

# Biodiesel Production from Waste Cooking Oil A Renewable Blend for Diesel Engines

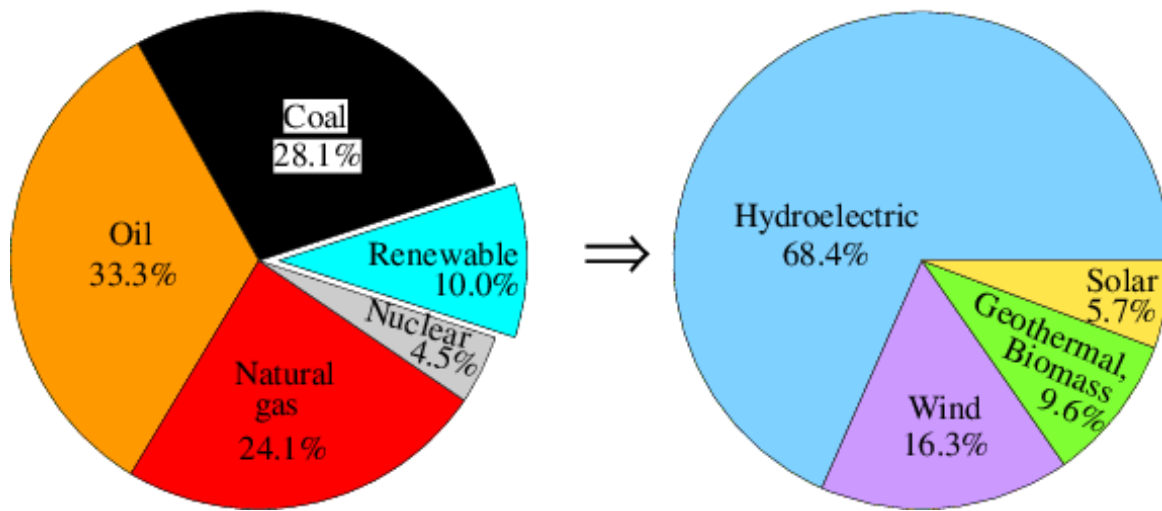


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# Alternatives to Fossil Fuels

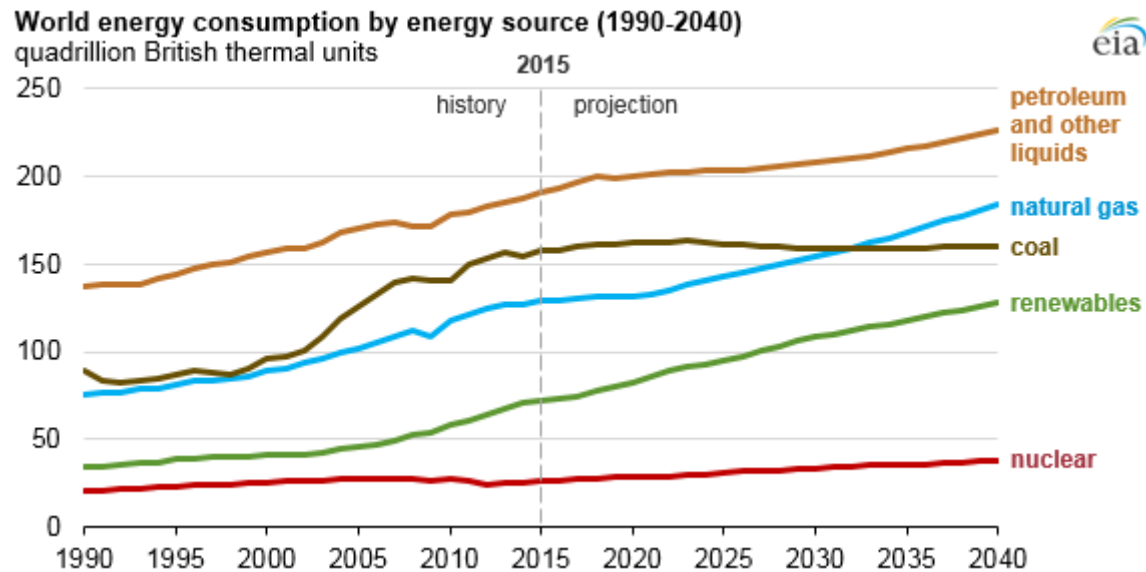
- 80% of our energy comes from oil, coal, and natural gas.
- Five alternative energy sources are currently the most developed and most widely used: nuclear energy, hydroelectric power, wind, solar and energy from biomass



Global Energy Consumption in Fraction, 2016

# World energy consumption

- World energy consumption will grow by 28% between 2015 and 2040
- Renewables are expected to be the fastest-growing energy source

