HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Alternative drive systems for agricultural machinery

Climate neutrality in Austria by 2040

Ausstieg aus fossilen Energieträgern in der Landtechnik
Webinar am 30. November 2021
Ewald Luger

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

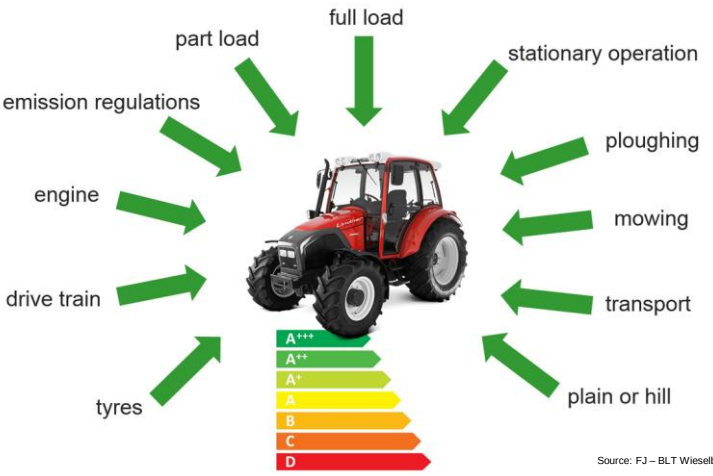
Overview

- Influence on the fuel consumption of a tractor
- More fuel efficient diesel engines
- Biofuels, methyl esters and admixtures to fossil fuel
- Second-generation biofuels
- Methane powered tractor
- Tractor electric power off-boarding
- Hybrid tractors
- Battery electric tractors
- Hydrogen fuel cell electric tractors
- eFuels
- How much horsepower do we really need?
- Working autonomous and in small units

Phasing out fossil fuels in agriculture
Can we really do that?

Influence on the fuel consumption of a tractor

Technical parameters

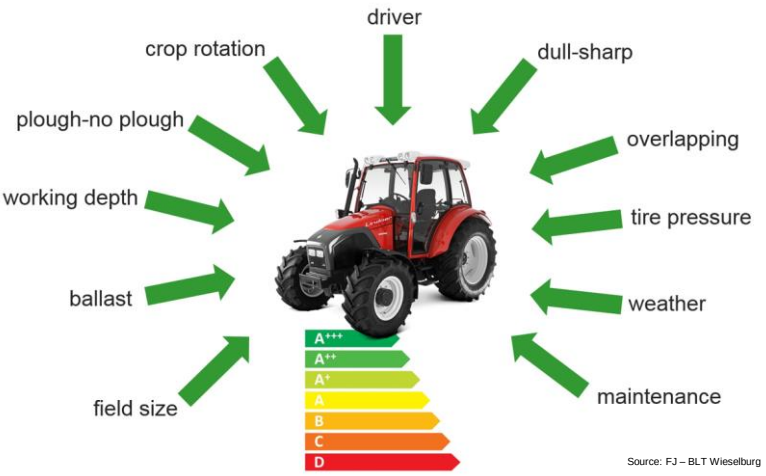


HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Influence on the fuel consumption of a tractor

Process parameters



More fuel efficient diesel engines

- increase of diesel engine efficiency to 50 percent
- electrification and diesel powertrain for hybrids
- a robust, reliable and cost-effective solution for heavy vehicles in the future too
- renewable fuels enable net zero carbon footprint

Bosch Mobility Solutions
https://www.youtube.com/watch?v=K357ndwqiMg
EN | Bosch Diesel technology, 25.09.2020, 3:33 min

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Biofuels, methyl esters and admixtures to fossil fuel

- vegetable oil as a fuel requires engine modifications
- condensation of water in fatty acid methyl esters - biodiesel - causes problems in common rail technology
- costs of rape seed oil / liter
- soybean oil 10 cent / l cheaper
- palm oil 20 cent / l cheaper
- statutory biodiesel admixture of up to 7 % by volume causes rainforest deforestation

Biofuels, methyl esters and admixtures to fossil fuel

B10 diesel

- fossil diesel is mixed with up to 10% biodiesel

B100 diesel

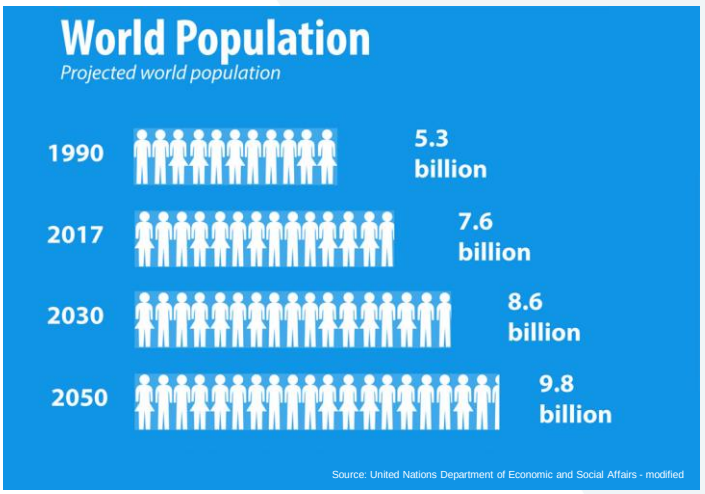
- 100 % biodiesel

E85 gasoline

- 85% bioethanol is added to fossil gasoline
- Production of bioethanol from sugar cane, sugar beet, grain, potatoes, corn, ...

