its efficiency, (*d*) that exhaust tailgas from the nitric acid plant turbine is nearby enough for effective *gas-to-gas* heat exchange with boiler, air, and finally (*e*) that boiler feedwater could be heated with boiler stack gas (which presumes that the stack gas is not being used for air preheat already). However, the authors do present conditional results, in case air preheat already exists or cannot be tolerated; in our opinion it is this conditional result that should be the basis for comparisons with the base case (or with the improvements made with other methodologies, such as exergy analysis).The authors cite many "clear and realistic" constraining assumptions in Appendix I. Yet, in order to implement pinch technology, they have made serious presumptions about the equipment.

4 The authors assume that no changes to flow rates, temperatures, or pressures of any of the nitric acid plant streams are to be allowed (such as the inlet temperature to the tailgas expansion turbine). We agree that the chemical process is not to be changed, but there is no reason to disallow rerouting of flow streams and changing of intermediate temperatures that have no effect upon the process. Invoking such conditions, say, so that Pinch Technology procedures can be applied, imposes unnecessary constraints, which limit the potential for energy conservation. For example, in the assumptions of Appendix I, Linhoff and Alanis state that the tail gas temperature entering the expansion turbine after leaving the first converter gas cooler must be set to 536°C, that used by the contractor. However, the converter gas exits the converter at 840°C; and we maintain that full advantage should be taken of this high temperature, to maximize tailgas turbine output. We do not understand the authors' comments about how this would lead to the need for multistage cooling, cause significant changes in the design of the reaction vessel, or be considered a complete chemical process design problem rather than a heat and power recovery problem. In any case, certainly gas expansion turbines do not need to have their inlet temperatures limited to values such as 536°C for materials reasons; temperatures up to 1000°C can be handled without any need for blade cooling, and values higher than 1300°C with cooling.

5 The authors invoke the constraint that for heat exchangers $\Delta T_{\min}$ must be greater than 28°C. In our opinion, the minimum ΔT allowed should depend upon the heat transfer situation; e.g., for gas-to-gas heat transfer it should be greater than this value, for liquid-to-liquid cases it should be less, and for cases with heat transfer between a liquid and a boiling or condensing stream it should be less yet.

6 Finally, we feel compelled to point out that the large energy savings reported by both Linnhoff and Alanis and ourselves are not solely reflections of the value of pinch technology, or of exergy analysis. They are, to a large extent, the result of starting with an obviously poor (at least from an exergy usage point of view) combination of existing site and contractor's design.

Authors' Closure

We agree that site-specific optimization is a general objective and that there are various ways of pursuing the objective, including Pinch Technology, Thermoeconomics, Exergy Analysis, and even intuition.

We feel that Exergy Analysis is a thought provoker, supporting the intelligent user in open-ended problem formulations. Pinch Technology sets more meaningful targets and gives more design information for the more closely defined problem. Within the boundaries of its applicability, Pinch Technology makes the use of Exergy Analysis or similar procedures unnecessary. However, a good engineer should always look "beyond" his problem and it is here where Exergy Analysis can score. Our aim in research and development is to extend the scope of problems for which Pinch Technology is applicable (i.e., heat and power, total site integration, chemical process reactors and separators, etc.).