

# Envisioning Transmission Transition: Denmark's Incremental Shifts Towards Energy Independence

A PHOTO ESSAY

By Michael Cote

## Abstract

On the surface, Copenhagen, Denmark is the ultimate green city. Bike lanes thread the medieval cobblestones like smooth ribbons. Old, European stone architecture is inflected with modern, steel and glass, and highly efficient buildings. And wind turbines file like soldiers in the Baltic Sea. Yet, as this photo essay will show, the huge coal plants that ring the city are not what they seem.

Denmark is recognized around the world for its highly advanced energy, environmental, and land use regulations and policies. It was one of the first countries to adopt both national sustainability initiatives and greenhouse gas emissions regulations. Its energy infrastructure, the most efficient on earth, is as unpretentiously integrated with the social fabric of the country as it is visually striking. Yet, despite 30 years of aggressive anti-fossil fuel mandates, Denmark is still struggling to attain energy independence.



The greenest of cities, Copenhagen is proud of the fact that old infrastructure can be tastefully retrofitted with new technologies. As a result, energy production and consumption is at the forefront of the minds of the Danes. Rather than demolishing or abandoning its dirty, aging coal fired plants, Denmark has slowly been converting them into cleaner, highly efficient cogenerators. Cogeneration power plants burn multiple fuel types such as wood pellets, natural gas, straw, and even trash to produce electricity both for the grid and for distributed heat to homes and businesses. This scheme is accepted at nearly every level of Danish society, from student commuters to sleek new businesses. Denmark's energy technologies are exported around the world. Unfortunately, the transition is largely incomplete.

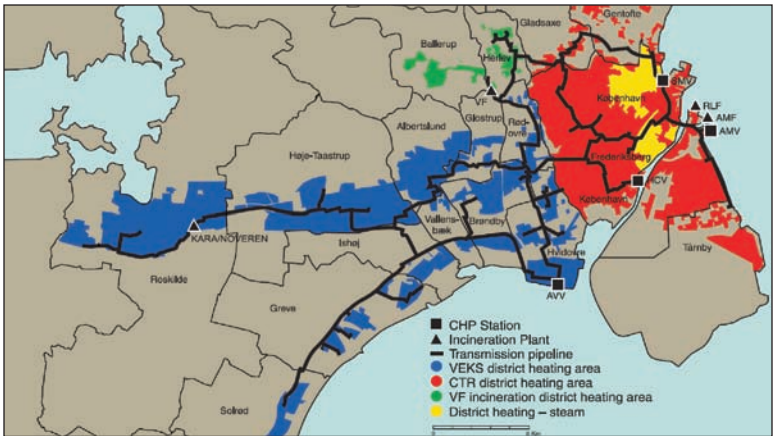


Not only has the power grid been retrofitted, its ownership structure has evolved as well. The leading example is the once privately held Avedøre Power Station, now owned in cooperative by the Danish citizens. The station is recognized as one of the most efficient multi-fueled power plants in the world. Avedøre Unit 1 (left) burns imported coal as efficiently and cleanly as possible. The newer biomass cogenerator, Avedøre Unit 2 (center left), burns a combination of natural gas, straw, wood pellets, and other bio fuels. The wind turbine to the right provides on-site electricity. Together the plants produce 825MW of electricity for 1.3 million people, and 900MW of district heat for 200,000 people.

Avedøre Unit 2 was built in 2001 on condition that three older coal fired power plants be decommissioned. Developed and engineered in partnership with energy technology firms Energy E2 and Vattenfall, it is now managed by Dong Energy under the control and direction of the Danish government and the Danish citizens.



Denmark's Electricity Act of 1994 took the extraordinary step of completely phasing out the use of coal as an energy source by 2030, and in 1997 the Danish government banned any new power plants from burning coal. Today, a new impetus exists for energy independence: climate change. Denmark's stated goal is to lower carbon emissions by 21% from 1990 levels by 2012, reducing further the number of coal plants in the country. Collectively, these policy efforts have led to major investments in its combined heat and power plant infrastructure. Expanding regionally since the 1920s, for example, Denmark's district heating network is the most successful in the world. For decades, power plants discharged used heated wastewater directly into the busy Øresund sound, essentially wasting good energy. That energy is now harnessed for good use and pumped through a complex network of underground pipes servicing the Øresund Region, which encompasses several large municipalities with about 2.5 million residents.