Biofuels, methyl esters and admixtures to fossil fuels

- a short term solution
- long-term food and fuel conflict
- growing world population
- decreasing cultivated land area
- decreasing yields caused by increasing water shortage, temperature increase, more and more unfertile soil or even death soil



Second-generation biofuels

- waste from food crops, agricultural residue, wood chips, waste cooking oil, …
- for example, wheat straw from wheat production
- no food and fuel conflict
- figure: 42.5 gallons (161 l) of cellulosic ethanol in one bale of corn stover
- ethanol can be blended with gasoline (petrol) for use in gasoline engines

Second-generation biofuels – R33 diesel, C.A.R.E. diesel, HVO diesel, …

R33 diesel

- consists of 33 % biogenic raw materials - of this, 26 % is hydrogenated vegetable oil (HVO) made of residues such as used cooking oil and 7 % used cooking oil biodiesel
- the remaining 67 percent is a high-quality fossil diesel fuel
- CO2 reduction at least 20 % when made from residual materials compared to diesel

C.A.R.E. diesel

- **C**O_2-Reduction - **A**rctic Grade - **R**enewable - **E**mission Reduction
- synthetic diesel mostly made from plant residues and plant waste materials
- C.A.R.E. diesel is produced by a Finnish oil company
- CO2 reduction between 70 % and 90 % compared to fossil diesel

Second-generation biofuels – R33 diesel, C.A.R.E. diesel, HVO diesel, ...

HVO diesel

- HVO stands as an abbreviation for **H**ydrogenated **V**egetable **O**ils
- HVO is a synthetically produced fuel that is mainly obtained from vegetable and animal oil and fat waste from the food industry
- these oils and fats are converted into hydrocarbons with the addition of hydrogen

The disadvantage of second-generation biofuels are the high processing costs.

Third-generation biofuels

- biofuels from microalgae
- are considered as the feasible and sustainable solution for future energy demand

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Methane powered tractor

- New Holland launched the world's first methane powered production tractor in 2019
- natural gas has a methane content of 89 % to 98 % and biogas approx. 52 % to 65 %
- farmers can grow energy crops and use agricultural waste to produce biomethane

New Holland methane powered tractor
https://www.youtube.com/watch?v=xgn5lqze-9M
T6.180 Methane Power. Powered by Nature, 10.11.2019, 1:36 min

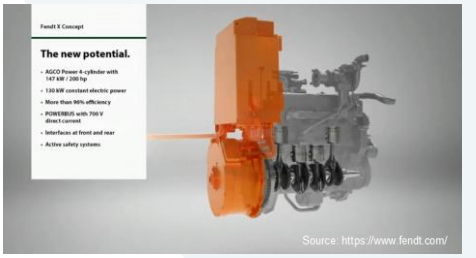
Tractor electric power off-boarding

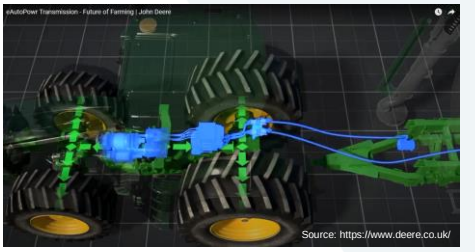
Electricity, which is generated by a generator on the tractor or from batteries, is supplied to power agricultural machines electrically.

Fendt X Concept
- 700 V DC (Direct Current)
- inverters on the implement

John Deere eAutoPowr Transmission
- 480 V AC (Alternating Current)
- inverters on the tractor

DC versus AC - on implement versus on tractor



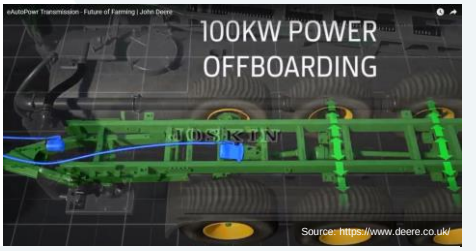


HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Tractor electric power off-boarding

access to official video on Fendt homepage
https://www.fendt.com/uk/page_916_web_en-GB
Fendt X Concept, unkown, 3:02 min



John Deere - EAutoPowr
https://www.youtube.com/watch?v=edhZn48RZJc
eAutoPowr Transmission - Future of Farming | John Deere, 10.02.2020, 1:39 min

