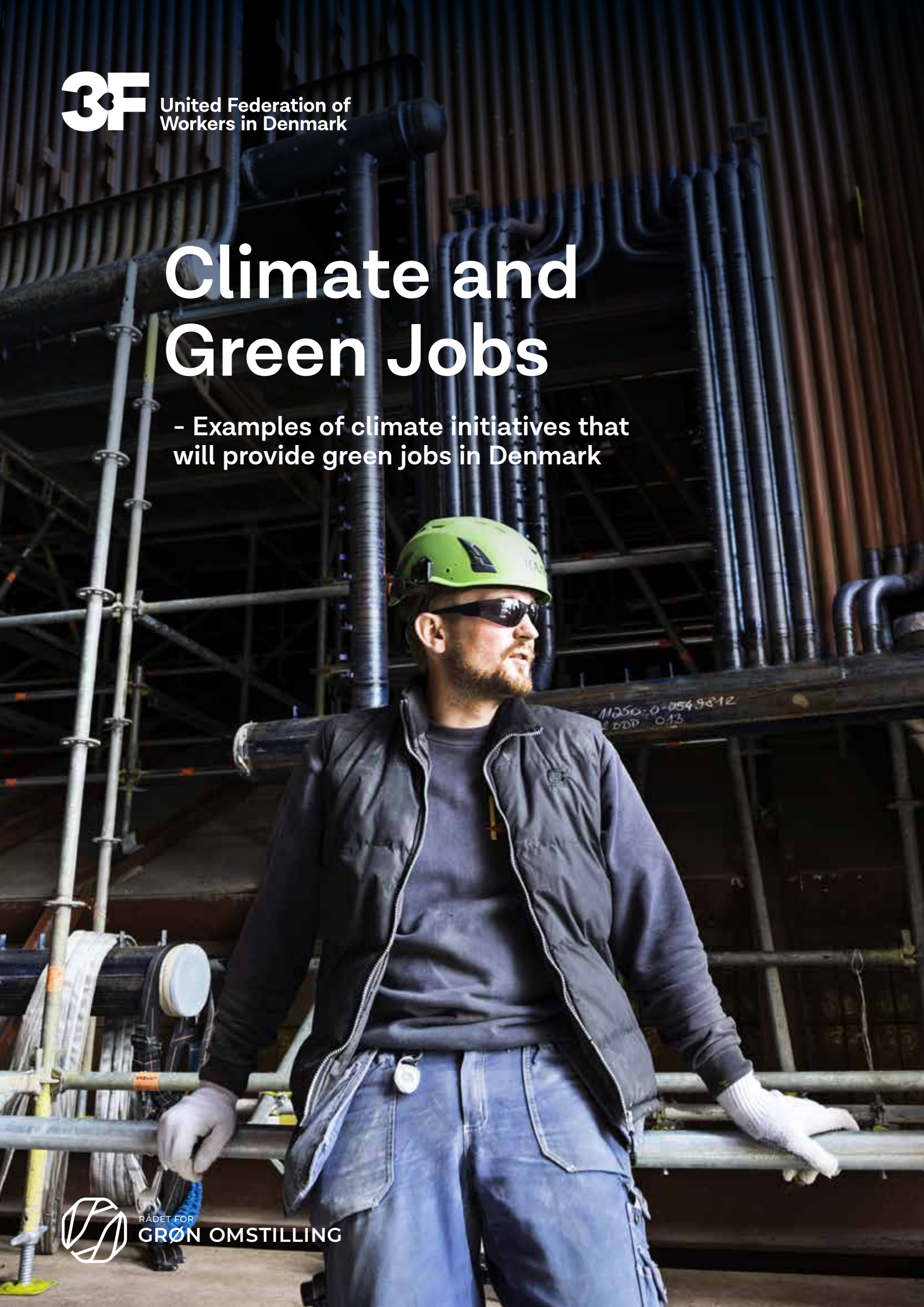
United Federation of Workers in Denmark

Climate and Green Jobs

- Examples of climate initiatives that will provide green jobs in Denmark



RÅDET FOR GRØN OMSTILLING

Climate and Green Jobs
- Examples of climate initiatives that will provide green jobs in Denmark

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Climate action and green jobs

We need to implement a green transition in our society, and we need to do it in a just way.

In Denmark we have set an ambitious target for reducing our CO_2 emissions by 70% by 2030 in order to comply with the Paris Agreement and to set an example for other countries. It is an ambitious target that will require change in our society. This means that some of the jobs that are linked to the burning of inexpensive fossil fuel, such as oil and coal, will be phased out. Fortunately, it will also be necessary to invest in many different new initiatives in order to ensure the green transition. These initiatives must be complemented with an increased focus on education and supplementary education so that we can guarantee the necessary labour for the climate-friendly society of the future. We need everybody to participate.

3F and Green Transition Denmark have assembled several examples of the necessary initiatives that will create new green jobs and make a big difference to the climate.

Denmark is one of the richest countries in the world. Denmark also has one of the highest CO_2 emissions per capita in the world. Therefore, we have an important responsibility to reduce our emissions, but also to implement investments to develop solutions that can be used around the rest of the world. These solutions will also ensure jobs in Denmark in the future.

