

Nancy: It's Sunday, April 4, 2010, and Svein Richard Brandtzæg is in a taxi on his way to Heathrow Airport, headed back to Norway. And he's bummed.

As the CEO of Norsk Hydro, he had just spent the last four days negotiating with the CEO of a Brazilian company, Vale, over the purchase of one of the largest bauxite mines in the world, as well as the company's gigantic alumina refinery.

The purchase would solve Norsk Hydro's biggest problem — they needed access to raw materials to make aluminium, one of their core products.

The price tag was huge —\$6 billion dollars. If it went through, the deal would be record breaking, the biggest single purchase by a Norwegian-owned company in the history of the nation.

But after four days of hard haggling...

Svein Richard: I said that this is not going to work.

Nancy: So...

Svein Richard: We didn't agree and I said I will go back to the airport. I thought that the deal was lost.

Nancy: As the taxi wound its way westward, Svein Richard pondered the situation. Since he took over as CEO in 2009, he'd worked day and night to keep Norsk Hydro afloat. A weak dollar and declining aluminium prices meant Norsk Hydro had been hemorrhaging money — at one point roughly 10 million kroner — or 2 million US dollars— a DAY. Everyone in the aluminium industry was struggling. But as the saying goes, out of crisis comes opportunity.

Svein Richard (6:00): That was a good opportunity for me to talk to the CEO of Vale, which also had some problems with aluminium, because the aluminium business globally was very much down and many companies lost money at that time.

Nancy: The deal with Vale could have been a life saver. And then the phone rang in the back of the taxi...

Nancy: I'm Nancy Bazilchuk, and you're listening to 63 Degrees North, an original podcast from NTNU, the Norwegian University of Science and Technology.

Today I'm going to tell you the surprising stories of how aluminium became one of the driving forces in the Norwegian economy, and what that means now, as more and more people rely on aluminium for everything from making electric cars to energy efficient windows and doors. I'll even take you behind the scenes to see what

the future holds, as researchers figure out advanced ways to make aluminium stronger, more energy efficient and easier to recycle.

It's a story of a new nation trying to find its way in the global economy, brilliant engineers who found themselves forced into an uncomfortable alliance with Nazi Germany, British transplants who early on built worker welfare into their industrial planning, and a young Norwegian engineer and NTNU graduate who after 24 years, took the helm of his company and transformed it into a global giant. Even the Luftwaffe's Hermann Göring plays a cameo role.

Hans Otto: The aluminum industry connected Norway, the political system and the Norwegian economy to the global economy. It's a crucial part of Norwegian history. And It's really a good story to learn about globalization, the goods and the bads of globalization.

Nancy: That's....

Hans Otto: Hans Otto Frøland, and I am a professor in contemporary European history here at NTNU.

Nancy: Hans Otto has combed through public documents, company records, private letters and newspaper articles to put together the economic history of aluminium in Norway.

Hans Otto: It is so illuminating, it helps me understand the Norwegian political economy in a country highly dependent on foreign markets. Because Norway is too small. We would have had a subsistence economy had we been doing only farming.

Nancy: It wasn't until the late 1800s that scientists and engineers began to figure out how to extract it from ore at anything approaching useful amounts.

Part of the problem was that extracting aluminium from bauxite ore needed something that was in desperately short supply at the turn of the last century.

That thing — was electricity.

In the early 1900s, Norway was a place that earned most of its export income from its merchant fleet, and from fish and wood. It turns out what saved countless numbers of Norwegians from having to subsist on cabbage, potatoes and cod was water.

More accurately, hydropower.

Hans Otto: Norway had abundant resources of cheap energy. ...

Hans Otto: The technology was in place to refine bauxite into alumina and to send alumina through electrolysis to produce, to smelt aluminium.

Nancy: But while Norway had plenty of waterfalls, it didn't have much capital to build a modern economy. For one thing, when the aluminium age first began, Norway was still a very young country.

