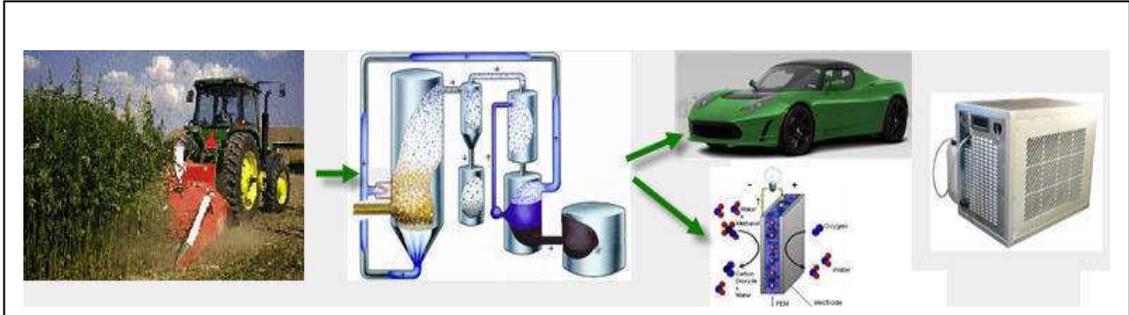


How to be Fossil Free by 2033

And Bring Wealth to Rural Areas and Reduce Pollution and CO₂



Tractor Trailer Pic from Pixabay



Power Plant Picture from Pixabay



Tractor Pic from Pixabay



Airplane Pic from Pixabay

Bob Leggett



CONCORD MINUTEMAN
Solutions Group INC.
Environmentally Sound Energy Solutions

Sudbury, MA 01776

Bob@cmsgx.com

15-July-2020

Fossil Free by 2033

Table of Contents

1	Introduction and Overview.....	3
2	Objectives for Fossil Free Transition.....	4
3	Implementation Strategy	4
4	Major Advantages.....	5
5	Ten Steps to fully transition by 2033.....	6
5.1	Reduce subsidies for fossil-fuel energy sources-starting 2026	6
5.2	Implement human powered transportation and work from home alternatives wherever practical-starting 2022.....	6
5.3	Convert existing engines to run on non-fossil fuels-starting 2025	7
5.4	Make all new engines fossil free capable-starting 2027.....	7
5.4.1	New land and marine gasoline engines should be either electric or GEM capable (<u>G</u> as- <u>E</u> thanol- <u>M</u> ethanol).....	7
5.4.2	New land diesel engines should be electric or diesel/DME capable.....	8
5.4.3	New marine vessels should be powered by wind and/or diesel/methanol/DME capable	8
5.4.4	New airplane engines should be either electric or non-fossil fuel capable-starting as soon as practical	9
5.5	Produce methanol and DME from biomass and waste	9
5.6	Use industrial hemp-based building and other materials for a carbon sink-already started	11
5.7	Convert natural gas and coal fired power plants to run on methanol/DME - starting 2028.....	11
5.8	Transition from centralized to decentralized power distribution	11
5.9	Reduce the amount of animal-based food consumed	11
5.10	Encourage a decrease in population growth – zero growth goal by 2030	12
6	Timeline	13
	Appendix.....	14
	Bibliography	14
	Figures.....	14
	Foot Notes	15

Fossil Free by 2033

1 Introduction and Overview

It is possible for the world to be fossil free by 2033.

The United States was able to put men on the moon in 7 years, and that took lots of research and new technologies. The transition to environmentally sound energy alternatives can be done quickly by taking advantage of existing technologies.

Specifically, we need to expand on solar, wind and hydro generated energy and add biomass-based fuels to fill in where these are not sufficient.

The ideal biomass-based fuels are methanol and dimethyl ether (DME).

This transition addresses the need to mitigate climate change due to increased CO₂ in the atmosphere and oceans and addresses the impact the extraction of oil has on the environment and rural and indigenous people. It will in fact have a substantial positive impact on rural communities and families in terms of wealth, health and education.

