ALTERNATIVE TRANSPORTATION FUELS OVERVIEW

Follow the QR code for other factsheets, background information and references:

Alongside the transition to a lower greenhouse-gas-emission economy, conventional fossil fuels (gasoline, diesel, jet fuel) are being replaced by alternative fuels.

Alternative fuels have the potential to reduce greenhouse-gas emissions, and to reduce some other environmental impacts compared to producing and using fossil fuels.

Other environmental impacts may be more-or-less unchanged by moving to alternative fuels, or may even be exacerbated.

KEY TERMS

Feedstock: the material from which a fuel is produced.

Biogenic: produced from feedstock of plant or animal origin.

Biofuel: a fuel produced from biogenic feedstock.

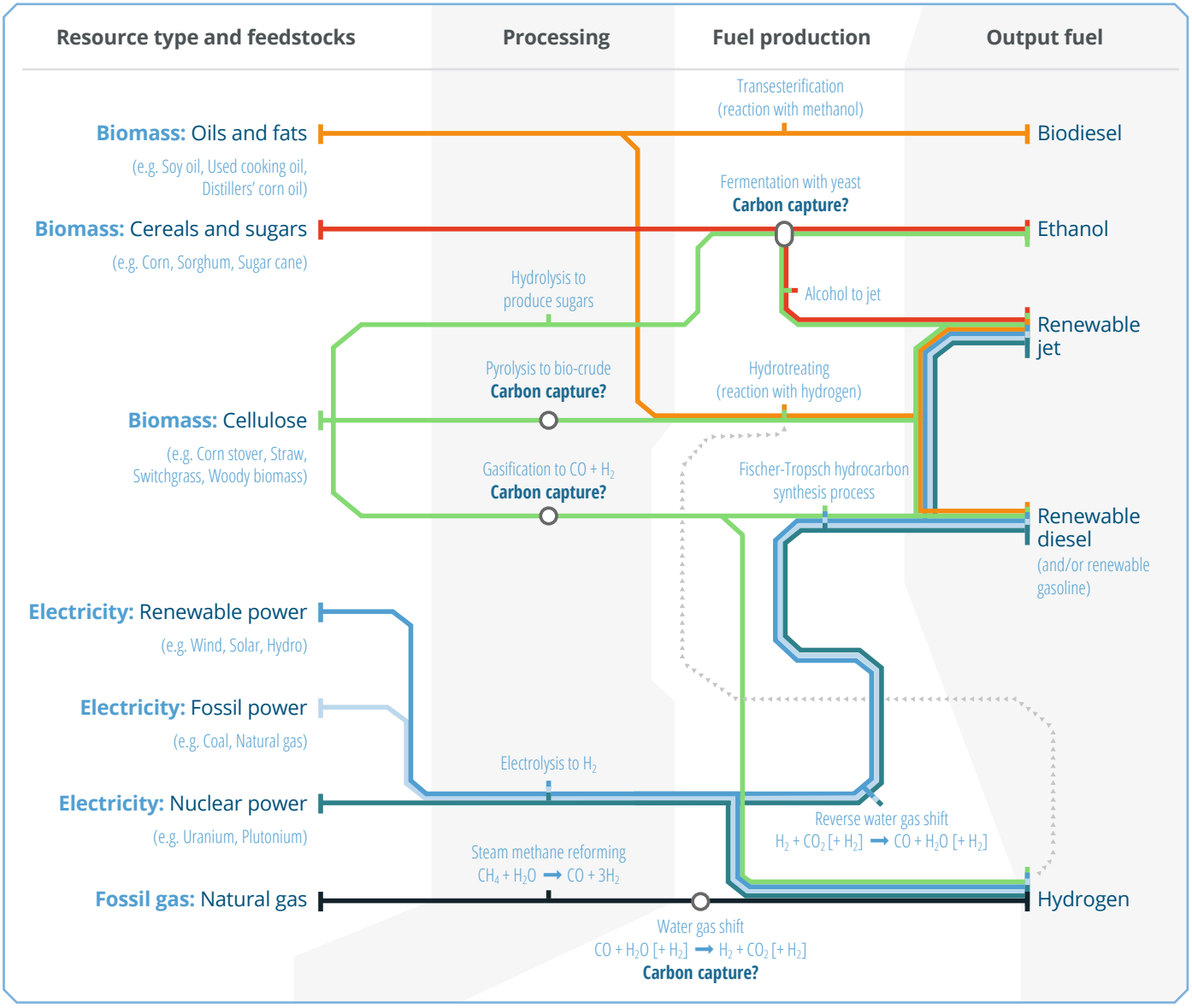
Lifecycle emissions: the greenhouse gas emissions from producing feedstock and making and using fuel.

