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URBAN ENERGY OPPORTUNITIES

by

Norman F. Kron, Jr.

MASTER

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Norman F. Kron, Jr.
Energy and Environmental Systems Division

When I was asked to talk about "Urban Energy Opportunities", for some reason my mind flashed back to about 1969, when gas at the cheap stations was 32.9¢ a gallon and my friends and I figured that the stations charging the exhorbitant price of 39.9 should throw in a whole new car. In reminiscing about 1969, I found a song running through my head. Do any of you remember a song named "Alice's Restaurant?" I only remember one line -- something about "You can get everything you want at Alice's Restaurant."

Well it's about the same with urban energy opportunities, but the words are a little different -- "You can get everything you want if you're willing to pay a lot."

In short, recent experience with some community or city scale emerging energy technologies has highlighted the unfortunate fact that in the short run it is going to cost a bundle to convert our urban areas to renewable fuels.

With current technology, community or city scale use of solar and wind power cannot economically or practically compete with oil. In solar for example, a recent irrigation project in the southwest indicated that in this sun-rich area a solar field of 5,000 square feet was required to run a 50 hp irrigation motor. In wind, although large wind units have been tested by NASA, about the largest commercially available windmill that can produce electric power in light breezes is about 20 kW. You would need from 50 to 100 of these for the average K-Mart. Seriously considering either of these as a replacement for oil, nuclear, or coal *on large scale* is premature.

Surface water and groundwater both contain quantities of heat that can be extracted by using a heat pump or piping systems. The technology for extracting the heat is available for use on a neighborhood or industrial park level and should, in a few years, be ale to compete with traditional fuels.

Solid and Liquid Wastes and Agricultural Refuse (or Biomass) hold promise for producing a great deal of our urban energy supply. The solid waste produced by a family of four could be used -- with current technology -- to produce enough electricity to supply their lights, TV, refrigerator, and miscellaneous appliances. Liquid waste, particularly sludge, can be dried and burned.

Biomass can be burned or turned into fuel. Gasahol, which they recently began marketing in a Northern suburb is partially a biomass product. DOE's Urban Waste Technology Branch is funding pilot waste to energy projects in various communities to help clear up the remaining technological problems.

One occasionally ignored energy source is better utilization of the fuel we are already using for electricity production. Power plants, in general, can use only about one third of their fuel to produce electricity. The rest is either sent up the exhaust stack or dissipated in cooling towers. The overall fuel efficiency of the plants can be improved if the waste heat is delivered to customers for use in heating and cooling their homes and businesses. The technology for transferring the heat by hot water or steam exists. The chief problem is how can you economically run pipes from the power plants to the users? Those of you in urban government and utilities know that tearing up streets to lay utility lines is an expensive undertaking. However, recent Argonne studies have shown that it would be economically feasible to supply the entire heating load for cities such as Philadelphia and Washington D.C. and the central sections of Chicago -- provided payback periods of 8 to 12 years are acceptable.

LIGHTS, PLEASE

This introduction brings me to two examples of community scale use of emerging energy systems.

The first involves Soldier's Grove, Wisconsin, a 524 person town on the banks of the Kickapoo River in the southwest part of the state. Soldier's Grove has a major problem, their 100 year flood occurs about once every 7 years. This flood culminates in about five feet of water standing in the downtown business buildings. The Corps of Engineers was going to solve the flooding problem by building a dam upstream. But, last year President Carter halted dam construction on the basis of unfavorable economic and environmental reports. Shortly after the fund cut, the 100-year flood hit again. The town asked for federal aid to move the downtown from the flood plain to higher ground and has received help from HUD, EPA, SBA, and EDA. Soldier's Grove was interested in building an energy efficient downtown and asked the Wisconsin Energy Extension Service, Department of State Planning and Energy, and the Environmental Awareness Center at the University of Wisconsin - Madison for help. The Extension Service called the Chicago Region V DOE office, which called Argonne. Argonne computed the service loads of the new downtown and conceptualized 13 different energy systems (listed in Table 1). Our study concluded that the downtown could burn waste-wood from nearby lumber mills in a central boiler to supply heating, cooling, and domestic hot water. A general diagram is shown in Figure 1. The system, which uses very little oil (for igniting the wood), should pay back in about two years. The city is currently pursuing ways to organize itself to run the system and looking for an engineering firm to complete the designs.

