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Heating the 'Hood

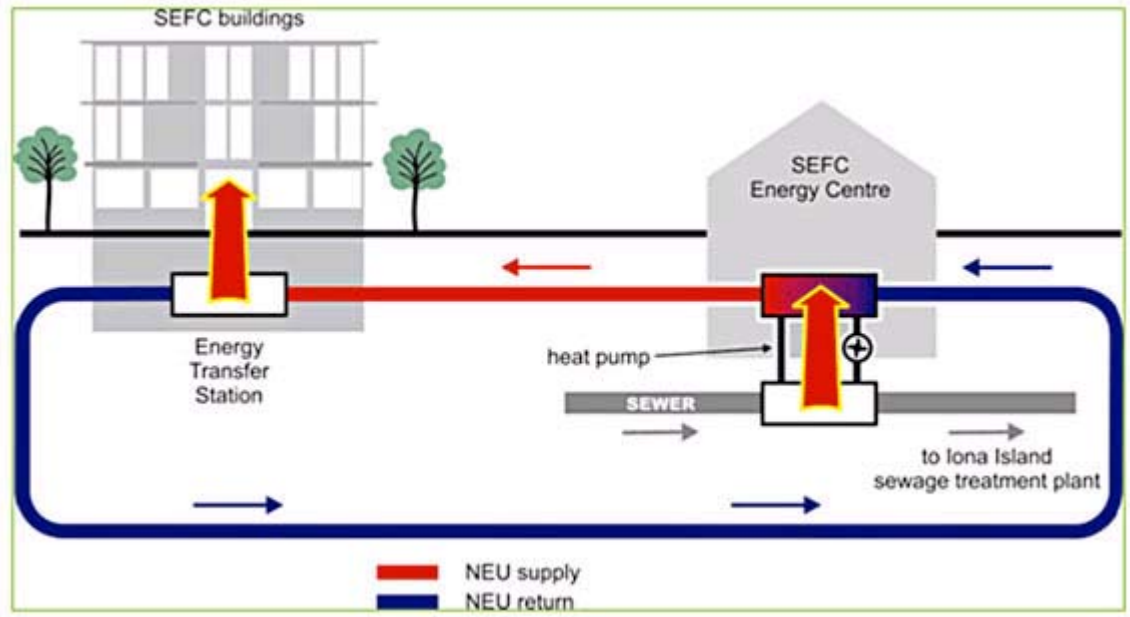
District heating plants are getting a whole new lease on life.

By Linda Baker

When the first phase of the 80-acre Southeast False Creek development opens in Vancouver, British Columbia, this winter, the mixed use project will include several familiar green building features, such as leed gold-rated buildings, eco-roofs, and rainwater harvesting schemes.

But the much-anticipated development, which will initially house Olympic athletes during the 2010 games, will also include designs that are not so familiar — most notably a community heating plant, powered by raw sewage.

Located beneath the Cambie Street Bridge on the downtown waterfront, the Southeast False Creek Neighbourhood Energy Utility will eventually provide heat to the entire six-million-square-foot development and is expected to spew only half the greenhouse gas emissions of a conventionally heated project. In addition to the green fuel source, the key to the utility's efficiency is consolidating energy production, explains city of Vancouver project manager Chris Baber. "Rather than install a renewable energy source at each building parcel, which can be very expensive, you centralize the heat source in a single plant and get economies of scale" for the whole neighborhood, he says.



The Vancouver neighborhood energy unit is one of a small but growing number of renewably powered, community-based heating systems springing up across North America. Such projects, which are also called district heating or central plants, are not entirely new. Thermal energy systems have served commercial business districts in New York, Chicago, and other cities for more than a century. In Scandinavian countries, most residential communities are hooked up to community thermal systems.

Now a 19th century technology is getting a new look, this time as a clean energy and global warming mitigation strategy. Canada is ahead of the game, pioneering solar thermal and waste sewage heat recovery systems. But the U.S. is also experiencing a surge of interest in this sector, says Rob

Thornton, executive director of the International District Energy Association. "It's driven by a convergence of factors: carbon footprint objectives and the energy crisis," he says.

