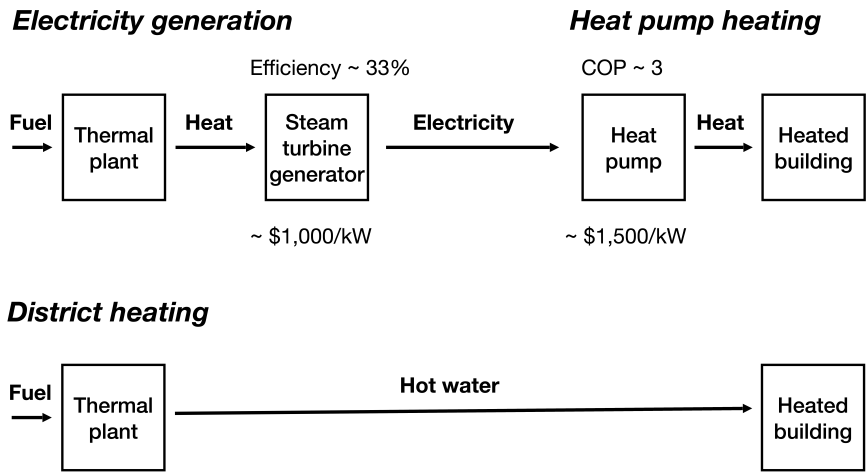
Building heating

Generating electricity together with operating buildings is responsible for half of global energy demand and CO2 emissions. With efficient regulation, nuclear power can be the cheapest, fastest way to provide reliable heat and power and to halve emissions.

Buildings are typically heated by burning natural gas from wells or burning heating fuel distilled from crude oil. To reduce CO2 emissions an environmentally popular alternative is to use electric heat pumps to transfer heat from earth, water, or air to the inside of a building. This is effective if electricity generation does not emit CO2.

Thermal power plants convert heat to electricity. Examples are coal-fired generators, natural gas generators, and nuclear power plants. Typical thermal heat-to-electricity efficiencies are 33%, though the *new nuclear* technology reaches 46%.

Heat pumps' coefficient of performance (COP) is the heat power transferred divided by the electric power used, kW(t) output / kW(e) input, typically ~3.

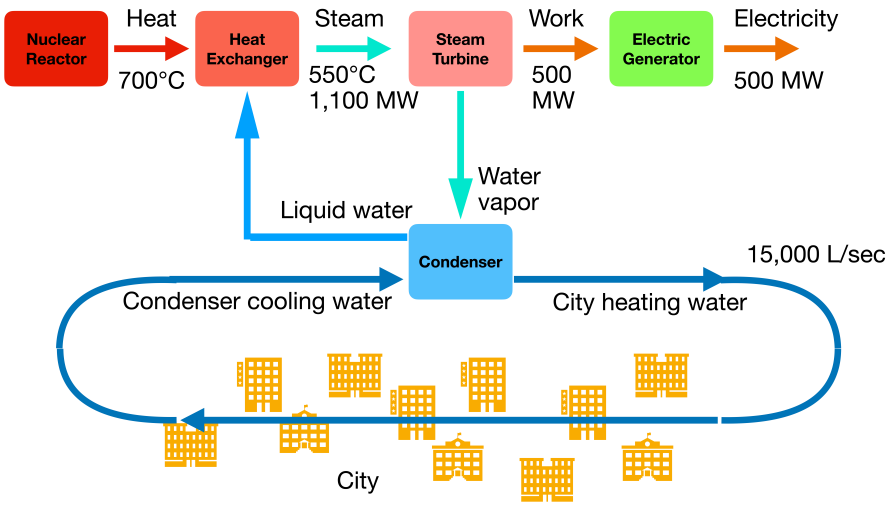


Converting heat to electricity to heat adds costs.

The electricity generation efficiency of 33% is roughly overcome by the 3X coefficient of performance of the heat pump, so the building gets about as much heat as was generated at the thermal power plant.

The capital cost of electricity generation from heat is ~ $1,000/kW(e) of capacity. The capital cost of a heat pump is ~ $1,500/kW(e). Non-thermal sources such as hydro, wind, or solar don't need the generation equipment investment.