The transition away from fossil based energy does not require radical changes and is not overly expensive. We can still drive cars and trucks, fly planes, vacation on boats and continue to eat meat (but maybe a little less). However, we do have to change the energy fuel we use. It will be good for us, our children, grandchildren, future generations and the world economies.

Oil from the Exxon Valdez oil spill over 30 years ago (1989) still lingers on 1,300 miles of Alaskan shores. The impact of the 210 million gallons of oil from the British Petroleum Deepwater Horizon rig in the gulf over 10 years ago (2010) is still being felt by local fishermen and tourists in Louisiana and other coastal towns and may still be leaking. Oil pipeline leaks occur often and threaten clean drinking water and wildlife ¹. And most unfortunately, we leave to future generations the impact on water supplies from injecting millions of gallons of poisonous fracking mixtures deep into the earth.

A major spill of methanol or ethanol either on land or in water will virtually disappear in a matter of days or weeks and leave not a trace whereas oil spills can leave environmental and economic destruction for decades.

Lets get started... it only takes ten steps to be fossil free by 2033!

Fossil Free by 2033

2 Objectives for Fossil Free Transition

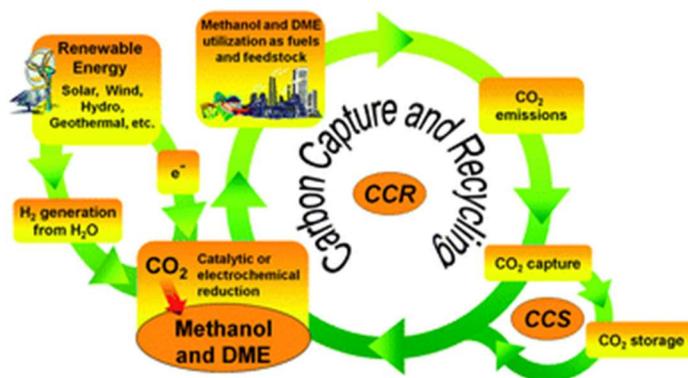
Transition to be 90% fossil free and carbon neutral by 2033 with a positive impact on economies and employment with minimal impact on existing infrastructure.

This is possible because it requires almost no new technology and there's a minimal impact on existing infrastructure.

3 Implementation Strategy

Implementation will vary based on geography (mainland vs island), economic stage (developed vs emerging), and economy type (city, rural, suburbs)

Includes continued transition to non-fossil energy like solar, wind and hydro and a transition to decentralized methanol economies.



“Liquid methanol is preferable to highly volatile and potentially explosive hydrogen for energy storage and transportation. Together with the derived DME [dimethyl ether], they are excellent transportation fuels for internal combustion engines (ICE) and fuel cells as well as convenient starting materials for synthetic hydrocarbons and their varied products. Carbon dioxide thus can be chemically transformed from a detrimental greenhouse gas causing global warming into a valuable, renewable and inexhaustible carbon source of the future allowing environmentally neutral use of carbon fuels and derived hydrocarbon products.”²

Fossil Free by 2033

4 Major Advantages

- ✓ Increased wealth (up to ½ trillion dollars annually) and employment in rural areas.
- ✓ Minimal impact on existing infrastructure and minimal dependence on new technologies.
- ✓ Reduction of CO₂ and other pollutants in the air and oceans resulting in a positive impact on health.
- ✓ Positive impact on the environment by eliminating the need to drill in wilderness and other pristine and environmentally sensitive areas like oceans and the arctic.
- ✓ Increased national security and reduction in military spending.
 - Eliminates the concentration of energy supply and refining
 - Decreases the need to protect transportation/shipping lanes where supplies are concentrated. (Middle east, Strait of Hormez, 5th fleet)

Fossil Free by 2033

○

5 Ten Steps to fully transition by 2033

(Listed in priority sequence for the quickest and most efficient implementation.)

5.1 Reduce subsidies for fossil-fuel energy sources-starting 2026

The planning for this should start immediately. Direct world subsidies for fossil fuels run about \$780 billion/year. ³ Starting in 2021 reduce these by 1/5th each year and increase the investment in non-fossil energy sources by the same amount.

The transition is slow enough to reduce the impact on fossil industries, and fast enough to provide initial funding for businesses involved in the conversion to alternatives.