Cellulosic: biogenic material made mostly of cellulose, which forms the walls of plant cells.

Electrolytic: produced from electricity in an electrolyser.

FUEL	USE AND VEHICLES	GREENHOUSE GAS IMPACTS	OTHER POLLUTION	OTHER ISSUES
ETHANOL	Blended 10% ('E10') with gasoline and used in normal gasoline vehicles. Blended up to 85% ('E85') with gasoline and used in special flex fuel vehicles.	Probably lower than fossil gasoline. Depends on processes and sustainability of feedstock production. Indirect land use change emissions are uncertain.	**From the vehicle:** Similar to fossil gasoline. **In production:** higher than fossil gasoline due to farm emissions and water use.	Most ethanol is produced from corn, competing with food markets. New technologies are being developed to make ethanol from farm and forestry residues (cellulose).
CELLULOSIC ETHANOL	See ethanol.	Lower than fossil gasoline providing feedstock is sourced sustainably.	See ethanol.	Large quantities of cellulose are potentially available, but some sourcing practices could have negative ecological impacts.
BIODIESEL	Blended 5% ('B5') with diesel and used in normal diesel vehicles.	Significantly lower than fossil diesel for waste oils. Probably lower than fossil diesel for crop and residue oils.	**From the vehicle:** Similar to fossil diesel. **In production:** higher than fossil diesel due to farm emissions and water use (except for waste feedstocks).	The vegetable oil market is linked to deforestation – for soybeans in South America and for palm oil in Southeast Asia. Residual oils may be taken from existing productive uses.
RENEWABLE DIESEL (OR GASOLINE)	Used neat or blended in any proportion with fossil diesel/gasoline in normal vehicles.	See biodiesel.	**From the vehicle:** Cleaner than fossil fuels. **In production:** see biodiesel.	See biodiesel.
RENEWABLE JET	Blended up to 50% with fossil jet fuel in existing plane fleet; in future 100% use will be possible.	See biodiesel.	**From the plane:** Cleaner than fossil fuels. **In production:** see biodiesel.	See biodiesel.
CELLULOSIC DIESEL/JET	See renewable diesel/jet.	Lower than fossil fuels providing feedstock is sourced sustainably.	See renewable diesel.	Large quantities of cellulose are potentially available, but some sourcing practices could have negative ecological impacts.
HYDROGEN	Used in fuel cell vehicles that are more efficient than conventional vehicles and are zero emissions.	Lower than fossil fuels for hydrogen from renewable electricity or produced with carbon capture.	**From the vehicle:** water vapor only. **In production:** cleaner than liquid fossil fuels.	The climate performance of electrolytic hydrogen depends on the source electricity. Low carbon hydrogen requires additional renewable electricity production.

STAND UP TO OIL communities fueling change



PROCESSES

- **Fermentation:** using yeast to turn sugars or starches into ethanol (alcohol).
- **Transesterification:** a chemical reaction to biodiesel from methanol and vegetable oils/animal fats.
- **Hydrotreating:** reacting vegetable oils/animal fats with hydrogen to produce synthetic hydrocarbon fuels (such as diesel and jet fuel).
- **Hydrolysis:** here this refers to a reaction in which sugars are produced from cellulose.
- **Pyrolysis:** production of a low grade oil by heating cellulose to temperatures of 750 °F or higher.
- **Gasification:** a reaction in which hydrogen and carbon monoxide are released from cellulose at temperatures of 1300 °F or higher.
- **Fischer-Tropsch synthesis:** chemical synthesis of hydrocarbons from hydrogen and carbon monoxide.
- **Alcohol-to-jet:** a reaction to produce synthetic jet fuel from alcohol.
- **Electrolysis:** using electricity to split water into hydrogen and oxygen.
- **(Reverse) water gas shift:** a reaction to convert water and carbon monoxide into hydrogen and carbon dioxide, or vice versa.
- **Steam methane reforming:** a reaction to produce hydrogen from natural gas and water.

This is the first of five factsheets about alternative transportation fuels (follow the QR code on the front for more). The other factsheets cover:
Factsheet #2 First generation biofuels;
Factsheet #3 Renewable diesel and renewable jet fuel;
Factsheet #4 Cellulosic biofuels;
Factsheet #5 Hydrogen.