Resume

The initiatives in this publication may overlap each other, meaning that e.g. the figures for CO_2 reduction cannot just be added up. The figures of the initiatives for investments and CO_2 reduction are rounded-off figures. The figures for employment are based on calculations prepared by the Economic Council of the Labour Movement for 3F.

Impact of the initiatives by 2030	CO_2 reduction	Investment per annum	Duration	Investment	Temporary employment	Permanent employment
	Megatons (MT) per annum	**Billion per annum**	**Year**	**Billion in total**	**Persons per annum**	**Persons per annum**
3 GW offshore wind farms	Energy for other proposals	4.1	10	40.9	2,750	687
Replacing 80,000 oil-boilers with heat pumps and district heating	0.4	0.9	5	4.7	1,440	
Replacing 400,000 gas-boilers with heat pumps and district heating	0.9	1.7	10	17.0	2,720	
Installation of 1800 MW heat pumps	2.8	1.0	5	5.0		
Energy upgrades of the old building stocks	1.7	4.06	10	40.6	5,684	
1 million electric cars	2.4	0.4	10	4.0		
Electrofuel production	0.6	2.3	6	13.8		
Installation of 15 biogas plants annually	2.6	2.6	8	20.8	1,970	1,989

Initiatives

Energy
3 extra offshore wind farms
Phasing out oil boilers
Phasing out gas boilers
Installation of large heat pumps

Buildings
Energy upgrades of old buildings

Transport
1 million electric cars
Production of electrofuels

Agriculture
Biogas plants

Offshore wind farms

Initiative: Establishment of three new offshore wind farms of at least 3000 MW

CO_2 reduction: Will replace about 6.7 MT of CO_2 annually by providing power to the other initiatives in this publication

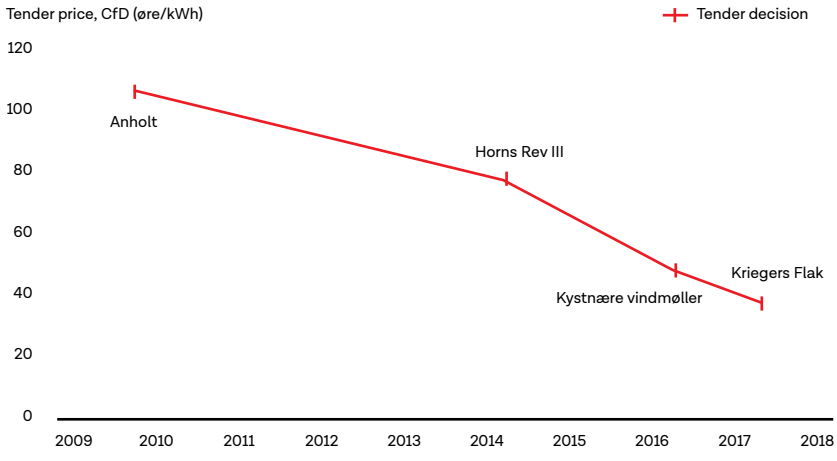
Investment: Approx. DKK 40.9 billion in total for a period of 10 years

Denmark has a special attachment to wind turbines and offshore wind turbines. In 1991, Denmark was the first country in the world to build an offshore wind farm, and until 2002, Denmark developed the energy technology that made it possible to construct an offshore large-scale wind farm (Horns Rev 1). Today, Denmark is still a leading global offshore wind turbine nation[1].

In order to reduce global warming, it is important that we replace fossil fuels as quickly as possible with new kinds of renewable energy in Denmark. Wind energy plays an important role in the green transition of the energy system, when it comes to the replacement of fossil fuels. Offshore wind turbines are becoming ever more efficient, which means that today it is possible to set up fewer wind turbines and at the same time generate a larger output than before.

In addition to be the least expensive energy technology in Denmark, wind energy is also pollution-free and renewable. This means that our electricity production in Denmark will become less expensive as well as greener when we build offshore wind farms[2]. For the past 10 years offshore wind turbines have become significantly less expensive to produce and build. It is therefore crucial to build more offshore wind farms in order to ensure a more rapid transition to a low-emission Danish society. See the decreasing sales prices over time below:

Price development in Danish offshore wind farms (2010-2017)



Source: https://www.regeringen.dk/media/5155/energiudspil-final.pdf

Note: The tender prices are stated under different tender conditions, and reservations must therefore be made for a direct comparison between the tender prices. For example, the tenders for offshore wind turbines near the shore (Vesterhav Syd/Nord) are inclusive of connection to the mains supply. However, the figure shows a clear tendency towards declining bid prices for offshore wind energy.

Energy for 3 GW offshore wind farms	CO_2 reduction	Consumption	Installed effect
	MT per annum	**MWh per annum**	**GW wind**
Phasing out of 55,000 oil-boilers in favour of heat pumps	0.3	319,000	0.1
Phasing out of 200,000 gas-boilers	0.6	1,160,000	0.3
Installation of 1800 MW heat pumps	2.8	3,078,310	0.7
1 million electric cars	2.4	2,833,333	0.7
Electrofuel production	0.6	5,031,512	1.2
Total	6.7	12,422,155	3.0

Recommendation for the construction of offshore wind farms

The 2018 Danish Energy Agreement guarantees financing for the construction of three new offshore wind farms of a total of 2400 MW by 2030. In addition to the tender of three offshore wind farms in the Energy Agreement, 3F and Green Transition Denmark recommend that a further three offshore wind farms are established with a total capacity of 3000 MW by the end of 2030. The Danish Social Democratic Party went to the polls on a promise to build two extra offshore wind farms by 2030[3]. We support this promise and recommend that one additional offshore wind farm is constructed, i.e. a total of three, as well as the three offshore wind farms of the Energy Agreement.