When it became independent of Sweden in 1905, Norway had an economy that was based on the extraction of natural resources. The question then, Hans Otto says, was how to enter the world economy in a smart way.

For one thing, Norway had the ability to exploit its waterfalls to generate electricity, but smelting aluminium? That was pretty complicated. So they needed outside help. And they needed outside money, foreign capital.

Hans Otto: It was only in 1906 that the British aluminium company started investing in aluminium production. And this was really big issue at the time because Norway was a new nation in 1905. And so economic nationalism was much preferred. And the regulations set up to control foreign investments in the Norwegian electrochemical and metallurgical industries were widely supported, but they were managed quite liberally simply because this was a part of Norwegian modernization strategy. And there was not sufficient capital in Norway to build up the aluminum industry.

Nancy: It turned out that Norway's national fervor stood the country in good stead. Why? One of the risks of having a country's export economy based on the extraction of natural resources and raw material is that the foreign companies — but not local entities — can profit a lot by developing these resources or raw materials.

Norway, it turns out, realized early on that they had to protect themselves from by foreign companies coming in and buying up all the rights to the country's waterfalls. So they enacted a series of laws that continue to be unique in Europe that have strict requirements for any non-Norwegian companies looking to exploit the country's waterfalls — or other resources as it happens.

Hans Otto: There was one law that called the panic law because so many foreigners came to Norway to buy up waterfalls cheap, because it was poor peasants who own these waterfalls, and they didn't know the future value of it.

Nancy: Essentially these laws and regulations limited the time a foreign entity could license a waterfall for power production, and returned the rights to the waterfall to the state after the license period ended. The government also created other requirements, such as requiring foreign companies be registered and governed by

Norwegian law, and to buy as much as possible of the materials they needed in Norway. The law also allows the government or municipalities to enact a tax on the use of the waterfall.

Hans Otto: And many scholars would argue that these regulations specifically is crucial to understand why a resource abundant country like Norway never was forced into the resource curse. So the theory of the resource curse says that the most resource rich countries are the poorest countries.

Nancy: Think of exploitation in countries like Angola, Nigeria, Sudan and Republic of Congo, which are rich in oil, diamonds and other minerals, and yet residents have a low income and low quality of life.

Hans Otto: Very often this is foreign capital coming in, grabbing the resources, and taking out the resources and taking all the profits from it. So, through these regulations, the Norwegian government parliament has been able to establish inward linkages into the domestic economy.

Nancy: In fact, this lesson would stand Norway in good stead 60 years later, when another abundant natural resource —oil — was first discovered on the Norwegian continental shelf. Hans Otto thinks that this kind of foresight is actually one reason why Norway's welfare system is as strong as it is today.

Hans Otto: Yep. So I will take it even further and argue that Norway wouldn't have had the welfare state it has without these kinds of regulations on natural resources.

Nancy: But who were the people who set the stage for developing Norway's aluminium industry? For that, we have to go to Stangfjorden, where the first aluminium ever produced in Norway came from. The company there, Stangfjorden Elektrokjemiske Fabriker, was actually owned by the British Aluminium Company, called BACO. They came to Stangfjorden because local residents had already developed the town's waterfall to produce electricity to make fuel out of peat. While producing peat for fuel turned out not to be that profitable, BACO saw they could take advantage of the hydropower and the town's ice-free harbor for an aluminium smelter. It was a good deal for Norway, too, because it needed foreign expertise and foreign capital in the early years. So BACO brought in a British engineer to run the smelter, a man named....

Hans Otto: Maurice Russell Turner, a British citizen, who actually was the only foreign manager in the aluminium industry who integrated into Norwegian society.

Nancy: This is the early 1900s, and industrialization, coupled with electrification, was in full swing. Companies are building factories all over Europe and North America, and they are eager to keep their workers happy. Maurice Russell Turner, who

married a Norwegian woman in 1911, just a year after he was appointed manager of the smelter, was no exception — except that he went above and beyond what most would do.