2026	2027	2028	2029	2030
\$156b	\$312b	\$468b	\$624b	\$780b

Figure 5-1. Reduction of fossil fuel subsidies and increase in alternative subsidies

In addition to government subsidies, banks also need to begin reducing their lending to fossil industries and increasing lending with favorable terms to companies working on environmentally sound alternatives.

5.2 Implement human powered transportation and work from home alternatives wherever practical-starting 2022

This is a way to reduce the need for fossil fuels and alternate fuels by using human power, specifically bicycles. This is clearly most effective in cities. Provide safe and planned routes into and out of cities from 4 points – north, east, south, west, or whatever directions work best for the city.

Most likely, 20% of a city's population would enthusiastically do this today, and another 25% could be persuaded. This then would reduce the fuel used by these people by up to 20 to 45%. The likelihood of significant participation in this has been seen by the popularity of bike Friday's in various cities. See also "[Could New York Finally Become a Bike City](https://www.nytimes.com/2020/07/03/nyregion/coronavirus-nyc-bike-paths.html)". ⁴(<https://www.nytimes.com/2020/07/03/nyregion/coronavirus-nyc-bike-paths.html>)

In addition, people can take advantage of working remotely to reduce the need for transportation fuel. The viability of this has been demonstrated by the large number of people who were forced to work from home because of Covid-19. If people not

Fossil Free by 2033

commuting by bike could work remotely just one day per week, this could reduce the fuel required for transportation up to another 11%. There are many countries around the world, like Holland where currently much of the population use bicycles for transportation.

5.3 Convert existing engines to run on non-fossil fuels-starting 2025

Conversion kits for internal combustion engines are readily available and have been used in Brazil since the 1970's.

A non-flex fuel gasoline vehicle can be converted to run on alcohol for under \$400 with about an hour or less labor. A mechanic can do the conversion for about \$500 including parts.

Methanol conversions are more complicated since they may include the replacement of more parts and fuel additives.

Diesel engines can be converted to run on DME for somewhere between \$700 and \$10,000. The wide spread in cost is due to the now limited number of options for this conversion. Once scaled up prices should fall considerably.

5.4 Make all new engines fossil free capable-starting 2027

5.4.1 New land and marine gasoline engines should be either electric or GEM capable (Gas-Ethanol-Methanol)

This includes cars, light trucks and small engines. It requires no new technologies and is a simple and straight forward transition due to the introduction of computerized fuel injection. The technologies for this was made available from Lotus over 12 years ago.

The cost of GEM cars is surprisingly low. According to Lotus' chief engineer Jamie Turner, he estimates that in production modes it would only add about \$60 (2008 dollars) to the price of a conventional single fueled car.

Tesla has successfully designed and sold electric cars, along with Chevy, BMW, Kia, Hyundai, and there are several hybrids that could be powered by methanol fueled engines.

It is worth noting that methanol for car fuel is not a new concept. The race cars in the Indianapolis 500 switched to methanol for safety reasons in 1965, and have been using methanol and ethanol ever since.

Fossil Free by 2033

The technology is here, but we need to ensure that all new engines can be powered without fossil fuels.

5.4.2 New land diesel engines should be electric or diesel/DME capable

[“The benefits of DME are numerous,”](#) said Kevin Flaherty, president of Mack Trucks North American Sales & Marketing. “It’s better for the environment because it burns clean, and it can be made from sources that are domestically available. Mack trucks are built in the U.S.A., and with DME, we’ll be powering our vehicles with a fuel made in America as well.” ⁵

Volvo worked with Oberon Fuels to pilot DME powered trucks in 2015, proving that the technology already exists. In late 2014, [the EPA approved](#) Oberon Fuel’s biogas-based DME as meeting the agency’s Renewable Fuel Standard. ⁶

[Oberon Fuel’s DME is also being piloted](#) (2017) by the New York City Department of Sanitation in a Class 8 Mack Pinnacle model truck equipped with a 13-liter engine. “The GHG reductions make DME one of the first fuels for heavy-duty trucking that could result in a net CO₂ reduction. DME engines are also easier to maintain, offer excellent cold weather performance, and run quieter than diesel counterparts.” ⁷