PTO, hydraulically or electrically powered implements?
It´s a kind of the chicken or the egg problem

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Hybrid tractors – steps of evolution

according AVL

Step 1 – Mild Hybrid

- downsizing of diesel engine
- small e-machine for peak-power
- battery charged by diesel in low power ranges
- electrical implement power with 20kW max

Step 2 – Full Hybrid

- downsizing of Diesel-Engine
- additional e-machine for fully electrical driven front axle
- battery charged by diesel in low power ranges and recuperation
- electrical implement power with 20kW max
- short range full electric drive
- pull-during-shift

Source: https://www.avl.com

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Hybrid tractors – steps of evolution of electric tractors

according AVL

Step 3.1 – Full Electric

- battery system instead of diesel-engine
- usage of todays transmission (no impact on main tractor structure)
- driving front and rear axle totally independent of each other
- high electric implement power
- electrical drive for around 5 hours under real conditions max power

Step 3.2 – Full Electric

- battery system instead of today's drivetrain
- integration of completely new tractor structure
- high electric implement power
- electrical drive for around 9 hours under real conditions

Source: https://www.avl.com

Hybrid tractors – they will soon be on the market

Steyr hybrid electric tractor

presented in 2019. A diesel engine with 150 kW powers it. There is a generator that either feeds the battery inside or feeds the in-wheel motors. The maximum power of the tractor is 340 hp. Electrical power off-boarding is 700 V and 48 V.

Steyr hybrid electric tractor
https://www.youtube.com/watch?v=AycTlUeVpWw
STEYR Konzept, 18.11.2019, 2:35 min

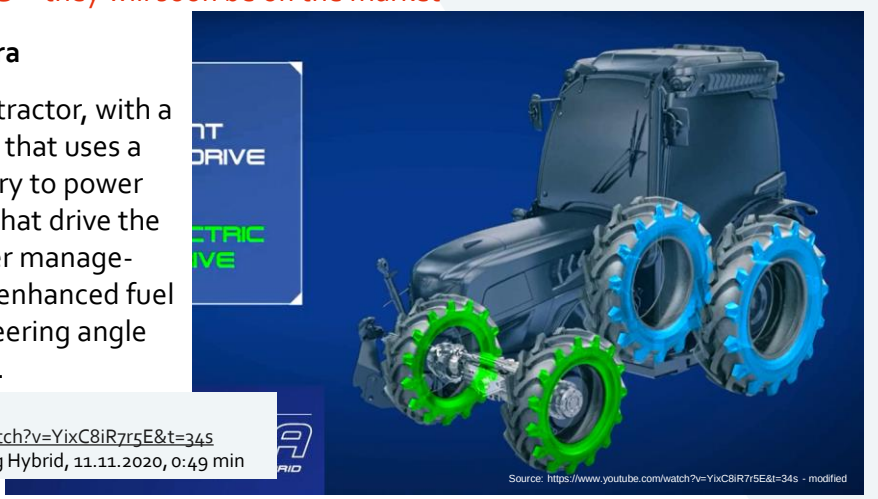
HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Hybrid tractors – they will soon be on the market

Landini REX4 Electra

is a compact hybrid tractor, with a 110 hp diesel engine that uses a generator and battery to power the electric motors that drive the front axle. The power management system offers enhanced fuel saving, improved steering angle and greater stability.



Landini Rex4 Electra
https://www.youtube.com/watch?v=YixC8iR7r5E&t=34s
Landini Rex4 Electra - Evolving Hybrid, 11.11.2020, 0:49 min

Battery electric tractors

Solectrac eUtility electric tractor

Rated power: 29 kW
Battery: 28 kWh lithium-ion
Available: since 5 years in US

https://solectrac.com/

Solectrac battery electric tractor (US)
https://www.youtube.com/watch?v=8DdIcbfJMnY
Get to know Solectrac, 27.08.2020, 2:03 min

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Battery electric tractors

Rigitrac SKE 40 Electric

Rated power: 40 kW
Battery: 50 kWh lithium-ion
Available: expected in 2022

https://www.rigitrac.ch/

Rigitrac battery electric tractor (Switzerland)
https://www.youtube.com/watch?v=nHXMx3q-xyg
Rigitrac «SKE 50 Electric», 22.08.2019, 4:17 min