He built housing, schools, a shipyard. And....

Hans Otto: He wanted streetlights. He took the energy from the factory and built streetlights, a school was set up and a public bath..... And at least two shuttle boats, so the people in the community could travel.

Hans Otto: While company towns were built all over where the aluminium industry settled.... Turner wanted to develop this society in which he wanted to live as well with his family and socialize with the locals, which was not very usual among the foreign managers of the other company towns and factories.

Nancy: A photograph from this period shows Turner with his wife and three children in Stangfjorden. He's wearing a grey three piece suit with knickers instead of slacks, and a flat cap that looks like something a newsboy might wear. In other words, he was a fairly typical businessman of the time. Except...

Hans Otto: he was very early aware of the externalities, the environmental impact of the aluminium production, you know from electrolysis there is a emission of fluoride.

Nancy: You probably know fluoride because it's used in toothpaste to strengthen our teeth. But what you may not know is that too much of it can damage your bones. Hans Otto says that local farmers started to notice that their cows had skeletal problems. Turner decided to do something about it.

Hans Otto: Turner acknowledged this and he even drafted a plan for taking care of this, or find new technology to capture it, so that it did not destroy the environment. However, the London office turned him down. They even rejected that this was the case although it seems to me that they were aware of it.

Nancy: Turner eventually got the British Aluminium Company to pay the farmers for their dead or dying cows, but it would be decades before the industry acknowledged the fluoride problem and did something about it.

Nancy: All might have continued to go swimmingly for Turner, but for one thing.

And that one thing.... was Nazi Germany.

Nancy: Fast forward to April 1940.

The Nazis shocked the world and the Norwegian population when they marched into Norway and took full control of the country in a matter of months. Norway thought it would be able to remain neutral, like it did during the First World War, but Hitler had other plans.

Why was Norway, this little country on the northern fringe of Europe, so important to Germany? Well, Norway offered the Nazis access to neutral Sweden and its iron ore deposits, which Germany needed. But the Germans also needed something else.

Hans Otto: Well, to understand this, we have to take account of the fact that aluminum had become a strategic metal. If you want to win the war, you have to control the air, and to control the air you need airplanes and to produce airplanes, you need aluminum and other light metals, and to produce aluminum, you need energy. And Norway had a lot of energy.

Nancy: So when Germany occupied Norway in 1940, Field Marshall Hermann Göring, as leader of the Luftwaffe and the air ministry, put in motion an expansion plan for Norway to make this newly occupied country the supplier of aluminum for the German Luftwaffe and the German aircraft industry.

Hans Otto: this was a very strong German policy.

Nancy: The policy included...

Hans Otto: ...what the Germans called Fiendfarmugen, enemy property that the Germans could manage.

Nancy: And Stangfjorden Fabriker was owned by the British — Germany's enemy.

Hans Otto: So, Russell Turner fled back to England.

Nancy: Turner and his family left Stangfjorden on May 1 and were able to board a British warship as refugees. They escaped just in the nick of time. The Gestapo came looking for him right after he left.

The smelter that Turner left produced small amounts of aluminium during the war, but shut down in 1948. It left a legacy, though— the workers who were trained there went on to work in other Norwegian aluminium smelters. In fact, the largest aluminium smelter in Europe, in Sunndal, has workers whose great-great grandparents worked at Stangfjorden.

Nancy: Another Norwegian aluminium pioneer didn't weather the war quite as well as Turner.

His name was....

Hans Otto: Sigurd Kloumann. He, up to the Second World War, pursued a national strategy of industrialization. He wanted to set up a national industry, freed from the power of the multinational aluminium companies.

Nancy: Kloumann's determination allowed him to establish the Norwegian Aluminium Corporation, or NACO, and build a solid industry in the pre-war years. There were other multinational companies that also invested in Norwegian aluminium, but Kloumann's NACO was the key producer.