5.4.3 New marine vessels should be powered by wind and/or diesel/methanol/DME capable



“SPIRETH (Alcohol (Spirits) has shown that [it is feasible to convert ships to operate on methanol and DME-based fuels,](#) and these fuels are viable alternatives to reduce emissions...Low emissions, high efficiency, robust solution and cost-effective conversion were key factors considered when evaluating the different combustion concepts and design solutions...” ⁸

“For compliance with 2020 as well as a pathway fuel for 2030, [methanol provides a safe cost effective and regulated alternative,](#) with no SO_x or PM [particulate matter] emissions, very low CO₂ emissions during combustion and NO_x Tier III compliance without SCR [selective catalytic reduction]...It has been said that the shipping industry will wait a long time for a liquid fuel that it can use to replace fuel oil, but for the moment, that alternative is already in reach.” ⁹

Fossil Free by 2033



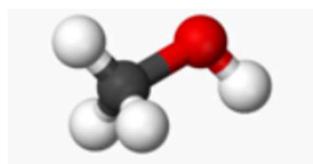
5.4.4 New airplane engines should be either electric or non-fossil fuel capable-starting as soon as practical

[Eviation](#) company is currently (2020) qualifying its all electric commuter planes planned to be delivered to Cape Air (Massachusetts) by 2022.

The US Navy (NRL) has been working on a way to [convert sea water into jet fuel](#) on aircraft carriers by extracting CO₂ and hydrogen.¹⁰ This would reduce the need to extract and refine fossil fuels and then transport these through the oceans to the carriers.

Ireland has the potential to shape the future of [sustainable aviation fuel manufacturing](#). It is developing a [Sustainable Aviation Fuel](#) (SAF) industry to meet EU climate targets, with a roadmap outlining production pathways and government support. The country aims to produce SAF from waste oils, agricultural residues, and synthetic fuels, potentially generating significant economic benefits and job opportunities by 2050.

5.5 Produce methanol and DME from biomass and waste



Methanol is the simplest alcohol and it can be produced from many feedstocks including biomass, waste, and even CO₂! Currently it is mostly produced from natural gas, but it will be necessary to transition the source to biomass and municipal waste in order to be able to get to a Net Zero state.

One of the best plants to use for conversion to methanol is industrial hemp. This is because of the amount of biomass it produces, and the hemp seed is an excellent food source that contains all the essential fatty acids and is 30% protein!

The hemp plant can be grown almost anywhere, including marginal land and highway meridians. It offers many advantages for farmers:

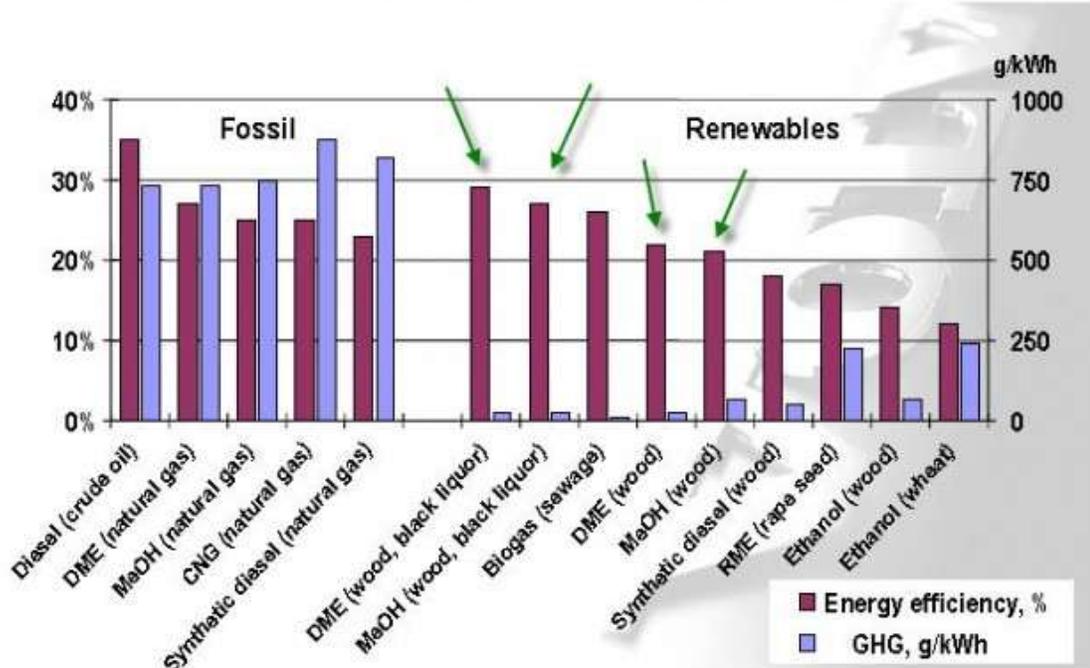
- ✓ Profitable cash crop
- ✓ Would bring money spent for energy to farming areas (for the US this is around \$1/2 trillion annually)