Battery electric tractors

ZY Elektrik Tractor

Rated power: 97 kW
Battery: 95 kWh
Available: series production start announced for the end of 2021

https://www.zyelektrikli.com/

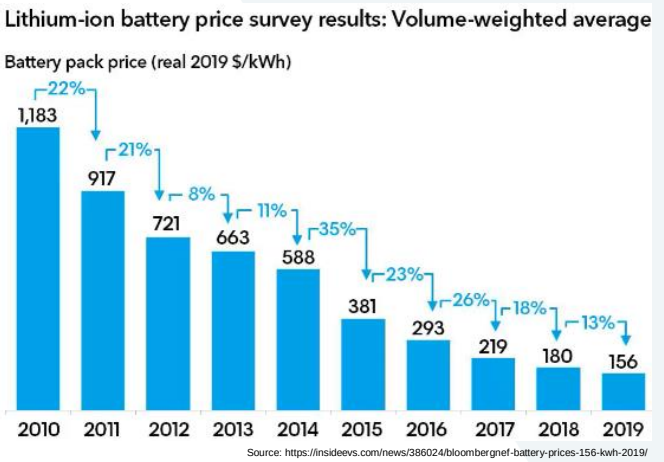
ZY battery electric tractor (Turkey)
https://www.youtube.com/watch?v=eotk8otSun8&t=2s
130 hp electric tractor from Turkey, 11.08.2021, 0:32 min

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Battery electric tractors – Key point battery price

- Lithium-ion battery price reduced by nearly 90 % within 10 years
- Lithium batteries in development today will be cheaper as new technology is used with less rare materials
- new batteries are said to be a game changer – they will replace lithium-ion



Battery electric tractors – Key point battery capacity

- There is no need to transport the electrical energy stored in the batteries for a working time of 8 to 12 h at the tractor
- Battery quick exchange systems may allow to replace an empty battery by a fully charged battery within a minute
- Recharge battery pack next to the field at wind power or solar power recharge station
- Additional batteries may replace conventional balance weights for example as front balance weights
- Consider double use of additional batteries – they may be used also as a stationary electric power storage
- New technology batteries in development (Salt, Ambri, ...) have a higher capacity

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Battery electric tractors – Key point battery charging time

- Todays typical normal charging times of lithium-ion batteries are 5 to 8 hours
- Today quick charging of lithium-ion batteries takes about 1 to 2 hours charging time to charge to 80 % of full charge
- Quick charging is expected take in a few years 10 to 15 min to charge to 80 % of full
- Sald batteries are said to have faster charging times, quick charging will be able within not more then 10 min without negative effects on service life of batteries

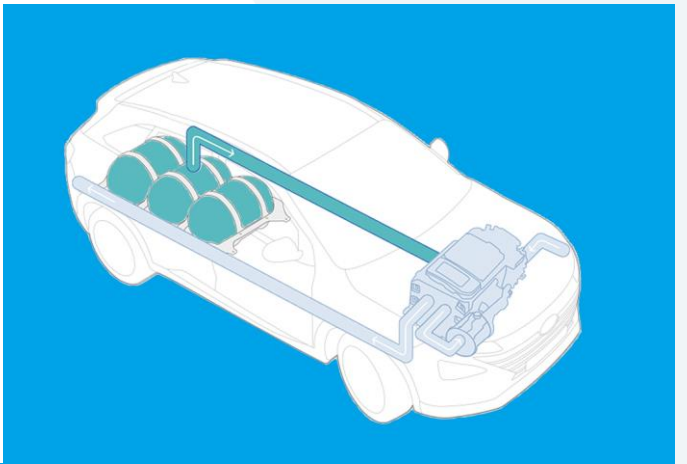
HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Hydrogen fuel cell electric tractors

Hyundai manufactures the fuel-cell-powered electric Nexo car for some years and is now applying the technology to heavy trucks. Switzerland plans to lease 1,600 hydrogen-powered heavy duty trucks from Hyundai.

Fuel cells are lighter then batteries, and a car can be refueled with hydrogen in five minutes.



HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Hydrogen fuel cell electric tractors – Key points

- Hydrogen can be produced by electrolysis of water by electrochemical splitting into hydrogen (H_2) and oxygen (O_2).
- Electrolysis preferably using renewable electricity generated from sun, wind, …
- The efficiency of the electrolysis process is up 75 %.
- Hydrogen can also be produced from natural gas. The cracking of methane (CH_4) breaks it down into the components hydrogen (H_2) and carbon (C).
- Gaseous hydrogen is not practicable due to the low volumetric density. It needs to be compressed and chilled. This process is about 90 % efficient.
- For liquid hydrogen, you need around 5 times the tank size compared to diesel fuel.
- For converting hydrogen back into electrical energy a fuel cell is used.
- The electrical efficiency of fuel cells is currently around 60 % in mobile applications.

