still very much reliant on carbon-based vehicle fuels.

With surplus electricity from the wind turbines, electric vehicles seem like an obvious solution.

But existing vehicles have quite a lot of limitations in their use, and the island authorities are waiting for the next generation of electric vehicles to become more widely available.

It's likely that these will be powered by fuel cells that run on hydrogen gas. On Samsø, the hydrogen could be locally produced, again using surplus electricity from the offshore turbines.

Hydrogen can also be burned in modified combustion engines.

Hydrogen combustion engines offer zero carbon solutions across the board – from private cars to public transport.

One option for the island is to create an infrastructure similar to this one in Munich, which was the first commercial hydrogen filling station in the world.

Hydrogen powered buses are being trialled in many cities across Europe, but at the moment, there are no affordable, commercially available hydrogen powered cars.

Søren Hermansen

We've written to the EU, said that we are ready to be a demonstration project for some hydrogen cars also and, hopefully, we'll be in a project where we can make a co-operation with other projects where it'll be a demonstration, I mean we can develop a demonstration project on Samsø.

We have the electricity where we could produce the hydrogen, so we already have the means or the sources of energy available, but it's a little bit out in the future.

Narrator

But one alternative fuel is already undergoing small-scale trials.

Søren Hermansen

We have a small demonstration project according to transport where we are utilising plant oil. We press, we have a rapeseed press, and we press virgin oil, and we can use it directly on, a little bit that transformed diesel engines - they need to have a pre-heating system and some new valves also - and then you'll be able to use plant oil for transportation: that'll be mainly for trucks and diesel engines – cars, not so much.

Narrator

Erik Andersen is one of the farmers involved in the trial.

Erik Andersen

I think running on vegetable oil is just thrilling, you know, first of all pump it up and refine it and transport it and there you can just take it from the seed, put the seed in the presser, and then have the oil, and the oil is just ready for putting on the tractor.

I choose it because of the renewable thing and its CO2 neutral, and it's an ideal thing for me to do. And because I can feed the cake for the cows, it's a very good protein source, and the cows have no use for the oil.

Narrator

So what's it like actually driving the tractor?

Erik Andersen

It smells like Kentucky Fried Chicken, and it's the same thing as driving and the tractor running on fossil oil. It's the same power and it's no different from, except from the smell.

Narrator

It might be smelly, but it's sustainable and carbon-neutral.

The problem of reducing carbon emissions is compounded by the fact that Samsø is a popular tourist destination.

It's not just residents and visitors' vehicles that count towards Samsø's emissions tally; it's the ferries as well.

The solution they came up with was a localised emissions trading scheme.

Søren Hermansen

And that is why we erected ten offshore wind turbines. And that was meant to be kind of compensation for the CO2 emission from the cars.

So we could then say that we cut down the CO2 by producing CO2-free energy in the same amount at the offshore wind turbines.

Narrator

In the short term, the turbines more than offset the emissions from vehicles and oil burning appliances. In the future they may well supply the energy for generating hydrogen used as vehicle fuel. The hydrogen could also be used in domestic and industrial boilers or CHP units.

Samsø is well on track to achieve its ten-year target of 100% renewable energy.