Fossil Free by 2033

- ✓ Less dependence on international markets when used as a biomass source for domestic energy production
- ✓ Has many alternative uses so is adaptable to changing markets (car body parts, clothes/textiles, building materials, CBD oils...)
- ✓ Requires less use of toxic herbicides and pesticides than soybeans and corn
- ✓ For efficiency, the processing plants to convert the biomass to methanol would also be located in the rural areas where the hemp is grown. This would further add to the employment opportunities for these regions.

When compared to fossil fuels on a “well to wheel” basis, methanol derived from biomass or waste (biogas from sewage) has high energy efficiency and very low greenhouse gas emissions.

Fuel comparison - efficiency and greenhouse emissions



Source: Volvo Technology Corporation. These estimates include production, transport, and end use GHG emissions. KEY: DME dimethyl ether; MeOH methanol; CNG compressed natural gas; RME rapeseed methyl ester; GHG greenhouse gas.

Figure 5-2 Fuel Comparison - Efficiency and Greenhouse Emissions

Fossil Free by 2033

5.6 Use industrial hemp-based building and other materials for a carbon sink-already started

“Industrial hemp has been scientifically proven to absorb more CO₂ per hectare than any forest or commercial crop and is therefore the ideal carbon sink. In addition, the CO₂ is permanently bonded within the fiber that is used for anything from textiles, to paper and as a building material.”¹¹

Hempcrete is a mixture of hemp hurds and lime and can be used in building construction to replace siding, insulation and interior sheetrock.

5.7 Convert natural gas and coal fired power plants to run on methanol/DME - starting 2028

Studies as far back as 2001 determined that natural gas fired turbines could be easily converted to run on DME. “According to GE, [DME can be fired in existing gas turbines](#), currently using natural gas... with some hardware modifications to the fuel delivery system.”¹² They can also be converted to run on methanol. “Tests have shown that, with minor system modifications, methanol is readily fired and is fully feasible as a gas turbine fuel.”¹³

5.8 Transition from centralized to decentralized power distribution

Decentralizing electric power generation and delivery will add to the security of our power requirements. Currently a failure in a major portion of the power grid can cause power outages over large areas. This is also true with weather related disruptions.

With solar panels in fields and on roof tops, this transition has already begun. However, there is still a dependence on regional grids for power. With the addition of batteries, methanol fuel cells, and micro-grids like those from Bloom Energy, it is possible to transition to a fully decentralized model.