Hydrogen fuel cell electric tractors – in development

EOX H2trac EXO - 175

Rated power: approx. 130 kW
Battery: hydrogen fuel cell
Available: in development

https://www.e-ox.nl/

EOX H2trac EXO - 175 (The Netherlands)
https://www.youtube.com/watch?v=PG8OkUHOx-A
EOX Groene zomer door 100% H2O, 18.06.2021, 1:58 min

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Hydrogen fuel cell electric tractors – versus battery electric

Hydrogen fuel cell electric

- 100 watts of electricity produced by a renewable source such as a wind turbine
- electrolysis is 75 % energy efficient
- compression, chilling, transport are 90 % efficient
- fuel cell is 60 % efficient
- electric powertrain is 95 % efficient
- only 38 watts of 100 watts can be used high losses by energy vector transition

Battery electric

- 100 watts of electricity produced by a renewable source such as a wind turbine
- grid supply is 95 % energy efficient
- charging and discharging a lithium-ion battery is 90 % energy efficient
- electric powertrain is 95 % efficient
- about 80 watts of 100 watts can be used

Hydrogen fuel cell electric – versus battery electric
https://www.youtube.com/watch?v=ls8QjJ2Rfog
Hydrogen Cars Are Taking Over Electric!, 15.06.2021, 8:05 min

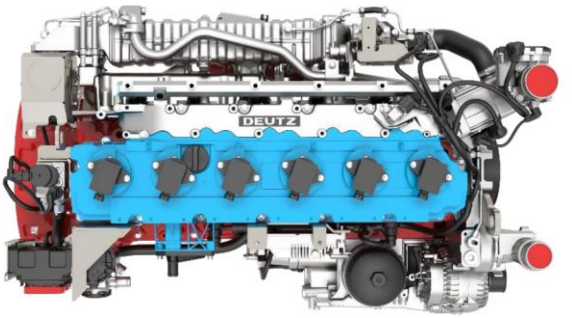
Hydrogen combustion engine – ready for the market

DEUTZ hydrogen engine

Rated power: 200 kW
Type: six-cylinder engine
Available: scheduled in 2024

- meets all criteria set by the EU for zero CO_2 emission engines
- for stationary equipment, generators and rail transport

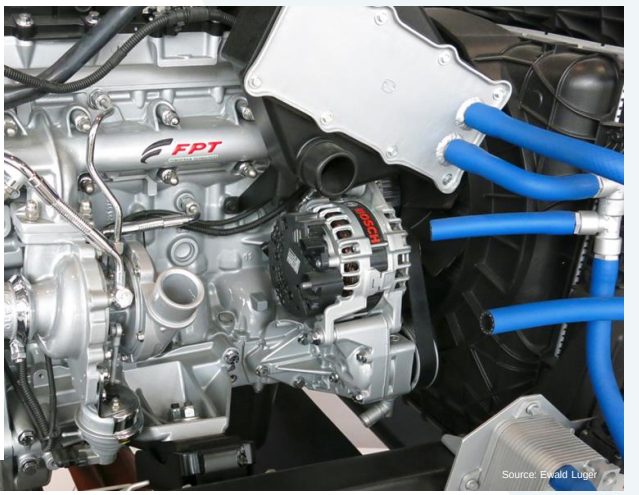
DEUTZ hydrogen engine ready for the market
https://www.deutz.com/en/media/press-releases/deutz-hydrogen-engine-ready-for-the-market



Source: https://www.deutz.com

eFuels – Key points

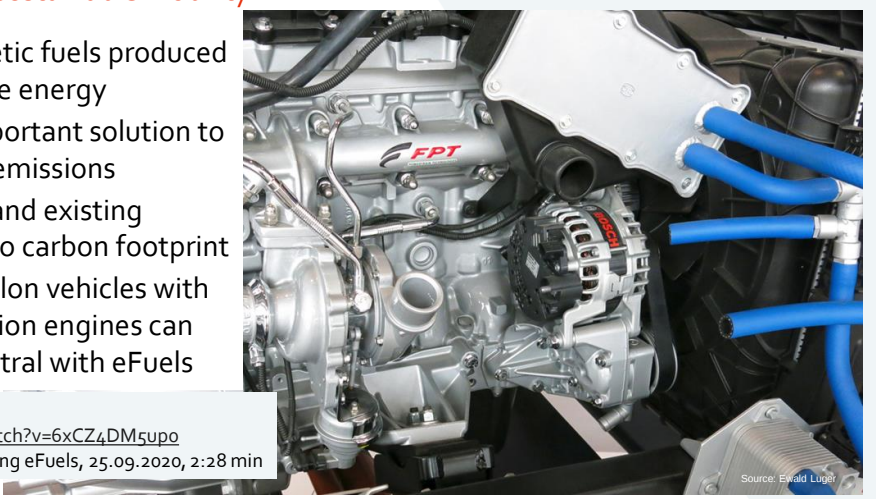
- in the so-called Power-to-Liquid (PtL) process, renewable electricity is used to generate hydrogen (H_2) through electrolysis
- H_2 is mixed with carbon dioxide (CO_2) and chemically liquefied using the Fischer-Tropsch process
- this creates synthetic fuel that can be further processed into e-fuels, heating oil, diesel, kerosene, etc..
- eFuels are climate-neutral



Source: Ewald Luger

eFuels – a key to sustainable mobility

- eFuels are synthetic fuels produced from regenerative energy
- eFules are an important solution to avoid fossil CO_2 emissions
- eFules give new and existing vehicles a net zero carbon footprint
- Worldwide 1,4 billon vehicles with internal combustion engines can become CO_2 neutral with eFuels



Bosch Mobility Solutions
https://www.youtube.com/watch?v=6xCZ4DM5upo
EN | Bosch is committed to using eFuels, 25.09.2020, 2:28 min

How much horsepower do we really need?

