

Attachment 6B:

Abstract and 287 References from: [“The Dual-Fuel Strategy: An Energy Transition Plan”](#)

One member of a dual-fuel pair is nitrogen-based, for example, ammonia, and the other is carbon-based, for example, methanol.

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Abstract

Depletion of easily accessible petroleum reserves has created unstable oil supply and price, opening the opportunity to replace oil as an energy source with other fossil sources and ultimately with renewable and perhaps nuclear sources. The dual-fuel strategy is a plan to facilitate the transition from fossil to renewable sources by first replacing fossil with renewable fuels. It stipulates that all energy sources (fossil, renewable, and nuclear) will be most efficiently monetized by conversion to three primary energy vectors: electric power and two liquid renewable fuels, all compatible with existing infrastructure. One member of a dual-fuel pair is nitrogen-based, for example, ammonia, and the other is carbon-based, for example, methanol. The two are complementary: ammonia is carbon-free, but has high relative toxicity, while methanol has low relative toxicity, but contains carbon. Unlike hydrogen (a gas), these liquid fuels are compatible with existing infrastructure with only modest modification. Alternatives to ammonia are liquid ammoniates; alternatives to methanol include ethanol, dimethyl ether, and higher alcohols, and alkanes. The two renewable fuels may be called nitrofuel and carbofuel to avoid prejudice as to their exact composition. Renewable fuels are derived from air, and because nitrogen is 2000 times more abundant in air than is carbon dioxide, nitrofuel will be most efficiently produced and at least cost; it will therefore be used whenever possible. In some applications, however, the additional cost of producing carbon-based fuel will be justified by ease of handling. A small number of applications require high energy density fuel; these will be served by a secondary carbon-based fuel vector, derived from primary carbofuel at further cost. The dual-fuel strategy is market-driven. It identifies the sources of competitive advantage for renewable fuels and relies on the force of free enterprise to create a postpetroleum civilization powered by a zero- -net-carbon energy system. The strategy enables global carbon emissions to be reduced significantly early in the transition, perhaps by as much as an order of magnitude by 2030, with zero-emissions perhaps as early as 2050.

- [References \(287\)](#)
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