Initial System Metrics for Thermal Energy Networks:

What is the capacity of that (Geo)Thermal Energy Network? What sounds like a very straightforward question for any engineer to answer is currently causing some confusion, even among experts. After careful analysis and consideration HEET has designed this set of standard metrics and language to ensure accurate evaluation of true 'thermal energy networks'. Specifically those thermal distribution systems with ambient temperature, single pipe 'loop' or ring design, and bidirectional energy flow.

BUILDINGS PEAK LOAD$_{(1)}$ – The sum of all the individual building peak hourly loads met over a given year (kBtu, tons, or KW), before connected to a Network (1). The peaks are non-coincident, and is reported for heating (H) and for cooling (C): BPL_{H1} & BPL_{C1}, if summed then BPL_1

> **BUILDINGS ANNUAL LOAD$_{(1)}$** – The sum of the absolute value of all 8760 individual building hourly loads for heating and for cooling over a given year (kBtu, tons, or KW) before connected to a Network (1). $|BAL_{H1}|$ & $|BAL_{C1}|$, if summed then BAL_1

NETWORK PEAK LOAD$_{(1)}$ – The peak hourly load of the network 'loop' (1) that connected thermal resources must meet for both heating and cooling over a given year (kBtu, tons, or KW), with all buildings connected. Reported for heating (H) and for cooling (C): NPL_{H1} & NPL_{C1}, if summed then NPL_1

> **NETWORK ANNUAL LOAD$_{(1)}$** – The absolute value of the sum of all 8760 coincident hourly loads of the network 'loop' (1) that connected thermal resources must meet for heating and for cooling over a given year (kBtu, tons, or KW) with all buildings connected. Reported for heating (H) and for cooling (C): $|NAL_{H1}|$ & $|NAL_{C1}|$, if summed then NAL_1

Network loads require transient or semi-transient modeling tools to adjust summed coincident building load peaks for heat pump thermal energy flow, horizontal network pipe and pump thermal exchange, and thermal flywheel effects of the 'loop' for a given design temperature window. In these calculations, additional interconnected network 'loops' (second, third, and so on) can result in lower network loads than if the loop considered was islanded. This is the network scaling factor.

These definitions allow us to more accurately compare systems and understand costs, savings, scaling benefits, and minimum viable scale for investment.

- The BPL must be used for comparison to an alternate energy system(s)
- Comparisons (& life cycle assessment) must include both heating and cooling
- The NPL primarily determines deliverability and the NAL primarily determines capacity, resulting in cost effective design and infrastructure investment
- The difference between building and network loads quantifies a new form of network energy efficiency that changes the calculation of performance[1]
- Reducing the difference between modeled and actual network loads can lower costs
- All systems should report each load, clearly labeled. Abbreviations illustrated above.

[1] The 'Network' COP(coefficient of performance) equation is not the standard 'Box' COP as the boundaries are different