- in many cases agricultural tractors and self-propelled harvesters have too much horsepower to do the job
- they are too big, too wide, too heavy
- cause a high soil compaction
- they are often not as energy efficient as smaller ones

- back to reasonable sizes and horsepower requirements

How much horsepower do we really need? – back to reasonable values

- moderate sizes of tractors, machines and harvesters
- minimize soil compaction
- minimum tillage whereever possible
- minimum of shredding and cutting
- conserving a fruitful soil
- sustainable agricultural production
- research on energy saving techniques and tools

Tillage fuel consumption

40 l/ha	conventional with plough	92 kW tractor
32 l/ha	conventional with plough	59 kW tractor
23 l/ha	conventional with cultivator	92 kW tractor
18 l/ha	conventional with cultivator	59 kW tractor
18 l/ha	minimum tillage	92 kW tractor
12 l/ha	minimum tillage	59 kW tractor
27 l/ha	tillage with plough every 4 years	92 kW tractor
21 l/ha	tillage with plough every 4 years	59 kW tractor

Source: Gerhard Moitzi, BOKU

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

How much horsepower do we really need? – energy saving practices

- Amish farmers work with low horsepower input
- we have forgotten to use and to further develop energy-saving techniques and tools
- the power requirement of tractors should be critically analyzed and discussed
- energy efficient powertrain
- electrically powered agricultural machines offer new ways for saving energy

Source: Elisabeth Luger

Working autonomous and in small units – driver optional

Monarch tractor - available

- all electric
- driver optional
- actionable intelligence
- works with existing implements
- with autonomous fleet capabilities
- for 24/7 operations

Monarch Tractor (US)
https://www.youtube.com/watch?v=uzqMUHIxbys
Monarch Tractor Launch Trailer 2020, 25.02.2021, 1:58 min

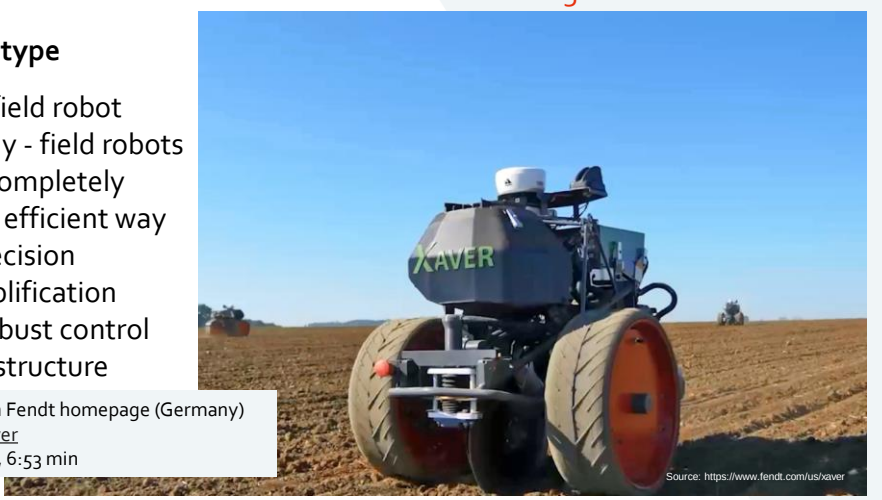
HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Working autonomous and in small units – working in swarms

Fendt Xaver - prototype

- all electric small field robot
- swarm technology - field robots collaborate in a completely autonomous and efficient way and with high precision
- basic idea of simplification
- fewer sensors, robust control units and a clear structure



Fendt Xaver access to video on Fendt homepage (Germany)
https://www.fendt.com/us/xaver
Fendt Project Xaver, unknown, 6:53 min

Working autonomous and in small units – ultra compact power unit

John Deere - prototype

- electric drive
- ultra compact power unit
- highly manoeuvrable
- 500 kW total power
- better soil protection
- fully integrated tractor/ implement

John Deere Autonomous Electric Tractor (Germany)
https://www.youtube.com/watch?v=gMaQq_vRaa8
Future of Farming | John Deere , 13.02.2020, 1:11 min

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Working autonomous and in small units - solar panel driven field robot

FarmDroid - available

- solar panel driven field robot
- seeding and weeding robot
- marks the placement of the crops at sowing and subsequently performs mechanical weed control
- ensures up to 24 hours of daily CO_2 neutral operation

Farmdroid seeding and weeding robot (Denmark)
https://www.youtube.com/watch?v=ZIqguf1J-38
Farmdroid FD20, 22.10.2020, 1:22 min

Working autonomous and in small units – safety requirements

Safety requirements

- no agricultural 'Robots' on public roads and public land
- fenced fields and fenced land?
- signage of fields: autonomous agricultural works in progress

Low safety risk when:

- velocity less than 1000 m/h
- weight less than 1000 kg

Source: FJ – BLT Wieselburg

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Phasing out fossil fuels in agriculture – can we really do that?

