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### **Section 1404(a)3 - The Adverse Consequence of Heat Pumps in Increasing Carbon Pollution**

The updates to Section 140.4(a)3 that require four pipe fan coils supplied by an air to water heat pump space-heating hot water loop which complies with Section 140.4(a)3C will increase carbon pollution. That air to water heat pumps are very efficient is beyond question. The problem is that besides the heat pump-based hot and cold 4 pipe systems being 5-10 times more expensive than equivalent capacity gas-fired boilers, the air-to-water heat pumps during cold periods consume electricity that is substantially gas generation via combined cycle or simple peaker gas turbine generation. In the quest to attain high efficiency, the source of electricity must be considered in order to attain the net zero carbon future.

The CEC and local air districts such as the South Coast Air Quality Management District seem to believe that because heat pumps are electrically driven, these Rankin cycles are then zero emission. This belief is fictional when the low-temperature heat sink is less than 40F. Unfortunately, low ambient temperatures often correspond with periods of low or no renewable generation meaning that the electricity is largely supported with natural gas generation.

Consider a 4-pipe water-to-air application with a 140F heating hot water loop and an ambient temperature of 40F; despite the impressive performance of an inverter-controlled air/water heat pump, the coefficient of performance is given this low ambient condition is less than 2 - meaning that the heat pump will consume at best one kilowatt to provide 2 kilowatts of heating. Given the average grid heat rate of 8000btu/kw (as of 2022) and the newest condensing gas fired boilers are >92% efficiency, the heat pump will require 512btus more than the condensing boiler to provide the 2 kilowatts of heating. Clearly, heat pumps can and will excel in higher ambient conditions, however with a higher cost as electricity is far more expensive than equivalent gas heating value.

The paramount concern for the CEC is increasing (or mandating) additional electrical load to the grid that could be complicit in causing electrical grid blackouts. The advent of AI combined with the electrification of transportation increases electrical demand far above the State's existing electrical capacity. The mandate of electrification of heat without consideration of whether the electrical grid can handle the extra load is at best myopic.