The second example is on a slightly larger scale -- Philadelphia. As I mentioned before, power plants waste an incredible amount of heat. An Argonne study on several North Central U.S. cities showed that the cities' heating loads could be supplied profitably through district heating using power plant waste heat. Figure 2 shows the locations of power plants and hypothetical distribution lines in the city. This system would have an

Table 1

Alternative	Name
1	Conventional
2	Wind Turbine - Electric
3	Wind Turbine - Heat Pump
4	Heat Pump - each Building
5	Heat Pump - Mixed (Cascade)
6	Heat Pump - Central
7	Central Hot Water - Oil
8	Central Steam - Oil
9	Diesel - Hot Water
10	Diesel - Steam
11	Central Hot Water - Wood
12	Central Steam - Wood (No Central Chiller)
13	Central Steam Improved - Wood

initial cost in the neighborhood of $2,460,000,000, but it should pay back in less than 9 years from fuel savings (study completed 1978). At over two billion dollars, you can see that this particular alternative is a bit costly.

LIGHTS UP

These two cases, and other work by DOE and ANL have pointed to four of the larger problems facing the further exploitation of urban energy opportunities.

First: Remember the SG plant? 524 people? If the town had wanted to own the system or if the system generated electricity, the town probably would have had to go through a complex regulatory review as a public utility under the jurisdiction of the Wisconsin State Public Service Commission. If the plant were much larger, they would have had to apply for a state air pollution control permit. In short, governmental regulations which often do a good job of protecting the public can, from time to time, inhibit or slow down the use of advanced energy concepts.

Second: This item is closely tied to the next two, the cost and inconvenience caused by trying to convert current heating systems to something new -- such as the retrofit required in Philadelphia -- is immense.

Third and Fourth: Energy systems require money to build and the profits may not be realized for many years. Securing millions or billions of dollars in capital and convincing people that 10- or 15-year paybacks may not be all that bad is very difficult. This suggests that urban areas should at least begin thinking about long-range planning and financing mechanisms for energy supply.

I am sure that long after Alice's Restaurant has been forgotten or converted to solar power, and we look back at seventy -- hmmmm -- I see that between the time I wrote the outline and now that 78.9 gas has already become a nostalgic item. Um, well, maybe 80 or 90 gas will eventually become nostalgic, who knows?

However, if we are going to succeed in defeating the energy problem -- and we must unless we expect to radically change our lifestyles, we are going to have to begin acting by considering the long-term future; as a former Chicago Mayor once said, "Today the real problem is the future."

Thank you.