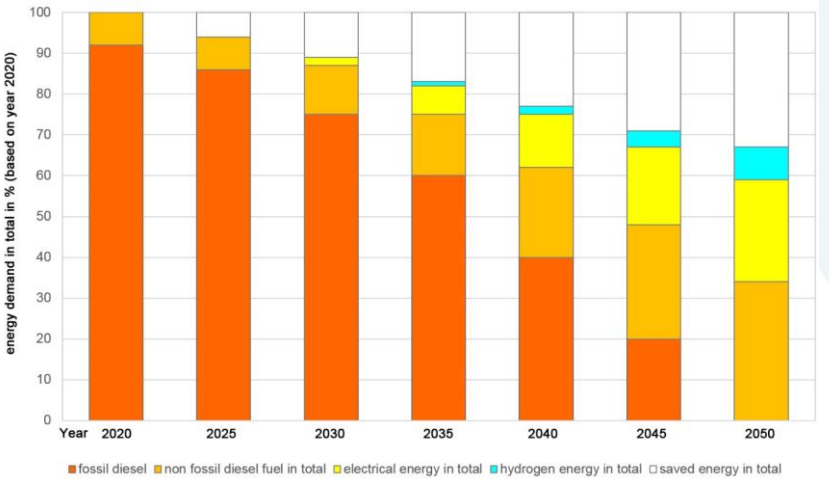
saved energy through more fuel efficient diesel engines	0	1	1	2	2	3	3
saved energy through optimized process parameters	0	2	4	6	8	10	12
saved energy through tractor electric power off-boarding	0	1	2	3	4	5	6
saved energy through resonable horsepower needs	0	1	2	3	4	5	6
saved energy through energy saving techniques and tools	0	1	2	3	5	6	6
saved energy in total	**0**	**6**	**11**	**17**	**23**	**29**	**33**
hydrogen fuel cell electric tractors	0	0	0	1	2	4	8
hydrogen energy in total	**0**	**0**	**0**	**1**	**2**	**4**	**8**
working autonomous and in small units battery electric	0	0	1	2	3	4	5
battery electric tractors	0	0	1	4	8	12	16
hybrid tractors energy share of electrical energy	0	0	0	1	2	3	4
electrical energy in total	**0**	**0**	**2**	**7**	**13**	**19**	**25**
hybrid tractors	0	1	2	5	8	10	12
hybrid tractors energy share of non fossil diesel fuel	0	1	2	4	6	7	8
others	1	0	0	0	0	0	0
eFuels	0	0	2	4	8	12	16
methane powered tractor	0	0	1	1	2	2	2
second-generation biofuels	0	0	1	1	2	4	6
biofuels, methyl esters and admixtures to fossil fuel	7	7	6	5	4	3	2
non fossil diesel fuel in total	**8**	**8**	**12**	**15**	**22**	**28**	**34**
fossil diesel	**92**	**86**	**75**	**60**	**40**	**20**	**0**
energy demand in total in % (based on year 2020)	**100**	**100**	**100**	**100**	**100**	**100**	**100**
year	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**

Source: FJ – BLT Wieselburg

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Phasing out fossil fuels in agriculture – can we really do that?



Source: FJ – BLT Wieselburg

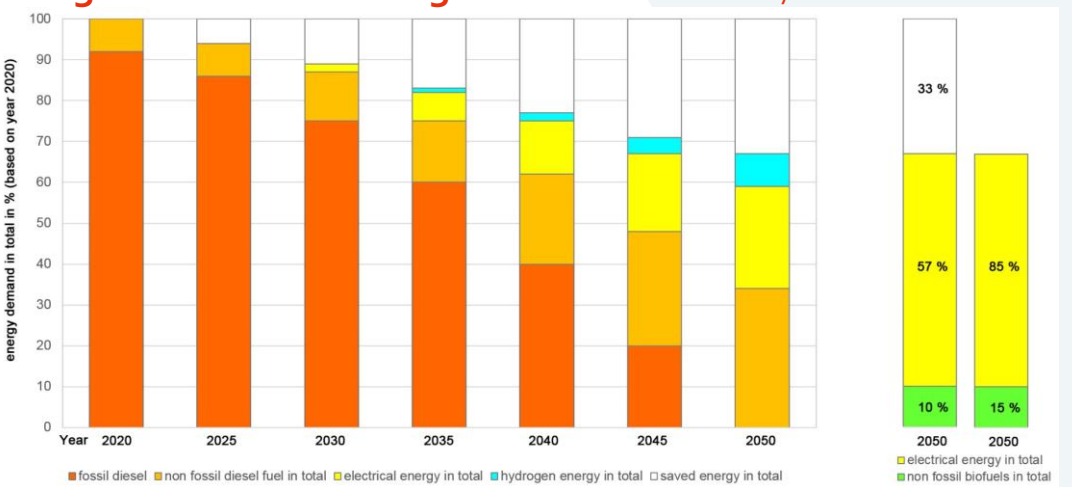
Ewald Luger - Alternative drive systems for agricultural machinery

41

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Phasing out fossil fuels in agriculture – can we really do that?