So when Hermann Göring showed up, it put Kloumann in a dangerous position. Göring was determined to ramp up Norwegian aluminium production. He had all those planes to build to win the war, after all.

Kloumann had to choose. He could either cooperate — or face the wrath of the Nazis. In the end, for a variety of reasons, he chose to cooperate....

Hans Otto: ...by supplying information to the Germans, in 1940 telling them where the power stations were located, where there was potential for setting up new power stations, how much power they possibly would produce, the capacity, et cetera. And this, information was absolutely crucial for the Germans when they planned for expanding the Norwegian aluminum production capacity during the occupation.

Nancy: the Germans were overly ambitious. For one thing, Allied blockades meant there were shortages of bauxite, the ore from which aluminium is smelted. Hans Otto called Göring's expansion plan megalomania.

Hans Otto: This program was overstretched from the beginning and never produced a kilo of aluminum in Norway.

Nancy: After the war, Kloumann was tried for treason — but not convicted. Nevertheless, he lived his life out in disgrace. But his cooperation with the Nazis actually benefitted Norway in the end.

Hans Otto: The Germans left a lot of capacities from the failed light metals expansion program, and the question for the new Norwegian government is what to do with this. The labor party government wants to establish an aluminum industry, which is free from the constraints of the global cartels. So in 1947, the parliament sets up Årdal Verk, which is largely based on the remaining capacities of Germany, the light metal program. In 1951, it sets up Sunndal Verk, based on the capacity left by the Germans in Sunndal, because they had almost completed the power station.

Nancy: So Kloumann's decision to cooperate actually set the stage for the emergence of one of the world's largest integrated aluminium companies — the Norwegian company you heard about at the beginning of this podcast, Hydro. The two plants, Årdal Verk, and Sunndal Verk, would grow, and eventually merge, and then in 1986, would become part of Hydro.

Svein Richard: If you look at Hydro today, it is the largest integrated aluminium company outside China.

Nancy: That's

Svein Richard: Svein Richard Brandzæg. And I have now I stepped down as the CEO of Norsk Hydro... after working for Hydro in 34 years.

Nancy: When we last heard from Svein Richard, at the top of the podcast, he had just concluded four frustrating days negotiating with the Brazilian company Vale . He was on his way to Heathrow.

Svein Richard: in the last meeting, I said that this is not going to work because the gap was too big. And we were talking about a lot of money, the deal was \$6 billion US dollars. So when you're negotiating that, we are talking about quite a lot of money when we have a gap. But we didn't agree and that last day I said I will go.

Svein Richard: So when I was in the taxi in the airport, he called me and then the he agreed with our position.

Nancy: The deal was ON!

Svein Richard: The taxi driver was probably surprised to hear that the person in the back seat actually was talking about billions of dollars.

Nancy: This purchase of Vale's aluminium business, including Paragominas, one of the largest bauxite mines in the world, and a 91 percent share of the world's largest alumina refinery Alunorte transformed Hydro into...

Svein Richard: a company with a full value chain from raw material to finished products, which is delivered to assembly lines of automotive industry, for example, and it's a company that is also have strong positions in the building and construction, engineering and several other market segments and it's really global company.

Nancy: Remember, alumina is refined from bauxite, and is the product used to actually make aluminium.

Think of Hermann Görings failed plans to expand Norwegian aluminium production during the war: One of the many reasons it bombed — sorry — was a lack of bauxite ore. In one big acquisition, Svein Richard remedied this problem.

Nancy: Another area where Svein Richard and Hydro have had a direct impact on the aluminium business is in making the company greener. Remember, one of the main reasons that Norway has become so invested in making aluminum is readily available hydropower. Yet it still has a pretty big climate footprint all told, something Svein Richard recognized. He set one of his goals to make Hydro

Svein Richard: the greenest aluminium company in the world. In fact, together with the researchers and professors at NTNU, we were able to develop the most energy efficient aluminium production in the world with also the lowest emissions in the world.