The Hans Christian Anderson Ørsted Power Station is one such station connected to the updated grid. Located in southwestern Copenhagen in the harbor neighborhood Kongens Enghave, its large stacks can be seen for miles around. Built in 1920, it burned coal until 1994 when it was converted to burn multiple fuels. Now the retrofitted plant produces 815 MJ/s of district heat and 185 MW of electricity for the city.



Denmark aggressively invests in the integration, expansion, and export of new energy technologies, yet it is highly dependent on imported foreign oil and coal. Here, oil tankers await their port call in the Øresund strait off the coast of Copenhagen and just beyond the 20-turbine, 40 MW Middlegruden Wind Farm. The country's stated goal is to achieve 50% wind power by 2025, and create a model smart grid for all the EU states. Paradoxically, this ambitious goal is overshadowed by the tangible demands of the renewable energy manufacturing sector. Construction and raw materials, ocean and land shipping, and the manufacturing plants themselves consume more fossil energy than can be produced by renewables. It is unclear how Denmark will overcome these contradictions.



In December, 2009, Copenhagen hosted the 15th United Nations Climate Change Conference of the Parties (COP15) with the goal of extending or renegotiating the expiring Kyoto Protocol. No official agreement was achieved. The conference will reconvene negotiations at Cancún, Mexico, in November 2010. As with most multi-national conferences that impact the environment, protesters assembled to demand that leaders immediately respond to the dangers of climate change. Here, a group of protesters travel to a peaceful march held outside the conference venue—in the background, a retrofitted power plant. Given the complex, high-level context of the COP15 negotiations, the question becomes: How will protesters obtain an effective negotiation seat at the international table? Further, does protest provide a viable alternative to negotiating?



The response from authorities to COP15 protesters was swift, visually pronounced, and had an air of the authoritarian. On the one hand, the Danish police were protecting leaders representing 115 countries and 20,000 attendees from ostensible harm. On the other hand, protesters' voices were shut down and left out of the climate negotiation process.



Protesters take to the streets of Copenhagen during COP15. Activists are more wired, Internet savvy, and socially interconnected than ever before. Yet, when shut out of the environmental negotiation process, efforts such as these become largely symbolic. It is difficult for the general public to comprehend and empathize with their cause. If energy independence is to be achieved around the globe, a more balanced, democratic approach, such as Denmark's, looks more and more cumbersome and ineffective. So, too, does protesting.



Denmark's efforts to move towards sustainable living clearly deserve respect and reverence. After all, over 30% of Copenhagen's residents currently travel by bike, a percentage that is growing due to the country's ever expanding regulatory incentives. Yet, its cities are far from the ideal model that they are often made out to be. Despite a severely prohibitive 200% vehicle tax imposed by the socialist-democratic country, automobiles and their respective advertisements are clearly abundant in urban areas.



In addition to investments in the energy grid and new technology economies, Denmark has invested billions in architectural efficiency, integrated pedestrian/bike/vehicular design, and urban planning research. Dozens of cities around the globe look to Denmark for transportation design and planning prototypes. What Denmark is not exporting is the incredible, long-term effort and commitment it takes to create valid expressions of these so-called utopian neighborhoods. Such persistent commitment captures “hearts-and-minds” only after decades of work. It is true that neighborhood infrastructure can be retrofitted to integrate better transportation uses—however, to actualize a low-consumption lifestyle takes not only tremendous political will, but also a receptive population. Fortunately, the citizenry of Denmark has been accommodating to such changes.



*Michael Cote, a planning and law student at UMass-Amherst and Vermont Law School respectively, attended the United Nations Climate Change Conference (COP15) in December 2009. A researcher of climate change adaptation techniques, he took many photos throughout the City of Copenhagen.*