

The Necessity for District Energy in New York

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The Problem

Although New York has the second lowest per capita energy consumption in the nation, it is hard to claim that that New York is a model of energy efficiency. Energy Information Administration data for 2004 shows that New York's residential and commercial energy costs to be among the highest in the nation:

Sector	Consumption (Btu per capita)	Rank	Expenditures (\$ per capita)	Rank
Residential	63.2	5	\$779.17	44
Commercial	72.8	45	\$778.31	50
Industrial	27.8	3	\$181.39	2
Transportation	57.4	2	\$783.83	2
Total	221.3	2	\$2,522.70	7

Recent data from NYSERDA shows that expenditures in 2005 were even higher than in 2004:

Expenditures (Billions of \$)	2004	2005	Increase
Total NY Energy	\$46.6	\$57.6	23.6%
Residential & Commercial	\$27.6	\$34.6	25.4%
Out of state energy expenditures	\$23.5	\$29.3	24.7%

In 2005, nearly ninety percent of New York's primary energy was purchased from outside the state at a cost of \$29.3 billion, a significant drain on the state's fragile economy:

New York State 2005 Energy Use (Trillion Btus)	Primary Energy Consumption	%	In state Production	Imports	Imports % by fuel
Petroleum	1,777.1	40.9%	37.959	1,739.1	97.9%
Natural Gas	1,237.7	28.5%	56.539	1,181.2	95.4%
Nuclear	438.0	10.1%	-	438.0	100.0%
Coal	316.1	7.3%	-	316.1	100.0%
Hydro	238.2	5.5%	238.2	-	0.0%
Biofuels	120.0	2.8%	120.0	-	0.0%
Net imported electricity	219.7	5.1%		219.7	100.0%
Total	4,346.8	100.0%	452.7	3,894.1	89.6%

All of this would be bad enough, but we then proceed to waste more than one-fourth of our primary energy (1,212 trillion Btus) in inefficient thermal electric power plants, primarily as heat rejected into the atmosphere. This wasted energy is nearly equivalent to the 1,242 trillion Btus of non-electric primary energy used in residential and commercial buildings.

These issues must be addressed – and quickly – if New York intends to survive and prosper in a world where cheap and plentiful fossil fuels are rapidly disappearing. State energy policy is largely focused on renewable electricity, transportation fuels, and energy conservation by individual building owners, including installation of kilowatt-scale combined heat and power. Even Governor Eliot Spitzer’s ambitious “15 by 15” plan is aimed at reducing electric demand, which is only one part of New York energy problem.

The Solution – or at least a part of it

New York today struggles with the same energy problems that many European countries faced after the first oil shock of the 1970s – importing and wasting too much energy. Scandinavian countries in particular have demonstrated enormous success in solving their energy problems and the solutions they have implemented could be applied with great impact here. Denmark, in particular, has demonstrated what can be done with focus and determination. Denmark’s energy consumption has held steady for thirty years even as its gross domestic product doubled, while US consumption has risen by 40% as GDP quadrupled. The average Dane today uses less than half the energy as an American.

Although Denmark’s energy strategy encompasses numerous measures – including high energy taxes – more than half of Danish energy savings over the past 25 years has come from widespread adoption of a technology first used commercially in New York 130 years ago. Instead of producing heat in each building, more than sixty percent of all households in Denmark are now connected to hot water district energy systems that distribute low grade heat from larger power plants, industrial facilities, distributed combined heat and power plants, and large solar thermal arrays, with many large communities receiving heat from sources more than twenty miles away. The entire Copenhagen region is served by a hot water transmission network extending nearly a hundred miles. As the Wall Street Journal reported last April, building these systems was a “pharaonic undertaking” that took more than a decade and delivers heat at a lower cost than natural gas or oil. One measure of this success is Jutland, the mainland part of Denmark, where no condensing power plants reject heat into the atmosphere – all electricity is produced by cogeneration and wind power – with the surplus exported to other areas.

The Danish district energy model has spread throughout Europe and Asia. In 1985 the South Korean government made a commitment to district energy and in less than ten years more than 1.3 million households were connected to such systems, reducing the primary energy required to heat these buildings by more than half and reducing costs by more than 25%. Similar success has been achieved in Sweden, Finland, and especially in Iceland, where more than 90% of households are heated that nation’s abundant geothermal resources.

The success of these large endeavors is largely due to adoption of uniform standards along with a high degree of quality control for materials and installation. Significant technical advances have reduced the installed cost of these systems while increasing efficiency and longevity, allowing them to be extended even into low density residential neighborhoods. Just as electric transmission networks are installed to the most stringent standards to insure safety, reliability, and efficiency, district energy system design and installation practices must adhere to applicable standards for exactly the same reasons. Several district energy systems in the United States already use these standards, including systems in St. Paul, Minnesota, Jamestown, New York, and a recently installed system at the University of Rochester that operates at a supply temperature below 200°F.