5.9 Reduce the amount of animal-based food consumed

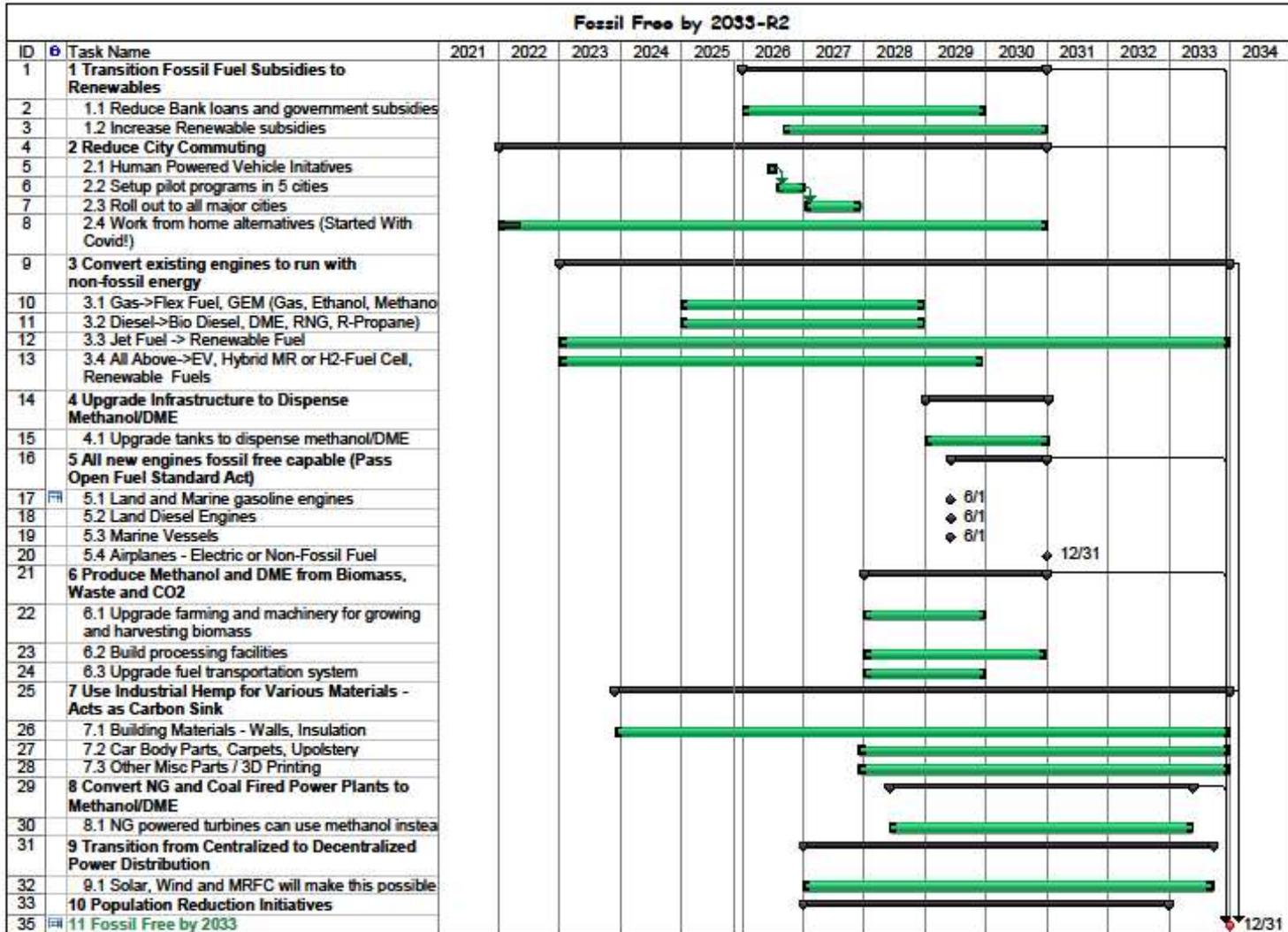
Encourage sustainable farming which will reducing the amount of pesticides and herbicides used and will limit the overuse of phosphorous fertilizer that is raising havoc with our rivers and water supplies.

Fossil Free by 2033

5.10 Encourage a decrease in population growth – zero growth goal by 2030

This is already occurring in some of the industrialized countries like Japan and Germany and needs to be encourage throughout the planet. A smaller population will require less fuel and energy and would result in less stress on the environment.