One indicator of U.S. demand is the federal stimulus package, which allocated $156 million for district energy projects. Last July, the Department of Energy received 356 proposals requesting a total of $3.4 billion in federal support. (Decisions on specific projects were pending at press time.) District energy proposals also show up in many city and state greenhouse gas reduction plans. In Portland, Oregon, the development of district heating was identified as a key action in the city's recently released climate action strategy, which aims to reduce greenhouse gases 80 percent by 2050. For their part, operators of existing thermal energy systems, most of which run on fossil fuels, are beginning to transition to renewable energy sources such as biomass.

Ins and outs

To understand the precise benefits of community heating systems, consider that heating and cooling consume a whopping 60 percent of a building's energy use. But unlike high-tech green power solutions, such as hybrid vehicles and fuel cells, district thermal technology takes a simple, conservation-of-energy approach to reducing fuel consumption. As Thornton puts it: "If environmental benefit is the result of district heating, efficiency is the mechanism."

Here's how it works: A central plant produces hot water (conventional systems use steam), which is then delivered via underground pipe to participating buildings. Inside the buildings, heat exchangers draw energy from the water to meet space heating and hot water needs. The water is then returned to the plant and recirculated in a closed loop system. As community-based systems, central plants eliminate the need to install individual boilers or furnaces in each building (or house), thereby reducing capital costs for developers. Inherent fuel efficiencies are associated with heating multiple buildings at the same time. According to IDEA, district plants are about 20 percent more efficient than building-based systems.

In an evolving renewable energy market, neighborhood thermal projects have another advantage. It's much easier to adapt a single plant to different fuel sources than to retrofit 100 different buildings. "From sewage heat recovery, to biomass to waste heat — who knows what will be the green technologies of choice in the future?" asks Baber. "District energy enables communities to be flexible with respect to energy use in future years." In the False Creek model, heat pumps transfer thermal energy from warm sewage, a latent heat source. A flue stack provides ventilation for the sewage handling area.

Snapshots from around the country reveal other possibilities. In Montpelier, Vermont, the fuel of choice for a proposed community energy system is locally sourced wood chips. "This is Vermont. We have a lot of trees," explains Gwendolyn Hallsmith, director of planning for the city of Montpelier. Last September, the city applied for $8 million in federal stimulus money to help fund the $22 million project, which would serve the state capitol complex, city-owned properties including schools and city hall, and up to 156 other downtown buildings. Collectively, these properties now burn about 913,694 gallons of oil per year and each gallon emits 22 pounds of carbon dioxide. The community energy system is expected to reduce those emissions by approximately 90 percent.

Echoing IDEA's Thornton, Hallsmith says the biomass proposal was inspired by a confluence of environmental and economic factors. The Montpelier climate action plan calls for reducing greenhouse gas emissions by at least 80 percent by 2030, and the Vermont Energy Act of 2009 created a pilot program to encourage the development of district heating systems. The private sector was also on board, Hallsmith says. "When we had that spike in oil prices, we had landlords knocking down our doors, saying: 'When are you going to get this plant built? We want it tomorrow.'"

In November, Seattle Steam, a district heating system powered by diesel oil and natural gas, converted one of the plant's five boilers to biomass sourced from construction wood waste. Says president Stan Gent: "I joined the company five years ago, and the owners when they hired me said, 'We've been providing heat to downtown Seattle for 115 years. What we really want to know is how do we do that for the next 100 years in a carbon constrained future?'" The biomass conversion didn't impact the cost to customers "and will reduce our carbon footprint by what looks like almost 50 percent," Gent says.

Then there's the nonprofit District Energy of St. Paul in Minnesota, which got its start as a coal-fired plant in 1993 and now serves 185 downtown buildings on a 70–30 mix of biomass and fossil fuels. The system is about 20 percent more efficient than a building-based approach and has reduced emissions by 280,000 tons annually, says District Energy president Anders Rydaker, who is also a recipient of an International District Energy Association Prize.

"Our success here is because of our flexibility with different energy sources," Rydaker says. "We

started off as a coal-fired plant because that's what was there. Now the majority is produced from wood waste, but we still have flexibility." The next step is to integrate thermal solar into the system; the company has already installed six panels near its downtown plant for testing purposes.

Start from scratch

The reinvention of district heating is part of a larger 21st century story. Today, everything old is new — bicycles, streetcars, and backyard food gardens — and now, district energy. Neighborhood energy plants also fit into the "buy local" philosophy, which has become something of a benchmark for sustainable urban planning. Or, as Seattle Steam's Gent puts it: "It all goes back to how you get a community to start thinking about energy."