Benefits to New York

Wide scale implementation of district energy in New York would deliver significant economic and environmental benefits. Using low grade heat from existing industrial facilities and power plants to supply district energy networks could potentially displace one-fourth of New York's primary energy requirements, much of it imported at great expense. More than 50 million barrels of distillate oil were used to heat New York's buildings in 2005, compared to 36 million barrels used for transportation fuel. Reducing heating oil consumption would increase the amount of petroleum available for transportation. Where heat from industrial and thermal electric plants is not available at a reasonable cost, new distributed combined heat and power plants would be constructed as low cost heat sources. In many upstate communities, these plants could use clean renewable resources such as wood residues and short rotation energy crops such as hybrid willow shrubs developed by SUNY ESF. Nearly one million acres of land in the state could reportedly be used to grow such crops, which could supply more than 80 trillion Btus of New York's primary energy needs. Solar thermal arrays would be incorporated wherever possible, in Scandinavia these provide up to five percent of annual heat requirements with zero pollution.

Although the primary emphasis of these projects would be providing low cost space and domestic hot water heating, hot water can also be used to create cooling using absorption chillers and liquid desiccant dehumidification. This has the dual benefit of increasing the heat load and thermally-driven electric production in the summer while simultaneously reducing the amount of electric demand, especially on hot summer days – perhaps the greatest challenge facing New York's electric grid.

Although each project will initially serve larger institutional and commercial customers in each community, expanding the systems to serve low-income households will be essential to reduce the high level of fuel poverty in New York State. According to the 2006 Home Energy Affordability Gap analysis prepared by Fisher, Sheehan & Colton:

Home energy is a crippling financial burden for low income New York households. New York households with incomes of below 50% of the Federal Poverty Level pay 61.3% of their annual income simply for their home energy bills. Home energy unaffordability, however, is not simply the province of the very poor. Bills for households between 75% and 100% of Poverty take up 18.0% of income. Even households with incomes between 150% and 185% of the Federal Poverty Level have energy bills above the percentage of income generally considered to be affordable. The number of households facing these energy burdens is staggering. According to the 2000 Census, more than 526,000 New York households live with income at or below 50% of the Federal Poverty Level and thus face a home energy burden of 61.3%. Nearly 236,000 New York households live with incomes between 50% and 74% of Poverty (home energy burden of 25.0%). And more than 280,000 *more* New York households live with incomes between 75% and 99% of the Federal Poverty Level (home energy burden of 18.0%).

The effect of fuel poverty extends well beyond low-income families. Schools, churches, not-for-profit organizations and many small businesses face ongoing challenges in paying their energy bills while maintaining their services and programs. Many companies have simply gone out of business or left the state due to high energy costs, further straining remaining taxpayers.

New Yorkers simply cannot bear a future of unrestrained energy price increases. Something must be done, and it must be done while there is still time and money to do it.

Implementation Strategy

Several factors contribute to the attractiveness of large scale district energy implementation in New York, especially the high cost of existing heating fuels. More than half of New York households are in multi-unit buildings, reducing the number of buildings that need to be connected. Another positive factor is the high percentage of people and households in urban areas, as shown in the following table:

New York Census Data (2000)	Population	%	Households	%
Total:	18,976,457		7,679,307	
Urban:	16,602,582	87.5%	6,571,343	85.6%
Inside urbanized areas	15,504,619	81.7%	6,103,246	79.5%
Inside urban clusters	1,097,963	5.8%	468,097	6.1%
Rural	2,373,875	12.5%	1,107,964	14.4%

Urbanized areas have a population of more than 50,000, urban clusters between 2,500 and 50,000. Both have a density of at least 1,000 people per square mile.

Reduced to its basic elements, implementation of district energy in New York would involve three separate but related activities:

- Develop and build new low temperature hot water district energy systems to distribute low grade heat from industrial facilities and power plants to commercial, institutional, and residential buildings to displace electric heat, natural gas, propane, and fuel oil.
- Install absorption chillers and liquid desiccant dehumidification to shift cooling loads from the electric grid to the new district energy system. (as is currently done on ConEd's steam system in Manhattan)
- Where no existing low cost heat source is available, construct new combined heat and power plants utilizing local renewable resources such as clean wood residues and short rotation energy crops such as willow shrubs (salix) develop by the SUNY School of Environmental Science and Forestry.

Although most newer buildings have hydronic heating systems that can easily be adapted to district energy, buildings with steam or electric heat will require modification and in some instances completely new heating systems. Ideally, additional energy conservation measures can be accomplished along with the connection to minimize use of both thermal and electric energy.