Energy from offshore wind turbines will contribute to the production of more than 100% of the present electricity consumption in Denmark. However, it may still contribute to significant reductions in CO_2 emissions if the extra production is used for the electrification of the energy consumption, which is currently covered by fossil fuels. 3F and Green Transition Denmark suggest that the green electricity is used for:

1) Electrification of the transport sector, e.g. for 1 million electric cars and electrofuels to replace diesel and jet fuel.
2) Electrification of a bigger part of the heat supply in individual households and in the district heating network in the form of big electrically powered heat pumps.

The table below shows what power from 3 GW offshore wind farms can be used for and how much CO_2 the offshore wind farms can replace each year:

Replacement of oil-boilers

In Denmark a big part of the individual heat supply is based on district heating. But in areas without connection to the district heating network the households primarily use oil-and gas-boilers as well as wood-burning stoves and wood pellet stoves for heating.

Oil-boilers are a CO_2-intensive and inefficient heat supply. This is a problem because other alternatives are available which are far more climate-friendly and energy-efficient. Today, an oil-boiler emits three times as much CO_2 compared to individual heat pumps. Therefore, there is great potential for reducing CO_2 emissions by replacing oil-boilers.

From oil-boilers to heat pumps
Data for the number of oil-boilers in Danish households vary between 150,000 to just under 70,000. According to the Danish Energy Agency, there are approx. 80,000 oil-boilers in Danish households today, of which about 55,000 are outside the district heating areas[4]. Regarding the data for the number of households located within the district heating areas, we use the Danish Energy Agency's data as a baseline case for the number of oil-boilers in Denmark.

In areas where it is not possible for households to be connected to the district heating network, 3F and Green Transition Denmark recommend individual heat pumps[5]. There are many advantages in exchanging an oil-boiler with a heat pump, both in terms of the economy and the environment:

1. Heat pumps are more energy-efficient than oil-boilers, gas-boilers and wood pellet ovens.
2. Heat pumps require less maintenance and have a simple payback period of under 10 years[6].
3. Heat pumps have a low CO_2 emission level and are an efficient way of replacing fossil fuels.
4. It is possible to receive a subsidy for exchanging your oil-boiler with a heat pump on a subscription during the period 2021-2024. This will reduce the start capital investment by approx. 30% for the household compared to buying and installing e.g. air-to-water heat pumps that in the period of 2020-2030 will cost approx. DKK 85,000[7].

The price of heat pumps is decreasing and according to the Danish Energy Agency, it will continue to decrease over the next 30 years. In 2020 a heat pump will cost just under DKK 90,000 including installation and VAT[8]. Moreover, it is significantly less expensive to invest in heat pumps in energy-upgraded and new-built houses where only a small installation is necessary[9].

CO2 saved by replacing an oil-boiler with a heat pump
On average, an oil-boiler emits 5.6 tons CO_2 annually[10] per household whereas a heat pump, with the present electricity mix, emits 1.7 tons CO_2 annually. An oil-boiler emits about three times as much CO_2 as a heat pump. A new-built house uses an average of 1.400 kWh annually, corresponding to an emission of 0.4 tons CO_2, based on the electricity mix in 2018[11], whereas a heat pump in 2030 will emit 0.09 tons CO_2, corresponding to a CO_2 replacement of 98% compared to heating by oil-boilers.

Compared to a heat pump, an oil-boiler is more CO_2-intensivebut also more expensive if the costs for energy consumption in the first years are included. The reason that heat pumps are energy-efficient is that they use the thermal energy of the surroundings, e.g. from earth or air and transform it into heat inside the house just as a refrigerator moves heat from the inside to the outside. Because heat pumps use the heat or cold of their surroundings you achieve more renewable energy from a heat pump than what you use. Therefore, heat pumps have a higher degree of efficiency compared to oil-boilers[13].

Initiative: All oil-boilers for individual heating must be phased out by 2025 at the latest and replaced with heat pumps outside district heating areas

CO_2 reduction: About 400,000 tons of CO_2 annually by replacing 80,000 oil-boilers

Investment: Approx. DKK 4.7 billion for replacement of 80,000 oil-boilers with individual heat pumps and conversion to district heating

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Recommendations for the phasing-out of oil-boilers

3F and Green Transition Denmark recommend that oil-boilers in Danish households are to be phased out by the end 2025 and replaced with individual heat pumps outside district heating areas. The replacement of the existing approx. 80,000 oil-boilers in Danish households will account for reducing about 400,000 tons of CO2 annually.

According to the Danish Energy Agreement of 2018, a support scheme of some DKK 20 Million annually between 2021-2024 has been established to cover the installation costs of individual heat pumps, while scrapping oil-boilers outside the district heating and gas networks[14]. In connection with this scrapping scheme, we suggest that it should no longer be permitted to have oil-boilers in private households. This applies to the installation of new as well as existing oil-boilers. In addition, it should not be possible to convert them into gas-boilers through the support scheme.