He relayed a story about a Seattle developer who was interested in building a mixed use project near one of the new Sound Transit light rail stations. After Gent identified a sewer line as a potential district heating source, the next step was to figure out how to actually extract the thermal energy. "That might mean a heat pump," he says. "Well, the heat pump needs electricity, and coal-fired is not so good." More investigation ensued, revealing a nearby city dump as a source of methane gas, which in turn could generate electricity to power the heat pump. "All of a sudden, after looking at what your local resources are, you have a total energy plan," says Gent.

Although that project is on hold until the economy recovers, the message is transferable. Energy planning cannot be an afterthought in the larger urban or community planning process, industry experts agree. In the case of district heating, one of the biggest challenges is the upfront capital cost, Chris Baber of Vancouver says. "Early on you want to make sure you're getting enough energy demand year round for the investment you're making in infrastructure." In Montpelier, city officials solved the demand conundrum by signing the state on as an anchor customer — ensuring almost one million square feet of development would be served by the community energy system. "It helped make the project viable," says Hallsmith.

Funding for the $29 million False Creek utility — the first district thermal project in North America to actually use sewage heat recovery — included a $9.5 million provincial grant and a $5 million low-interest loan from the Canadian government. The remainder came from city bonds, which will be repaid through rates billed to future customers. In a whimsical touch, the plant's flue stacks have been sculptured in the shape of a stainless steel hand. The fingernails, fashioned out of LED panels, change color depending on the amount of green energy being used. (Although most of the unit's thermal energy will come from sewage heat recovery, high-efficiency natural gas boilers will provide backup heat).

The economics of district heating does raise questions about the relationship between such systems and local gas and electric utilities. Existing models showcase possible synergies. Drakes Landing, a 52-home subdivison in Okotoks, Alberta, is served by a pioneering solar thermal system developed in partnership between Natural Resources Canada, the city of Okotoks, and ATCO Gas, an Alberta utility. ATCO is delivering both the back-up natural gas and the piping for heat distribution.

In St. Paul, Xcel Energy sells natural gas to District Energy, but the utility also competes with the nonprofit for customers. (So far, District Energy is winning, claiming 80 percent of downtown real estate.) In Portland, the city and private developers have proposed building a community thermal plant downtown — powered, potentially, by waste beer mash, a signature local resource. Bill Edmonds, director of environmental policy for NW Natural, a local natural gas utility, says the company could conceivably provide backup fuel or install the system piping. "The world is changing," he says, "and we will be changing with it."

District energy supporters are counting on it — even if change is happening more slowly than desired. "Since we started on this journey, the economy has gone into a tailspin, the cost of natural gas has dropped, nobody is building buildings, so there is not much wood around," Gent says. Still, he adds, "utilities have to take a longer view; we'll get through it."

As Congress takes up the issue of climate change, there are glimmers of hope on the horizon. Last summer, Senators Jeff Merkley (D-Ore.) and Bernie Sanders (I-Vt.) introduced a bill called the Thermal Efficiency Act, which would dedicate two percent of revenues from a cap-and-trade program to fund combined heat and power, waste heat recovery, and district energy projects. Based on

various estimates, this could mean between $1 billion and $1.5 billion per year for clean energy infrastructure.

Waste heat, a process in which unused heat generated from industrial production is recovered as thermal energy, is considered the next stage in district heating technology. But whatever the actual heat source, renewably powered neighborhood heating plants revolve around a single concept: leveraging unused community generated resources to, as Gent puts it, "heat the town."

"It's that lovely sustainable circle," he says.

Linda Baker is a journalist based in Portland, Oregon.

Resources

Images: Top — The Southeast False Creek Neighborhood Energy Utility makes use of sewage waste heat recovery technology. Thermal heat is captured in the SEFC Energy Centre and distributed to other buildings. Image City of Vancouver. Bottom — Seattle Steam's biomass boilers are powered by a steady stream of waste wood from local recyclers. Until recently, the district heating system operated on diesel oil and natural gas. Photo Seattle Steam Company.

International District Energy Association: **www.districtenergy.org**

Southeast False Creek Neighborhood Energy Utility:
http://vancouver.ca/sustainability/building_neu.htm

Seattle Steam: **www.seattlesteam.com**

District Energy St. Paul: **www.districtenergy.com**

Drakes Landing Solar Community: **www.dlsc.ca**