For district heating the heat is simply transferred directly in flowing water through kilometers of pipes linking the power plant to apartments in cities. ConEd operates the world's largest district heating system, in New York City, including serving the campuses of Columbia University and New York University. The NYC heat source burns fossil fuels.



District heating from rejected heat of steam condenser.

The graphic above illustrates how a nuclear or other thermal power plant accomplishes co-generation of both 500 MW of electricity and 600 MW of heat for district heating.

China built and operates four Westinghouse-designed AP1000 nuclear power plants, each generating 1150 MW of electric power. China added co-generation and district heating[171] to two of the nuclear power plants at Haiyang City, so the rejected heat now heats 30 million square meters of buildings instead of being wasted.

China will build four units of its more powerful nuclear power plant, the CAP1400, to provide all 658,000 Haiyang residents with heat[172], and to

generate electric power for a third of Shandong province, population 102 million.

Special, low temperature, nuclear reactors can make hot water instead of steam, specifically for district heating. The underground water-filled silo of China's DHR-300 contains fissioning uranium that heats water just to 98°C at low, 3 bar, pressure. Heat exchangers bring district heating water up to 90°C for circulation through 200,000 three-bedroom apartments. The heating plant reactor site is the size of a city block.

Public support for cheap heat

Not in my backyard! Wait. Cheap heat?

The potential to use **nuclear power for heating is virtually unknown** to the public and politicians. Heat from a purpose built nuclear heating plant can cost $0.01/kWh; heat from the steam condenser of a nuclear power plant is a nearly free waste product.

Almost all building heating comes from combustion of natural gas and fuel oil, emitting CO2. Concerns about global warming make these sources more expensive and less available.

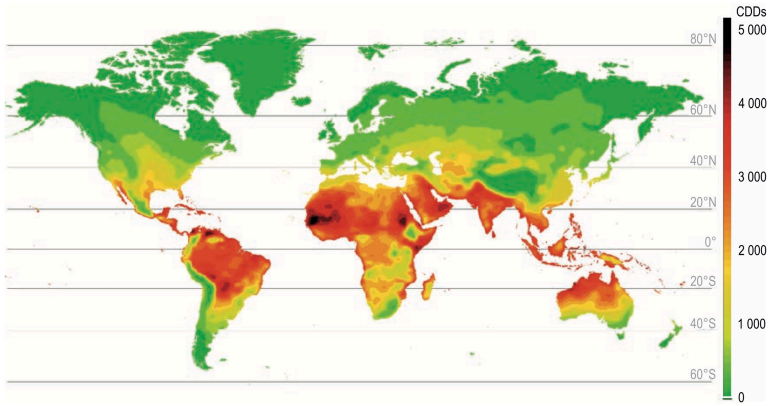
In northeastern US, for example, no new natural gas pipelines are permitted, even to nearby wells in Pennsylvania. New power plants use natural gas instead of coal, competing with building heating use. The liquified natural gas (LNG) import terminal in Boston Harbor is closing. Costs for heating are rising.

Cheap heat may suddenly be recognized as a real, **new benefit** of *new nuclear* power. Public pressure for cheap, clean heat for all city residents could force politicians and regulators to abandon the strictures that have made *new nuclear* power impossibly expensive. Will the public force them to adopt honest, cost-benefit analyses of benefits and observed detriments.

Will cheap heat unleash a *new nuclear* power watershed and permit a nuclear power plant in every city's backyard?

Air conditioning

Cooling consumes over 8% of all electricity. Two billion units in operation use 250 GW of electric power and are responsible for 1 gigaton of CO2 emissions. Growth of 10-15% per year is expected to increase power consumption to 700 GW by 2050[173].



Developing nations experience the most cooling degree days

As developing nations prosper, people will demand air conditioning to increase both productivity and comfort. 90% of US homes have air conditioning; 5% of Indian homes do[174].

Modern heat pumps can also act as air conditioners for those climes that may require heating and cooling in different seasons.