This combination will provide owners of oil-boilers with a financial incentive to replace their oil-boilers and will furthermore impose the obligation on them to do so whether they intended to replace it or not. In this way it will be easier to dispose all oil-boilers in Danish households within an overall time frame where the owners of oil-boilers are able to receive a grant for the installation of a heat pump on a subscription basis. This solution is particularly suitable for house owners who do not have the start capital to invest in a heat pump and who are not able to take out a mortgage on the house etc. With a heat pump on a subscription basis you pay for the heat pump, operation and maintenance over time, just as with e.g. district heating.

In the least energy-efficient houses, it will be necessary to energy upgrade them in order to replace the oil-boiler with a heat pump. If the house owner invests in an energy upgrade at the same time as getting rid of the oil-boiler, there is both huge financial as well as CO_2 savings oil-boiler.

Replacement of gas-boilers

Despite the term “natural gas”, it is a fossil fuel that emits considerable amounts of CO_2. In order to reach the Danish reduction target of 70% CO_2 by 2030, it is essential to start phasing out natural gas-boilers in Danish households. Other alternatives are available that are less climate-impacting and more energy-efficient such as individual heat pumps. At present, a gas-boiler emits more than twice as much CO_2 as a heat pump.

From gas-boilers to heat pumps
Today, there is a huge untapped potential for electrifying the heating supply to Danish households. During the period 2020-2030 it will cost about DKK 85,000 to install an air-to-water heat pump, inclusive of VAT, for an average household.

Initiative: By 2030 all gas-boilers in Danish households must be replaced with individual heat pumps, or connected to the district heating network

CO_2 reduction: By removing all 400,000 gas-boilers, approx. 950,000 tons of CO_2 will be replaced annually

Investment: About DKK 17 billion for removing 400,000 gas-boilers

According to the Danish District Heating Association, 25-50% of the approx. 400,000 homes heated by gas can be converted to district heating. The remaining 50-75% can be converted to individual heat pumps[15]. We recommend that as many houses as possible are connected to the collective heat supply in the form of district heating. In the following, we are presuming that the distribution between conversion to district heating and heat pumps will be 50%-50% for the 400,000 houses heated by gas.

For the 200,000 households outside the district heating areas, 3F and Green Transition Denmark recommend replacing gas-boilers with individual heat pumps. Heat pumps, particularly air-to-water heat pumps, are more energy-efficient and CO2-reducing compared to gas-boilers.

A gas-boiler emits an average of 3.6 tons CO_2 annually per household whereas a heat pump today emits 1.7 tons CO_2 annually[16]. A gas-boiler emits twice as much CO_2 as a heat pump. For a new-built house, a heat pump only emits 0.4 tons CO_2. The better insulated the house is, the more energy-reducing the heat pump will be, as the house has a better ability to retain heat. Heat pumps are therefore an efficient way to replace fossil fuels.

Another aspect of replacing gas-boilers with heat pumps is the political question of energy security of supplies and the independence of the import of gas from other countries. By phasing out fossil gas, Denmark becomes less dependent on importing fossil fuels. This means that Denmark will become more self-sufficient by replacing gas-boilers with heat pumps and converting to district heating. New heat pumps are so efficient that one kWh of electricity corresponds to approx. four kWh of heat. Thus, the output for heat pumps is far higher than for the burning of fossil gas[17].

Recommendations for phasing out gas-boilers

3F and Green Transition Denmark recommend that the installation of new gas-boilers should not be permitted after 2021 and that all approx. 400,000 gas-boilers in Danish households are phased out by 2030. Households with gas-boilers should instead be connected to the district heating system or replace their gas-boilers with individual heat pumps outside the district heating area. By phasing out 400,000 gas-boilers, Denmark can reduce approx. 950,000 tons of CO_2 annually[18].

Support schemes were established in the Danish Energy Agreement of 2018 for scrapping of oil-boilers in the period 2021-2024, and it is recommended that oil-boilers are replaced with heat pumps outside the district heating or gas network. 3F and Green Transition Denmark recommend, that it should no longer be possible to expand or be connected to the gas grid. It is problematic that the phasing-out of natural gas is being pushed further into the future just because it is a less CO_2-intensive fossil energy source than oil and coal. By 2030 all fossil fuels should be phased out in the heat sector, including natural gas.

It should be a political ambition to phase out all gas-boilers by 2030 in combination with a gradual increase in fossil gas taxes. If the tax for gas is higher, it will not be profitable to invest in a gas-boiler since the cost of operation and maintenance will be higher than for heat pumps.

In the Danish Energy Agreement of 2018, the electric heating tax will be reduced. In combination with the knowledge that in the future it will not be allowed to buy a gas-boiler, this will increase the incentive for investing in heat pumps, thereby guaranteeing greater use of renewable energy.

We also recommend that a support scheme is established for energy upgrading of houses when buying a heat pump. This will reduce the energy loss in the household and guarantee a lower heat requirement due to better insulation.