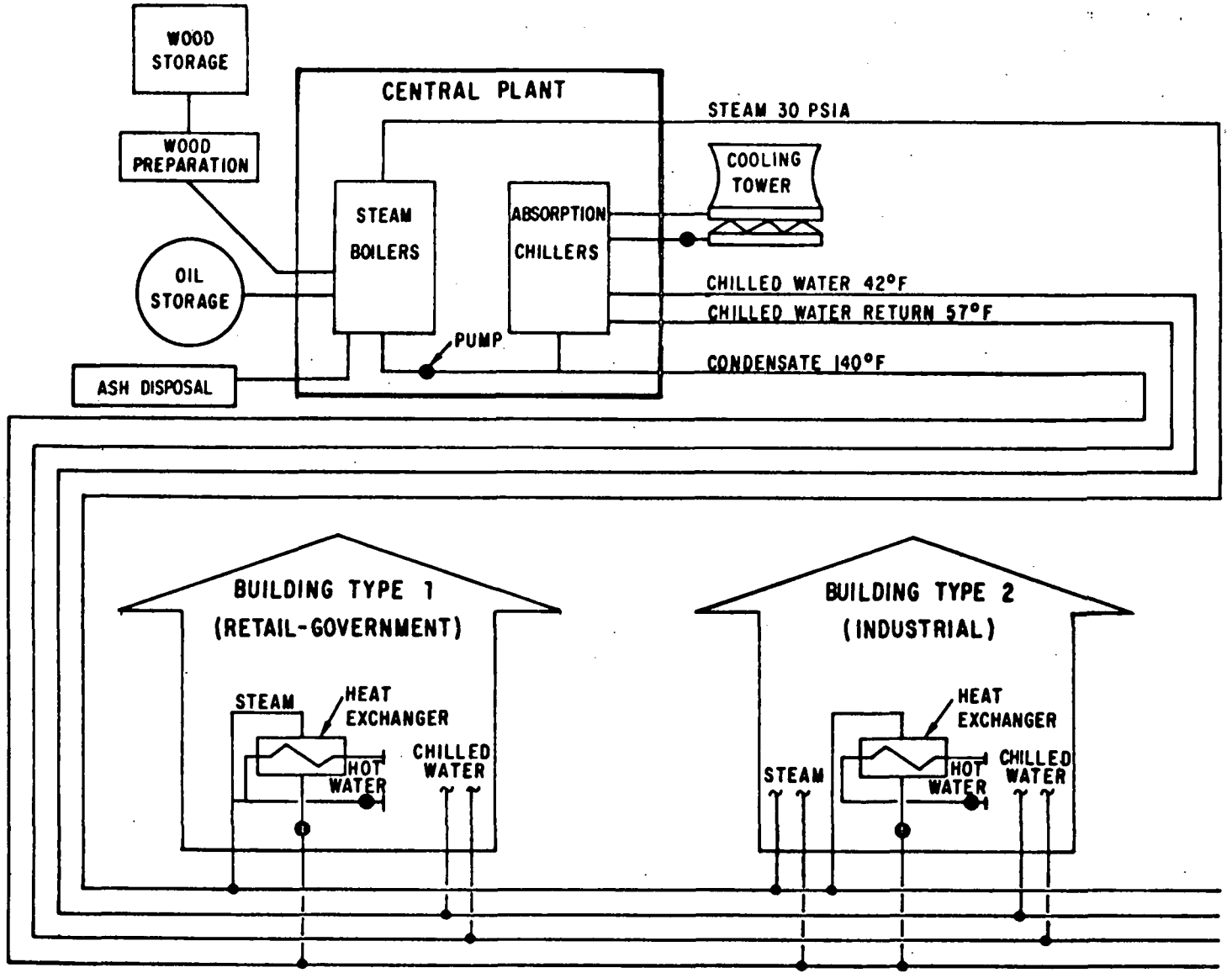
WOOD STORAGE
WOOD PREPARATION
OIL STORAGE
ASH DISPOSAL
CENTRAL PLANT
STEAM BOILERS
ABSORPTION CHILLERS
PUMP
STEAM 30 PSIA
COOLING TOWER
CHILLED WATER 42°F
CHILLED WATER RETURN 57°F
CONDENSATE 140°F
BUILDING TYPE 1
(RETAIL-GOVERNMENT)
STEAM
HEAT EXCHANGER
HOT WATER
CHILLED WATER
BUILDING TYPE 2
(INDUSTRIAL)
STEAM
HEAT EXCHANGER
HOT WATER
CHILLED WATER