Nancy: And one person who is helping make aluminium greener is...

Randi: Randi Holmestad in the Department of Physics at NTNU

Randi: Some of my colleagues say that everything about aluminium was figured out like 100 years ago. But if you go into this and really look at it, it's more like applied physics.

Nancy: To understand what Randi does, you first have to understand a little bit about aluminium and how its properties affect its use.

Randi: If you have a rod of 100% aluminium, and then you bend it, it will really easily be bent. If you change like one to 2% of the content in this rod, to magnesium and silicon and you try to bend this long rod, then it's completely different. And it's much much harder, it's much stronger.

Randi: And the reason for this extra strength is that this small, less than one or 1% magnesium and silicon, have made small small needles that are like 1000 times thinner than your hair that are lying in different directions inside this aluminium rod and that is making the strength.

Nancy: So Randi looks deep inside the atomic structure of the aluminium, to figure out what's going on.

Randi: To study these needles, which are so, so small, you need a microscope or atom probe or something much stronger because in an electron microscope we can see things because we use electrons instead of light, so we can see things that are

extremely extremely small, down to atomic size. And this is why Hydro is so interested in us and support us in our research.

Nancy: Randi can help figure out the best ways to make aluminium as strong and light as possible so it can be used in the cages for electric car batteries, for example. She can also figure out what happens to the strength and properties of aluminium when more and more of the aluminium is recycled. Pretty much all of the aluminium we use now is what is called an alloy, and has trace metals in it. But if you mix different kinds of aluminium alloys together when you melt it for recycling, it can cause problems.

Randi: This is all about trying to kind of get the industry more sustainable.

Nancy: But remember how Hans Otto said how the aluminium industry in Norway illustrated both the good and the bad of globalization? Svein Richard got to experience the down side of the Vale purchase with catastrophic rains in northern Brazil in February 2018.

Essentially what happened was that 200 mm of rainfall was recorded over 12 hours in the area where Hydro had its AluNorte alumina refinery, of which 150 millimeters came in just two to three hours.

The huge amount of water meant the refinery deliberately released partly treated rainwater to the Para River to prevent its waste treatment system from being overwhelmed. But the management didn't tell the local community what had happened, and denied at the beginning that there had been a problem. The local community was worried that the refinery wastes had leaked out of the plant's bauxite residue pits, although a number of independent studies, including studies by the Brazilian state and federal environmental agencies showed that did not happen.

Svein Richard: When I heard about that, I took the first plane down to Brazil and visited the villages just to see with my own eyes.

Nancy: Long story short, Hydro realized it had to do more to improve the situation of people living in the area around the refinery, where there were open sewage ditches which overflowed during the huge rains.

Svein Richard: ...It was terrible situation. So we saw that at that time that we had to do more for these people. And then we started a programme that has been continued after after I left and I think the relationship with neighbours, which is now living next to the fence of outside the fence of AluNorte has developed in a very positive direction.

Nancy: Global climate change means that Norway's fifty-year love affair with oil from the Norwegian continental shelf will have to come to an end. Does that mean that Norway's post-oil economy will be dominated by aluminium? We'll give Svein Richard the last word.

Svein Richard: we have been through a period where energy has been driven by petroleum. And in the next decades the energy development will be driven by materials. To develop solar solar panels, to develop wind turbines, to replace petroleum, it requires a lot of materials, and material technologies will be more and more important going forward. And there I think we can build on what we have in Norway and be prepared for the future.

Nancy: I'm Nancy Bazilchuk, and you've been listening to 63 degrees North, an original podcast from the Norwegian University of Science and Technology. If you'd like to learn more about the speakers on today's program, or look at some of the academic publications used to write this script, check out our show notes. Sound design, and editorial help from Historiebruket. Thanks for listening.