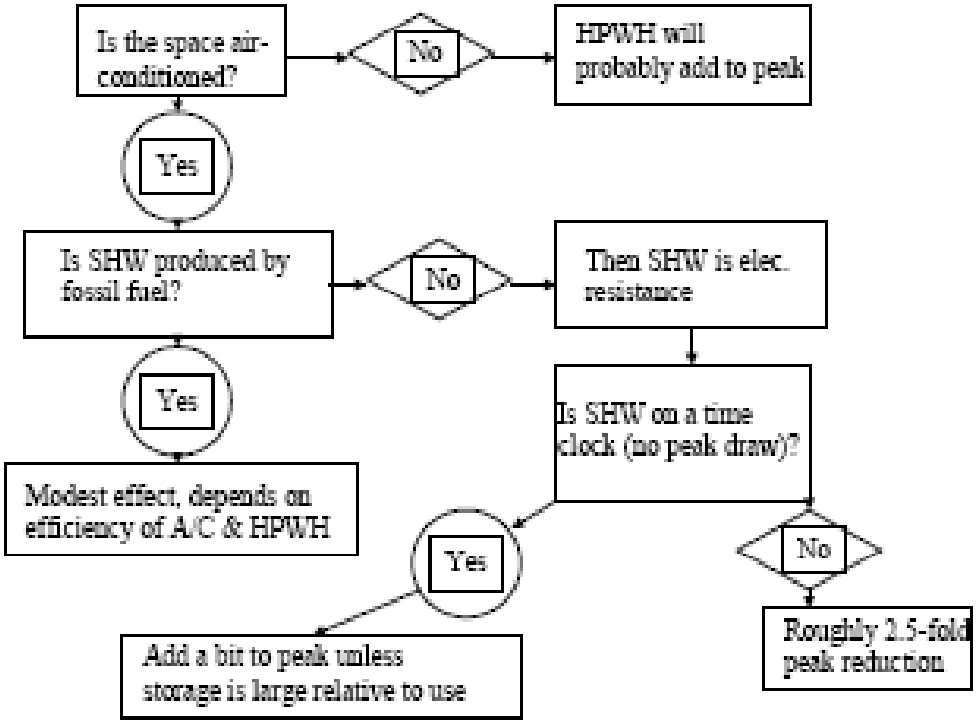
Attachment: Do HPWH Help Reduce Peak Electricity Demand?[1]

Peak system demand is a key parameter for planning the power system. Estimating the impact on system demand of large numbers of commercial heat pump water heaters would require relatively sophisticated analysis that includes data on present methods of providing service water heating for different market segments. As an alternative, this attachment illustrates the analysis pathways. As shown in the Figure below, the results will vary with water heating alternative energy sources and their controls.

Figure. Analysis framework for evaluating HPWH impact on system peak demand. Per installation impact depends on whether the space served is air-conditioned, the alternative source of water heating energy, and the pattern of water use (relative to storage). **SHW** means service hot water.



If a heat pump water heater is to provide service, including air conditioning, it may add to peak demand (if it is in use during system demand peaks, typically hot summer afternoon and evening hours). The per site demand will be roughly:

$$\text{Demand (kW)} = \frac{\text{Water heating capacity (Btuh)}}{\text{COP} * 3412\ (\text{Btuh/kW})}$$

from a letter from H. Sachs to L. Kokkinides, September 17, 2001

Of course, *system* demand will be less than the *unit* demand, unless all the heat pumps in all installations are running at the same instant. The reduction factor is called *load diversity*.

The second major analytical factor is how the facility would otherwise heat water. If its alternative is using fossil fuel (natural gas, propane, or fuel oil), then any electricity used for water heating during peak times will add to peak demand, regardless how efficiently it is done. On the other hand, if the alternative water heating method is resistive electric heating, then a heat pump water heater will reduce unit demand proportionally to the COP (typically reduce demand by 2/3, to 1/3 the demand of a resistive system). On the other hand, if the electric resistance system is on a time clock that locks out water heating during peak times, and if the HPWH were not demand limited, then the HPWH conceivably would add to peak demand.

For a given installation, the likely result ranges from adding to peak requirements (alternative fuel is fossil; space is not air-conditioned) to a significant peak reduction (factor of 2.5, if the space was air-conditioned, used resistance water heating, and did not have a mechanism to limit peak power draw.