6 Timeline



Appendix

Bibliography

These are some of the sources for ways and reasons to use methanol, DME and ethanol as energy alternatives:

Alcohol Can Be a Gas, David Blume, 2007

Beyond Oil and Gas: The Methanol Economy George Olah, Alain Goeppert, G.K. Surya Prakash, 2006

Clean Break, Osha Gray Davidson, 2012

Energy Victory, Robert Zubrin, 2007

Fill Your Tank With Freedom, Klassy Evans, Adam Khan 2012

Hemp Bound, Doug Fine, 2014

Methanol as an Alternative Transportation Fuel in the US, L. Bromberg and W.K. Cheng (Sloan Automotive Laboratory, Massachusetts Institute of Technology), 2010

Methanol -Bridge To A Renewable Energy Future, John H. and Christiana P. Perry, 1990

The Report. Cannabis: The Facts, Human Rights and the Law, Kenn and Joanna D'Oudney, 1st Edition 1994, Revised 2006

Turning Oil Into Salt, Gal Luft and Anne Korin, 2009

Figures

Figure 5-1. Reduction of fossil fuel subsidies and increase in alternative subsidies.....	6
Figure 5-2 Fuel Comparison - Efficiency and Greenhouse Emissions	10

Fossil Free by 2033

Foot Notes

¹ America's Dangerous Pipelines, Center for Biological Diversity, Richard Stover Ph.D
https://www.biologicaldiversity.org/campaigns/americas_dangerous_pipelines/

² Chemical Recycling of Carbon Dioxide to Methanol and DimethylEther: From Greenhouse Gas to Renewable, Environmentally Carbon Neutral Fuels and Synthetic Hydrocarbons, George A. Olah, Alain Goepfert, and G. K. Surya Prakash Loker Hydrocarbon Research Institute and Department of Chemistry, University of Southern California, UniVersity Park, Los Angeles, California 90089-1661,olah@usc.edu, June 11, 2008

³ Fossil Fuel Subsidy Overview, Oil Change International, Jan 2020,
<http://priceofoil.org/fossil-fuel-subsidies/>

⁴ "Could NY Finally Become a Bike City" Sasha von Oldershausen, New York Times, July 2020, <https://www.nytimes.com/2020/07/03/nyregion/coronavirus-nyc-bike-paths.html>

⁵ "Mack announces DME fuel offerings for 15" , Commercial Carrier Journal, June 2013,
<https://www.ccdigital.com/mack-announces-dme-fuel-offerings-for-15/>

⁶ "EPA Signs Off on Oberon's DME as an alternative fuel", Trucking Info, Sept 2014
<https://www.truckinginfo.com/120121/epa-signs-off-on-oberon-s-dme-as-alternative-fuel>

⁷ "Oberon Fuels, Mack Trucks, and DSNY begin first demo of DME powered truck" Jan 2017, <https://bioenergyinternational.com/biofuels-oils/oberon-fuels-mack-trucks-and-dsny-begin-first-demo-of-a-dme-powered-truck>

⁸ "Methanol, an alternative fuel for greener shipping", 2014,
https://www.sspa.se/sites/www.sspa.se/files/field_page_files/2014_sspa_highlights_59_methanol_an_alternative_fuel_for_greener_shipping_0.pdf

⁹ "Shipping's bridge to 2030 is already in place", Jan 2020, Christopher Chatterton, Methanol.org <https://www.methanol.org/wp-content/uploads/2020/01/Exclusive-Article-with-Sea-and-Coast-Magazine-about-methanol-marine-fuel.pdf>

¹⁰ "US Navy Has Found a Way to Convert Seawater Into Jet Fuel", Emily Thomson, Huffington Post, Apr 2014, https://www.huffpost.com/entry/seawater-to-fuel-navy-vessels- n_5113822

Fossil Free by 2033

¹¹ "The Role of Industrial Hemp in Carbon Farming", GoodEarth Resources PTY Ltd, 3/18/2019, <https://hemp-copenhagen.com/images/Hemp-cph-Carbon-sink.pdf>

¹² "Use of DME as a Gas Turbine Fuel", ASME Turbo-Expo June 2001, Arun Basu et al, http://www.xtlinstitute.com/13_PowerGeneration_articleASME_TurboExpoJune2001.pdf

¹³ "Feasibility of Methanol as a Gas Turbine Fuel", GE Position Paper, Apr 1993, <https://cmsgx.com/wp-content/uploads/2015/12/GE-White-Paper-Feasibility-of-Methanol-as-a-gas-turnbine-fuel.pdf>