

# A CASE FOR ELECTRIC AND FUEL AS THE ENERGY CHOICE FOR OVERNIGHT MAINTENANCE HEATING IN BUSES

## What is a good environmental investment?

The public transportation sector in Sweden has been quite quick to act when it comes to adjusting for the environmental impact of their operations. There is a sentiment of wanting to be part of the solution among the bus operators that we meet.

But what are the best measures for combating climate change? Doing our best to understand the problem, we suggest that the reduction of one's carbon footprint is the most comprehensible way to evaluate the effectiveness of a company's proposed environmental programs and investments.

For about a decade, some major Swedish bus operators have been keen to avoid electric and/ or fuel heaters in favor of waterborne infrastructure solutions powered by a local boiler or the district heating networks. This has its problems with ineffective heat transfer and leads to wasteful uses of energy. It also has problems with sudden stoppages, insufficient heat delivery and, in the case of district heating, the fact that the delivery model is not suited for intermittent heating which leads to the energy savings being lost as penalty fees for returning heat into the system. Buses are found unheated in the mornings, and sometimes this will occur despite a night of continuous energy consumption, where the system tries, but fails to reach dispatch temperature.

So, investments in this kind of infrastructure has not yielded the sought for returns when it comes to energy savings, and it has not made life at the bus depots any easier. So what about the environment? Let ´s make a comparison with using on-board heating systems:

It all comes down to three things: heat transfer efficiency, carbon footprint, and price. Swedish electric power production yields no carbon dioxide emissions according to the larger companies, and Diesel consumption produces less than 50% more than district heating. The systemic efficiency of on-board heaters is up to 50% better than waterborne infrastructure heating.

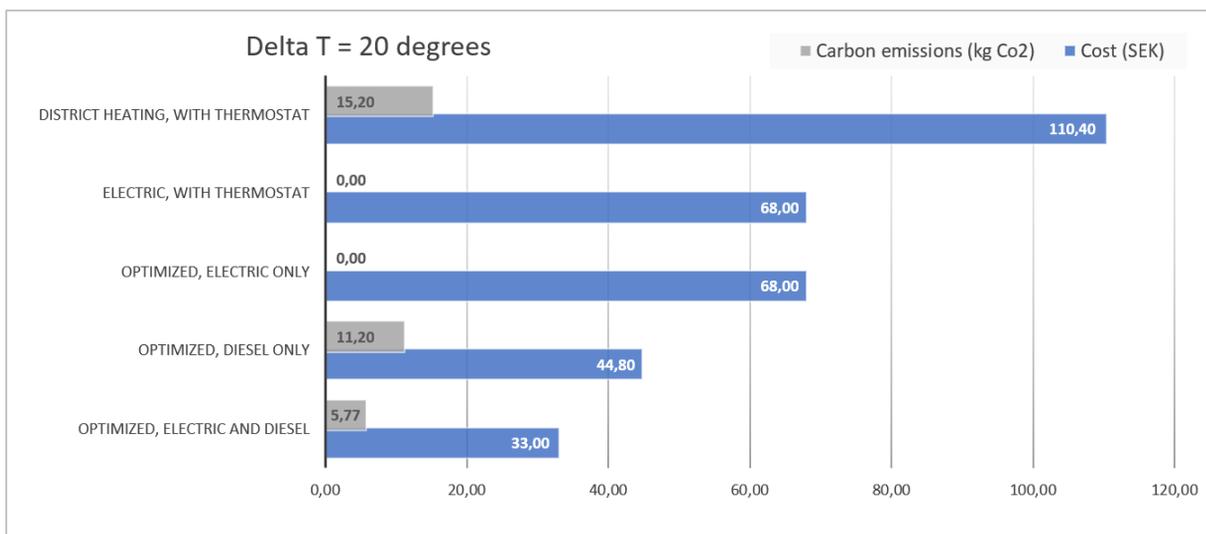
See table on next page:

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<b>Energy price per kwh</b>	<b>Electric</b>	<b>Diesel</b>	<b>District heat</b>
Cost/kwh in (SEK)	0,85	1,2	0,75
Effectivness (%)	98%	91%	50%
<b>Cost/kwh out (SEK)</b>	<b>0,87</b>	<b>1,32</b>	<b>1,50</b>
<b>Carbon emissions</b>			
Carbon dioxide in, g/kwh	0	300	103
Carbon dioxide out, g/kwh	0	330	206

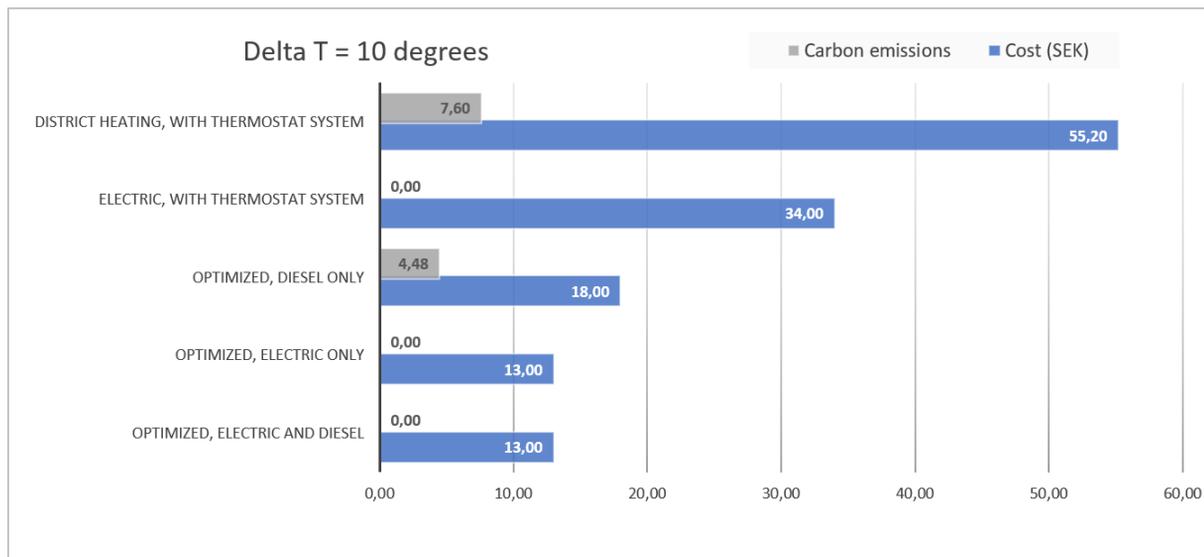
This shows that the best available heating model is a combination of electric and diesel/gas. Since the energy conversion efficiency is so much higher for the electric and diesel/ gas heating systems, the total energy consumption is way lower for electric and diesel/ gas, and so is the carbon footprint as a result. Especially if you are using an optimized model to reach set temperatures, as they will limit the total energy wastage and minimize consumption.

In the plot below, we show how the different heating systems perform in terms of cost and environmental impact. The comparison assumes an energyloss in the bus of 460 W/K, and that the temperature difference between the bus and outside is 20°C:



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In the next plot, the temperature difference between outside and inside the bus is 10°C, so there is less heating to do. In this example, the optimization model determined that electric heating will suffice, so no diesel heating is taking place in the combined system.



In all outside temperatures, an optimizing model utilizing electric and/or gas heaters will render the most efficient heating scheme. Every time. And it will be at the optimal price, both financially and environmentally.

All input data in these calculations are examples, and they may differ from your company's reality and energy contracts. Reach out to us and we will calculate your savings potential together!



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