Ewald Luger - Alternative drive systems for agricultural machinery

42

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Phasing out fossil fuels in agriculture – yes we can!

200 000 000	liters of diesel were used by Austrian agriculture in 2020
33 %	expected energy savings in 2050
67 %	expected demand for diesel equivalent fuel in 2050
134 000 000	liters demand for diesel equivalent fuel in 2050
85 %	diesel equivalent electrical energy in 2050
15 %	non fossil biofuels in total (methylesters, second-generation biofuels, biomethane, ...) in 2050
114 000 000	liters of diesel eqivalent electrical energy in 2050
20 000 000	liters of non fossil biofuels in total (methylesters, second-generation biofuels, biomethane, ...) in 2050
33 %	efficiency of diesel engine including conventional drivetrain
38 000 000	liters of diesel equivalent for tractor operation available
66 %	efficiency as average value of all electric alternatives (battery electric, hydrogen fuel cell electric, eFuel, ...) including drivetrain
58 000 000	liter diesel equivalent in form of electricity is the demand for tractor operation with electric alternatives including drivetrain in 2050
38	MJ is the specific energy content of 1 litre diesel
2200 000 000	MJ of electricity expected as demand for tractor operation with electric alternatives including drivetrain in 2050
1	Watt = 1 Joule / second
2200 000 000	MWs of electricity expected as demand for tractor operation with electric alternatives including drivetrain in 2050
3600	seconds = 1 hour
1000	kW = 1 MW
611 000 000	kWh of electricity expected as demand for tractor operation with electric alternatives including drivetrain in 2050
1300 000 000	kWh/year average electricity production of hydro power plant Ybbs-Persenbeug in 2020

Source: FJ – BLT Wieselburg

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Phasing out fossil fuels in agriculture – yes we can!

- climate neutrality for agricultural tractors and machinery in Austria by 2040 is a very ambitious goal
- the presented estimation and calculation for phasing out fossil fuels in agriculture is made for the year 2050, as this appears more realistic
- the phase out of fossil fuels in agriculture can be achieved at high costs by 2040, in particular through the use of a sufficient amount of eFuels
- electric tractors are under development and a wide market rollout is expected 10 years past electric cars
- in contrast to cars or trucks, agricultural tractors or self-propelled harvesters are not replaced every 5 to 10 years by new ones, but only every 10 to 25 years
- forcing farmers to adopt new technologies will force many farmers to stop farming

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Phasing out fossil fuels in agriculture – yes we can!

- the price of agricultural products on the world market determines the income and profits of the local farmers
- farmers using this new technologies must see a return of investment, if not they will be also forced to stop farming
- the self-sufficiency rate of agricultural products in Austria in 2020 was 88 % for wheat, 86 % for eggs, 72 % for poultry, 85 % for potatoes, 69 % for butter, 55 % of vegetables and 45 % for fruit
- there is the risk that the degree of self-sufficiency with agricultural products in Austria will decrease as the number of farms in Austria decreases
- going high-tech, going digital, going electric have the great risk that blackouts in power or acts of terrorism can no longer guarantee food for the population

HBLFA Francisco Josephinum
Wieselburg

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Phasing out fossil fuels in agriculture – the greatest risks

- blackout for days, no power supply, no internet, no high-tech tractors and high-tech agricultural machinery can be operated
- terrorist acts or armed conflict lead to disruption of satellite navigation or the internet, which means that high-tech tractors and high-tech agricultural machinery can only be operated to a limited extent, if at all
- unexpected event, extreme cosmic radiation, meteorite - destruction of microelectronics and high tech by radiation or magnetic fields - the electronics of high tech tractors and high tech agricultural machinery are irreparably destroyed

- Hopefully the worst case scenario never comes. High tech is risky.

Phasing out fossil fuels in agriculture – the worst case scenario

A return to low tech, tractors with simple diesel engines and without electronics, draft animals, human labour to do the work on the farm as it was back then. But how was that back then? You can't google it on the Internet, because in this scenario the Internet is dead, just as dead as the animals that perished in their stables and the people who died in their homes of lack of water and food.

An e-tractor for Africa – Volkswagen AG

Thank you very much for your attention

Feel free to ask questions

Ausstieg aus fossilen Energieträgern in der Landtechnik
Webinar am 30. November 2021
Ewald Luger