Waste heat management

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The experimental setup includes a rectangular box with dimensions of 100 × ...

In particular, waste heat may be used for heat pumps [11], or absorption ...

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Policies and ethics

With most of the world committed to limiting global warming to 1.5?C, many companies have set individual decarbonization targets for 2030 and even 2025. As we approach the end of 2023, we have only six years left to implement many decarbonization levers. But industrial companies are often uncertain about the right technical path to immediately reduce emissions. Technologies that are net present value (NPV) positive and quick to implement, such as various types of energy efficiency measures, can help companies achieve their decarbonization goals.

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Recovering waste heat is a potential avenue to effectively reducing emissions. Every year, the world consumes over 418 exajoules (EJ)--or 116,000 terawatt-hours (TWh)--of final energy, mainly by burning fossil fuels and generating heat.1Figures presented are for 2019; Key World Energy Statistics 2021, International Energy Agency, September 2021. Part of this generated heat is harnessed for useful purposes, such as producing electricity or driving chemical reactions, but most is unused. This unused "waste heat" is given off to the surrounding environment in the form of exhausts or effluents at different temperature levels. Recovering this waste heat can greatly reduce the use of primary fuels and, therefore, emissions.

While waste heat has been used in industrial companies for decades (to generate electricity through steam turbines or to provide process heating, for example), this potential remains largely untapped. Despite the benefits and possibilities of waste heat recovery, at least 3,100 thermal terawatt-hours (TWhth) of feasible waste heat is currently not being captured (Exhibit 2).

In this article, we explore how the stage has been set to access waste heat recovery across sectors, and what industrial companies can do to grasp this opportunity.

Over the past decade, gas, electricity, and CO2 prices have been low, and there has been limited incentive to

push waste heat recovery to the limits. For one, the payback time of waste heat recovery was long, and industry would typically only consider projects with a payback within one to two years. And, importantly, there wasn"t immediate pressure to act on decarbonization targets to drive action in waste heat recovery, so companies deprioritized energy efficiency in favor of projects with much higher returns. For example, it was financially more attractive to build another production line and burn more gas to run it than to save energy on an existing line--especially if companies were constrained in terms of capital expenditure (capex).

Historically, industry was focused on heat cascading (reusing heat) as the cheapest and simplest option of heat delivery (Exhibit 3). Heat pumps were expensive and not capable of delivering temperatures above 100?C, and conversion of low-grade heat into electricity did not make economic sense when energy prices were low. But times have changed: both in terms of technological developments and incentives.