Large heat pumps

Initiative: Installation of 1800 MW heat pumps by 2030

CO_2 reduction: Replacement of approx. 2.8 MT CO_2 annually

Investment: DKK 5 billion over a five-year period by installing 1800 MW heat pumps

In Denmark, 2 out of 3 houses are heated by heat from the district heating network. 30% of the district heating production is based on fossil fuels whereas the burning of biomass constitutes more than 50% of the total district heating production[19]. Therefore, electrification of the district heating sector is crucial for the green transition.

From burning to large electrically powered heat pumps

Large electrically powered heat pumps are an efficient solution to replace fossil fuels and biomass in the district heating network. Fossil fuels, and biofuels, are less energy-efficient than large electrically powered heat pumps that typically produce three to five times as much energy in the form of heat than the energy used to power the heat pump. This is due to the fact that large heat pumps transform power from e.g. wind turbines and photovoltaics into heat. Heat pumps make it possible to reuse waste heat and residual heat or utilize energy from the surroundings, e.g. sea water, waste water etc., which is otherwise not used in conventional heat generating technologies[20].

To make a green transition in Denmark it is absolutely crucial to increase the use of electricity in the heat supply. This can be achieved by e.g. installing large electrically powered heat pumps in the district heating sector. The phasing out of fossil fuels in the district heating supply corresponds to a CO_2 reduction of 2.8annually by installing 1800 MW electrically powered heat pumps. This is due to the fact that fossil fuels today make up for approx. 30% of the district heating production and emits about 2.9 MT CO_2[21].
A 150 MW heat pump annually reduce 380,000 tons CO_2 when the heat pump is replacing coal. In the case of natural gas, a 150 MW heat pump reduce 229,000 tons CO2 annually[22].

Recommendation for the installation of big heat pumps

3F and Green Transition Denmark find it essential to phase out fossil fuels and to reduce the burning of biomass in the district heating production. From our point of view, wood-based biomass should only be used for energy purposes where biomass can effectively replace fossil fuels and where it is not possible to use other renewable alternatives[23].

We therefore recommend that until 2030, 1800 MW electricity powered heat pumps are installed in the combined heat-power plants in Denmark. These will replace approx. 2.8 MT CO_2 annually. Large heat pumps are not a definitive solution for phasing out fossil fuels per se. Large heat pumps can be included in combination with other renewable energy sources depending on the location of the combined heat-power plants and on the energy sources available.

There are three centralized coal-fired combined heat and power plants left in Denmark: Esbjergværket, Fynsværket and Nordjyllandsværket. These three plants are to be renovated in 2022, 2025 and 2028, respectively. We therefore recommend that all combined heat-power plants invest in large electrically powered heat pumps in combination with e.g. geothermal energy and waste heat. In addition, we recommend against investing in new biomass boilers and plants and further recommend phasing out and reducing the burning of biomass in the heat supply.

Decentralized combined heat-power plants and district heating district heating plants burn natural gas to a great extent.

With the Danish Energy Agreement of 2018, a number of decentralized combined heat-power plants lost their basic grant as of 1st January 2019, a grant provided by the Danish State. This means that several of the plants have difficulties in breaking even. Many of the plants are now facing a situation where they need to decide whether new investments are to be made or whether the plant must close. From our point of view, it is obvious that these combined heat-power plants, like the three big coal-fired combined heat-power plants, should invest in big heat pumps with combined solutions without the use of biofuels or fossil fuels.

It is important to promote and improve the framework conditions for investing in and installing large heat pumps. Therefore, we also recommend a gradual phasing-in of higher taxes on all fuels, whether these are coal, oil, gas or biomass, in combination with low electricity heating charges for heat pumps.

Energy upgrades of old buildings

Initiative: By 2030, all buildings must comply with the present requirements of the building regulations with respect to energy upgrades

CO_2 reduction: 1.7 MT annually through energy upgrades of old buildings

Investment: DKK 40.6 billion over a period of 10 years until 2030

In Denmark about 65% of the existing buildings are constructed before 1980. At that time, the standards for energy saving were much lower than today[24]. When a house is inspected, it will be provided with an energy label on a scale from A to G, where A signifies the lowest energy consumption. Over the years it has been possible to implement energy efficiency measures in buildings to a higher level than what the standard for A used to be. Therefore, new and more up-to-date labelling has been made A2010, A2015 and A2020, where A2020 is the most energy-saving label for a house today[25].

Of about 650,000 buildings more than 400,000 buildings have the energy label D or below. A house with energy label G uses an average of about 20 times more energy per m2 than a new-built house with energy label A2020[26]. Therefore, there is great potential for energy and CO_2 reduction by renovating the existing buildings and increasing the buildings' energy label so that they comply with the requirements of today for energy upgrading.

It is necessary to energy upgrade old buildings
Energy consumption in buildings constitutes about 40% of total Danish energy consumption[27]. The Danish Energy Conservation Council has estimated that 85% of the existing buildings will also exist in 2050[28]. Energy upgrading of existing buildings are an important step in reaching the Danish 70% reduction target by 2030. The faster our buildings are upgraded, the less energy we consume. It is therefore necessary to accelerate the green transition as much as possible and prioritize the upgrading of existing buildings.

The Danish Building Research Institute estimates that the cost of an energy upgrade can be reduced by 45% if the upgrade is done together with other maintenance[29]. According to the Danish Building Research Institute, you will also be able to save about 30% of the energy consumption by energy upgrading buildings: 20-25% is saved through better insulation, and 5-10% is saved by converting e.g. oil- and gas-boilers. This means that you can save 2/3 by re-insulating and 1/3 by converting the heat supply.

