Andy Pearson

Big Heat Pumps

Justifying heat pumps for domestic use can be tricky, particularly in older buildings and in colder climates. Operating efficiency is critical to the financial case and small systems operating at cold source temperatures with a need for high temperature hot water are a tough proposition. However, there is an alternative way to achieve the necessary efficiency, using a principle that is universally understood and regularly applied in all walks of life. It's called "economies of scale."

The principle is much the same as the math that makes cooking one meal for 20 people cheaper than cooking 20 meals for one, or that makes transporting commuters in groups, on trains or buses, better than providing individual transport for each one. Industrial-sized compressors are typically 10% to 20% more efficient than small domestic ones because of economies of scale inherent in their construction; a large cylinder built to the same tolerances as a small one has much lower losses because the gaps are the same size but the internal volume is much larger.

Diversity adds a further improvement. If a system serves one home it may operate on low load for much of the year and spend a disproportionate amount of time heating up and cooling down as it switches on and off. However, if a big heat pump serves 5,000 homes, then many of the variances are smoothed out and the system runs at a more constant condition. If the central plant has several modules then the variation in load that can be achieved efficiently is even greater. The downside is that a central distribution network is required, and this can be expensive to retrofit, but that wasn't an impossible hurdle for the widespread use of electricity, gas, mains water, drainage or even cable TV, so there is still hope for some joined up thinking to prevail.

This is where government subsidies could be really powerful—encouraging communities to lay in the infrastructure required for the delivery of more efficient heating on a neighborhood scale in order to reap the carbon reduction benefits of these economies of scale for generations to come. This subsidy system would not even need long term support. The cost of the infrastructure investment could easily be paid back over a 10-year cycle from the profits of the district heating scheme, giving a significantly better rate of return than any government bond will offer while at the same time investing for a long-term benefit that will pay back many times over.

Where networks already exist, but big heat pumps have not yet been deployed, the economics are even more attractive. Use of big heat pumps can greatly reduce carbon emissions, particularly if the heat network is coal or diesel fired. In an economy such as Norway where the majority of electrical generation is from hydro power, or France where it is mainly nuclear, the carbon emissions from such a scheme would be virtually zero. Best of all for other countries as they clean up their generating stations, switching from coal to gas and from gas to renewable, the heat network just gets cleaner and cleaner.

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The key thing to understand about big heat pumps is that the rules of thumb for operating conditions and performance that are well understood for domestic heat pumps cannot be applied to large systems. Big heat pumps reach much higher temperatures more efficiently so that heating a water pipe network to 196°F (90°C) from a source at 46°F (8°C) with a heating coefficient of performance of 3.0 becomes possible. Of course, if the source is warmer and the delivery temperature is lower the performance is even better. The one thing missing from these systems is the sight and sound of the open log fire. Perhaps every installation should include a flat screen TV in a brick surround. ■

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