Figure 1

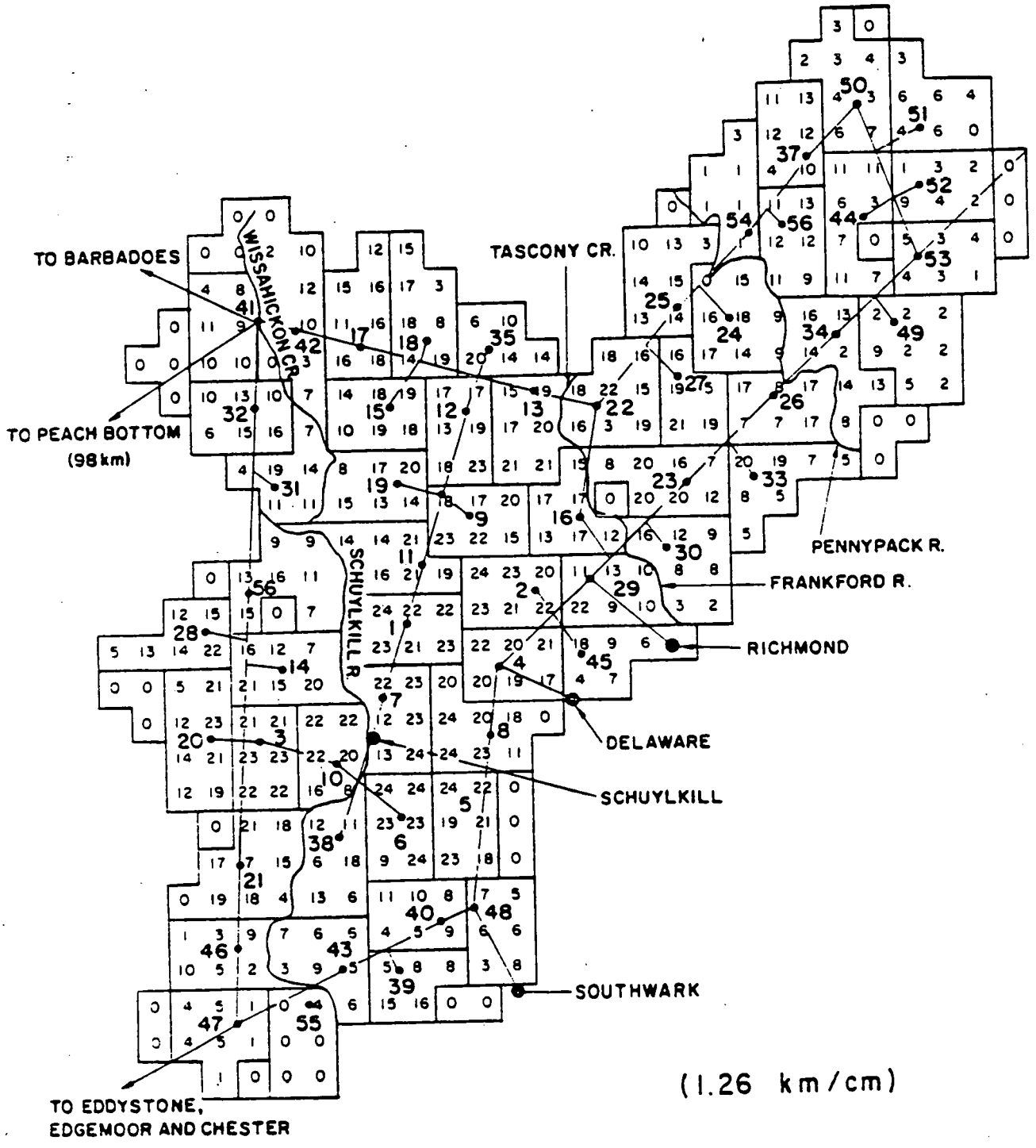
TO BARBADOES
WISSAHICKON CR.
TASCONY CR.
TO PEACH BOTTOM
(98 km)
SCHUYLKILL R.
PENNYPACK R.
FRANKFORD R.
RICHMOND
DELAWARE
SCHUYLKILL
SOUTHWARK
TO EDDYSTONE,
EDGEMOOR AND CHESTER
(1.26 km/cm)

Figure 2

REFERENCES

1. Kron, R., A. Davis, and H. Davis, *Energy Supply Options for Soldier's Grove, Wisconsin: A Summary of Recommendations*, Informal Report ANL/ICES/TM-32, Argonne National Laboratory, Argonne, Illinois (Feb. 1979).

2. Energy Systems Research Group, Inc., *An Assessment of the Potential for District Heating in Four Major Eastern Cities: Washington, D.C., Philadelphia, Baltimore, Boston*, Informal Report ANL/ICES-TM-11, Argonne National Laboratory, Argonne, Illinois (Aug. 1978).

3. Santini, D.J. and A.A. Davis, *A Test Case for the Potential Applications of District Energy Systems Using Thermal Energy Cogenerated at Existing Electric Power Plants*, Informal Report ANL/ICES-TM-13, Argonne National Laboratory, Argonne, Illinois (Jan. 1978).

4. Santini, D.J., A.A. Davis, and S.M. Marder, *Costs of Urban Area Retrofit to District Heating and Cooling Systems: North Central Cities*, Informal Report ANL/ICES-TM-9, Argonne National Laboratory, Argonne, Illinois (March 1978).

5. Harrison, W., et al., *District Heating and Cooling Utilizing Temperature Differences of Local Waters: Preliminary Feasibility Study for the Chicago 21, South Loop New Town Project*, Report ANL/WR-77-1, Argonne National Laboratory, Argonne, Illinois (May 1977).