CENTER FOR MIDSTREAM MANAGEMENT & SCIENCE
LAMAR UNIVERSITY

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2nd Place Winner: Colin Waguespack
Texas A&M University – College Station
BS Chemical Engineering (Honors)
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Potential and Pitfalls for Compressor Station Heat Recovery

Midstream oil and gas is a major forefront of the world's energy transition, belying its supportive role within chemical industry. Storage and transportation, the primary tasks of the midstream sector, do not conjure up visions of a renewable future like upstream and downstream operations often do. During the past decade, midstream business have begun taking a more active role in the energy transition, adopting technologies such as carbon capture and waste heat recovery. Aided by accelerating government initiatives, these technologies will become increasingly common. The Inflation Reduction Act for example, which could aptly be named Emissions Reduction Act, has dramatically changed the outlook of midstream oil and gas. In particular, waste heat recovery presents significant opportunities for growth considering the ubiquity of compressors and pumps in the sector.

One of the best candidates for waste heat recovery technology is America's vast network of natural gas compressor stations, or NG CS. According to the Homeland Infrastructure Foundation, there are over 2000 such compressor stations in the United States and Canada. Most stations combust a portion of the transported gas to power its compressors. High temperature flue gas is the main by-product of the operation, comprising the waste heat referred to. An ACS article by Tavakkoli et al., used data from 2008 and estimated a high quality (above 645 K) waste heat availability of 0.211 quadrillion BTUs from NG CS. Despite the promising abundance, several major roadblocks stand in the way of those seeking to harness this energy. First and most pressingly, the location factors of many NG CS present major inconveniences to the utilization of waste heat. Second, lackluster economic characteristics mean feasibility must often hinge on government incentives.

Gas pipelines span much land that, for all modern intents and purposes, is wilderness. Attempts to carry out projects at remote NG CS must weather the costs associated with location. The building costs for the purpose of waste heat recovery are especially inhibiting. New projects must therefore strive for long design lives to achieve satisfactory returns. Fortunately, the utility nature of this type of facility generally allows for decades of high output.

Geographical factors also limit the potential mode of operation. In many cases, heating utility as a form of recovery is more effective than electricity. The situations of some NG CS preclude this from ever being an option. Consequently, fluctuating electricity prices exert great influence over the feasibility of heat recovery. Not only that, but power grid accessibility presents a high barrier to entry for stations across the country. In contrast, NG CS located near major industrial centers can freely choose an operation type to capitalize on prevailing market conditions.

Viewing location from a different perspective offers an optimistic note on the situation. As businesses become more collaborative in pursuit of high sustainability targets, the advantages of location become greater. This collaboration is epitomized in the concept of eco-industrial parks, which describes the optimization of resource flows between multiple businesses working in a strong partnership. Given the relatively low complexity of mass and energy streams at NG CS, they can tie in readily with existing eco-industrial parks. For example, NG CS can partner with gas processing plants, providing inexpensive heating to hydrocarbon separator networks.

Overall, location factors heavily correlate with the success of waste heat recovery projects. Many NG CS are not worth pursuing for this reason alone. For hundreds on the edge between yes and no, other forces are bound to make an impact. Most notably, the actions of lawmakers will be felt as the world accelerates toward its decade-by-decade decarbonization goals. The U.S. Inflation Reduction Act of 2022 has already started to flip the math on midstream investment decisions.

The $370 billion investment of the IRA is largely directed toward the expansion of green energy. Several provisions benefit the use of waste heat to generate electricity. The two most impactful clauses provide investment and operations tax breaks. First is a $0.03/kWh credit for clean electricity. Second, there is a 6% investment reduction for clean electricity projects. Both tax break amounts increase five-fold upon compliance with wage and apprenticeship guidelines. A further 20% is available to facilities built with domestic materials and located in designated energy communities.

As a result of these incentives and books of provisions like them, midstream companies will find novel investment decisions opened to them; geographical obstacles will seem lower than before. More landmarks like the IRA are on the horizon, bound to further alter the American industrial landscape. Even considering sporadic political tides, it is hard to imagine the momentum of green energy faltering. Businesses will become very adaptive, providing value to their employees, clients and shareholders well into the future.