Recommendations for energy upgrading

3F and Green Transition Denmark recommend that old buildings are upgraded to the level that is required today for renovations by 2030 according to the building regulations. A rapid renovation of buildings will make the green transition less expensive and will reduce about 1.7 MT CO_2 annually by 2030.

Moreover, we recommend that energy upgrading efforts in municipal buildings are exempted from the construction ceiling for the municipalities, as this will be advisable due to operating costs as well as reduction of CO_2.

Production of electrofuels

Initiative: Production of 200,000 tons electrofuels annually to be established by 2030

CO_2 reduction: 0.6 MT CO_2 annually by replacing 120 tons of aircraft fuel and 80 tons of petrol and diesel annually

Investment: An investment of approx. DKK 13.8 billion over a 6-year period is expected

A direct electrification of the means of transport based on e.g. batteries, is the most energy-efficient way to achieve a conversion from fossil fuels. But nowadays, it is not possible to electrify all means of transport, and for means of transport such as e.g. aircraft it may never become an all-encompassing solution. Therefore, we need fuels that are not based on fossil energy. This can be achieved by producing the so-called" electrofuels".

Production of electrofuels
Electrofuels are fuels that may have the same chemical composition as fossil-based fuels but are produced by means of electricity. When producing electrofuels it is therefore important that the electricity mix is based on 100% renewable energy from e.g. wind turbines and photovoltaics.

It is possible to produce electrofuels in many ways, and most fuel types can be produced for e.g. aircraft, ferries and trucks. It is, for example, possible to produce hydrogen from water and electricity and you can then produce many different types of fuels from this in combination with carbon. This means that you can produce sustainable fuels for e.g. aircraft and ships where the possibilities for using other renewable energy sources are highly limited.

The production uses a lot of energy and has primarily become an option because the price of renewable energy has decreased significantly in recent years. However, electrofuels are still expected to be much more expensive than their fossil alternatives for many years to come.

Recommendation for the production and use of electrofuels

3F and Green Transition Denmark recommend that the production of electrofuels is to be based on e.g. hydrogen or biomethane and CO_2 from the air. The processes must be powered by electricity from renewable energy sources, e.g. offshore wind turbines. We recommend that offshore wind farms are established by 2030 for the production of electrofuels with a capacity of 3 GW, of which 1.2 GW is used for the production of electrofuels.

1.2 GW could be in the form of one or two small plants built by 2030, whereas large plants, e.g. in the form of actual energy islands, of e.g. 3 GW or 10 GW may not be established until after 2030.

A capacity based on 1.2 GW offshore wind will generate approx. 200,000 tons of electrofuels, of which approx. 60% will replace fossil aircraft fuel, whereas the remaining 40% will replace e.g. fossil petrol and diesel. This will correspond to 12% of all aircraft fuel fueled in Denmark, and there will then also be electrofuels for other means of transport, e.g. trucks and ferries.

We have here assumed that the CO_2 reduction corresponds to CO_2 emissions of the replaced fossil jet fuel and diesel. The total reduction will be 0.6 MW CO2 annually.

1 million electric cars by 2030

Initiative: Electric cars will replace fossil fuel cars so the number of electric cars will reach at least 1 million by 2030

CO_2 reduction: 1 million electric cars will replace 2,400,000 tons of CO_2 annually

Investment: DKK 4 billion for infrastructure

The transport sector in Denmark is responsible for 80% of the burning of fossil oil in Denmark and as much as 44% of Denmark's CO_2 emissions[30]. Passenger cars are responsible for the vast majority of CO_2 emissions from the domestic transport. Electric cars are now ready to replace fossil fuel cars.

From fossil cars to electric cars
Even if an electric car is basically just a car where the combustion engine has been exchanged with an electric engine, electric cars in many ways mark a significant progress with respect to the environment, climate and energy independence. With respect to the climate, it is particularly important that an electric engine is 2-3 times more energy-efficient than e.g. a modern diesel engine. At the same time the change in fuel will make it easy and inexpensive to rapidly replace vast amounts of fossil fuels with renewable energy. This makes electric cars the real solution in order to reach the Danish climate goals when it comes to passenger cars.

The Danish Council on Climate Change has calculated the climate impact from different types of cars. The graph below shows the difference in CO_2 emissions for electric cars and fossil fuel cars. Please note that car manufacturers are currently working hard to reduce the climate impact from the manufacture of cars (the green part) and batteries (the dark blue part), whereas electricity production is expected to have significantly lower CO_2 emissions by 2030 than today. So, time is on electric cars' side to an increasing higher degree.

Denmark is subject to a separate goal concerning most areas outside the Emission Trading System. This includes cars as well as people and houses. Changing from fossil fuel cars to electric cars means that the CO_2 emissions change from being outside the Emission Trading System to being within it, since petrol and diesel falls outside the Emission Trading System whereas electricity falls within the system. With electric cars it will therefore be easier to reach the target outside the Emission Trading System.

Recommendation for at least 1 million electric cars by 2030

As also proposed by several political parties, 3F and Green Transition Denmark recommend that we in Denmark need to have a minimum target of 1 million electric cars by 2030. This means that 1 million cars in 2030, which would otherwise be fossil fuel cars, will be electric cars instead. The necessary investment in infrastructure in order to provide 1 million cars with charging has been calculated by the Technical University of Denmark[31] at approx. DKK 4 billion, of which approx. DKK 1.5 billion is to be invested in the establishment of infrastructure for everyday charging, and DKK 2.5 billion for rapid charging.

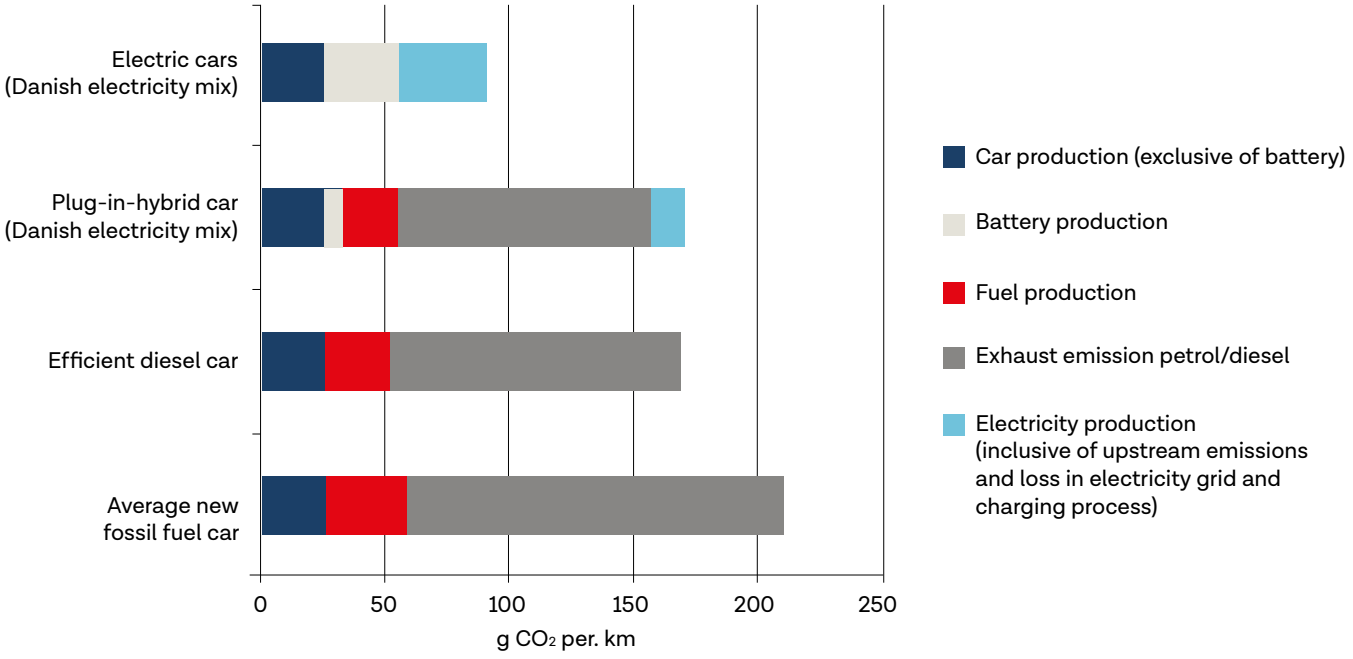
As it is estimated that electric cars will become as inexpensive to produce as fossil fuel cars by approx. 2023-24, we have assumed that the total cost for new electric cars compared to the cost for new fossil fuel cars will remain unchanged until 2030.

The saved CO_2 emissions per electric car replacing a fossil fuel car corresponds to approx. 2.4 tons CO_2 annually or 2.4 MT CO_2 annually at 1 million electric cars[32].

In addition, electric cars significantly reduce noise pollution in cities and air pollution in the form of ultrafine particles and NOx, why societal health costs will be reduced with this transition.

In the period until 2025 electric cars should be promoted through lower taxes than fossil fuel cars, and a number of other initiatives should be implemented in order to promote electric cars such as e.g. extended free parking for electric cars and zero emission zones in big cities.

Global CO_2 emissions per km in the lifespan of the car



Source: The Danish Energy Agency, "How climate-friendly are electric cars compared to cars run on petrol and fuel?", 2018

Biogas

Initiative: Install 15 biogas plants annually for 8 years

CO_2 reduction: Installation of 15 biogas plants will save 2.1 MT CO_2 annually by replacing natural gas

Investment: DKK 20.8 billion over an 8-year period

Biogas is an efficient way to reduce the climate impact from the agricultural and energy sector, and even if some biogas plants have been installed in recent years, there is still great potential for installing more plants.

Biogas instead of natural gas
Biogas is primarily methane based on a biological material, e.g. manure or straw. Biogas can also be made with raw materials such as household waste or plant residues. From a climate perspective, biogas makes a huge difference as you avoid having to spread untreated manure on the fields where it contributes to greenhouse gas emissions.

Without treatment in a biogas plant, a considerable amount of methane and nitrous oxide will evaporate from the fields. And since methane is a climate gas 20 times more potent than CO_2, and nitrous oxide is 300 times more potent than CO_2, this will mean a very significant climate impact that can be limited by gasifying the manure in a biogas plant. At the same time, you can remove CO_2 from the biogas and upgrade it so that it can be distributed in the gas network and replace the use of fossil natural gas. The treatment of manure in a biogas plant also means that the manure will become more suitable as a fertiliser in the fields and that odour problems and environmentally harmful nitrogen leaching are reduced.

Recommendation for the installation of biogas plants

3F and Green Transition Denmark recommend that 15 new biogas plants are established annually in Denmark and that it is considered politically whether to implement to introduce a blend-in mandate of biogas for private domestic heating instead of fossil gas.

The effect of using biogas depends on where it is used and thereby what it replaces. Biogas can be used to replace fossil fuels for transport, industrial use and heating. If you calculate the average for what biogas can replace, a biogas plant will in 2025 be able to reduce approx. 22,000 tons CO_2, corresponding to an overall annual reduction of 2.6 MT CO2 by installing 120 new biogas plants[33].

Endnotes

[1] https://ens.dk/ansvarsomraader/vindenergi/fakta-om-vindenergi
[2] https://winddenmark.dk/tal-fakta/hvorfor-vindenergi
[3] https://www.information.dk/indland/2019/03/socialdemokratiet-bygge-yderligere-to-store-havvindmoelleparker-inden-2030
[4] Energistyrelsen (the Danish Energy Agency) 2019
[5] However, it is an important condition for the recommendation that the district heating system be decarbonised. District heating is not a solution in itself until the heat supply is based on 100% renewable energy (see section on big heat pumps).
[6] https://www.bolius.dk/skift-til-varmepumpe-saa-meget-sparer-du-20192
[7] Energistyrelsen, "Teknologikatalog 2019" ("Technology Catalogue 2019")
[8] Energistyrelsen, "Teknologikatalog 2019" ("Technology Catalogue 2019")
[9] Energistyrelsen," Teknologikatalog 2019" ("Technology Catalogue 2019")
[10] An average 140 m2 house uses 2,100 litres of heating oil annually and 5,800 kWh electricity annually for a heat pump: https://sparenergi.dk/forbruger/spar-energi-i-dit-hus and Energistyrelsen, "Energistatistik 2018" and Energistyrelsen, "Energistatistik 2018"
[11] Energistyrelsen, "Samfundsøkonomiske beregningsforudsætninger for energipriser og emissioner 2019"
[12] https://www.bolius.dk/skift-til-varmepumpe-saa-meget-sparer-du-20192
[13] https://kefm.dk/media/12222/energiaftale2018.pdf
[14] Dansk Fjernvarme ("the Danish District Heating Association"), "500.000 boliger skal have grøn varme", 2019 ("500,000 households will be powered by green energy", 2019)
[15] Energistyrelsen, "Energistatistik 2018" ("The Danish Energy Agency, Energy Statistics 2018")
[16] https://www.varmepumpefabrikanterne.dk/VE_og_gasuafhaengighed.html
[17] Energistyrelsen, "Teknologikatalog 2019" and Energistyrelsen, "Energistatistik 2018" , ("The
[18] Danish Energy Agency, 'Technology Catalogue 2019' and the Danish Energy Agency, 'Energy Statistics 2018'")
[19] Energistyrelsen, "Energistatistik 2018" ("The Danish Energy Agency, Energy Statistics 2018")
[20] Energistyrelsen, "Teknologikataloget 2019", ("The Danish Energy Agency, 'Technology Catalogue 2019'")
[21] Energistyrelsen, "Energistatistik 2018" ("The Danish Energy Agency, Energy Statistics 2018")
[22] Siemens, "Elektrificering af Danmarks fjernvarmesektor", ("Electrification of Denmark's district heating sector")
[23] Rådet for Grøn Omstilling, "Bæredygtig brug af træbaseret biomasse", 2019, ("Sustainable use of biomass derived from trees", 2019)
[24] https://ens.dk/sites/ens.dk/files/Energibesparelser/esr_anbefaling_til_renoveringsstrategi.pdf
[25] https://sparenergi.dk/forbruger/boligen/renovering
[26] Own calculations based on data from BUILD, 2020
[27] https://www.danskbyggeri.dk/media/37418/klausuleret-byggeriets-energianalyse_2019_samlet.pdf
[28] https://ens.dk/sites/ens.dk/files/Energibesparelser/esr_anbefaling_til_renoveringsstrategi.pdf
[29] Statens Byggeforskningsinstitut, "Danske bygninger energibehov i 2050", 2010
[30] Drivkraft Danmark, ("Energistatistik 2019")
[31] DTU, Sådan skaber Danmark grøn infrastruktur til én million elbiler, 2019 ("How Denmark will create green infrastructure for a million electric cars", 2019)
[32] Klimarådet, Hvor klimavenlige er elbiler sammenlignet med benzin- og dieselbiler? 2018 ("How climate-friendly are electric cars compared to cars run on petrol and fuel?", 2018) Calculated at average CO2 emissions in the lifespan of the car at 17,000 km annually.
[33] A note from the Danish Energy Agency: "Effekt af biogasproduktion på drivhusgasemissioner" ("Effect of biogas production on greenhouse gas emissions") from 2016 describes the CO2 replacement (without nitrous oxide), and the figures for the biogas production come from the Technology Catalogue from the Danish Energy Agency.

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