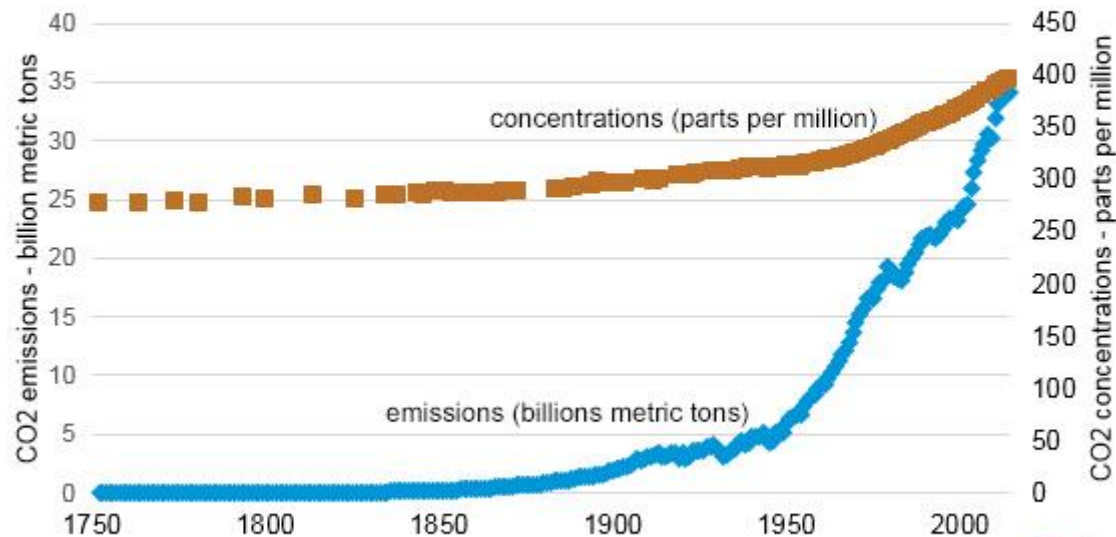


Source: U.S. Energy Information Administration, International Energy Outlook 2017

# CO<sub>2</sub> emissions

- Greenhouse gas emissions and atmospheric concentrations have increased over the past 150 years

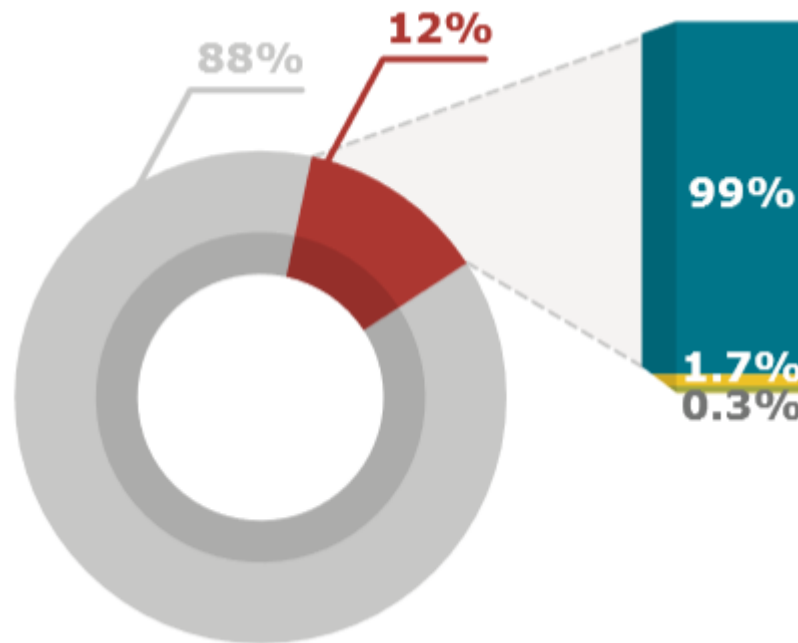
World carbon dioxide emissions from fossil fuel combustion and global atmospheric concentrations (1752–2014)



Source: Data from Oak Ridge National Laboratory, Carbon Dioxide Information Analysis Center, accessed July 26, 2017



# Lebanon relies on Fossil Fuels



Fossil fuel
  RE
  Wind
  PV
  CSP
  Hydro

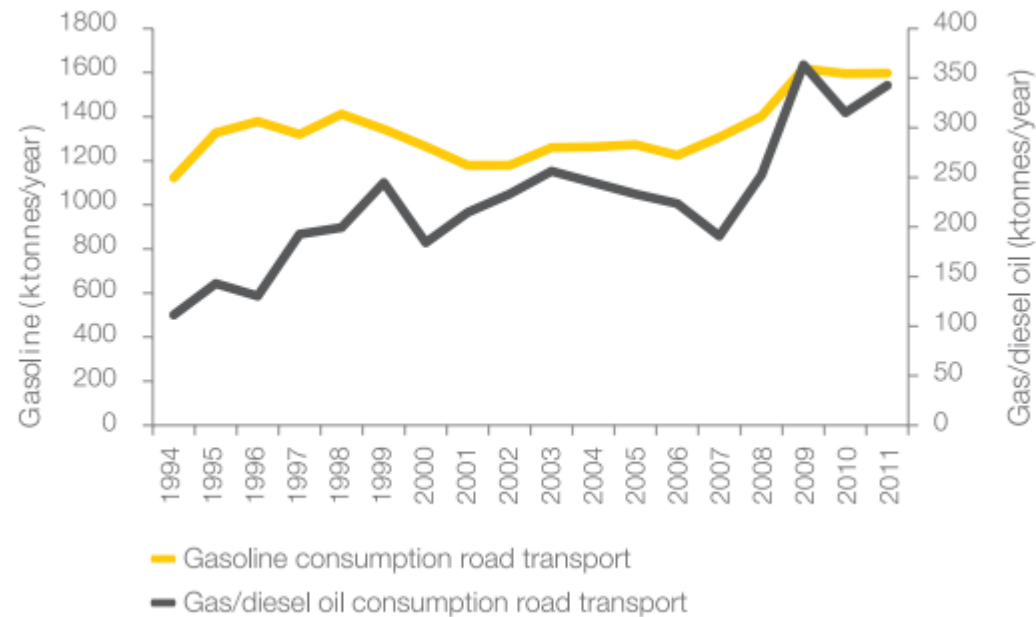
	Wind	PV	CSP	Hydro	Total RE	Total all Energy
MW	~0.5	1	0	*282	283.1	2313

\* Total operating capacity is around 150 MW.

Lebanon 2012. Copyright © 2013 RCREEE

# Transportation sector in Lebanon

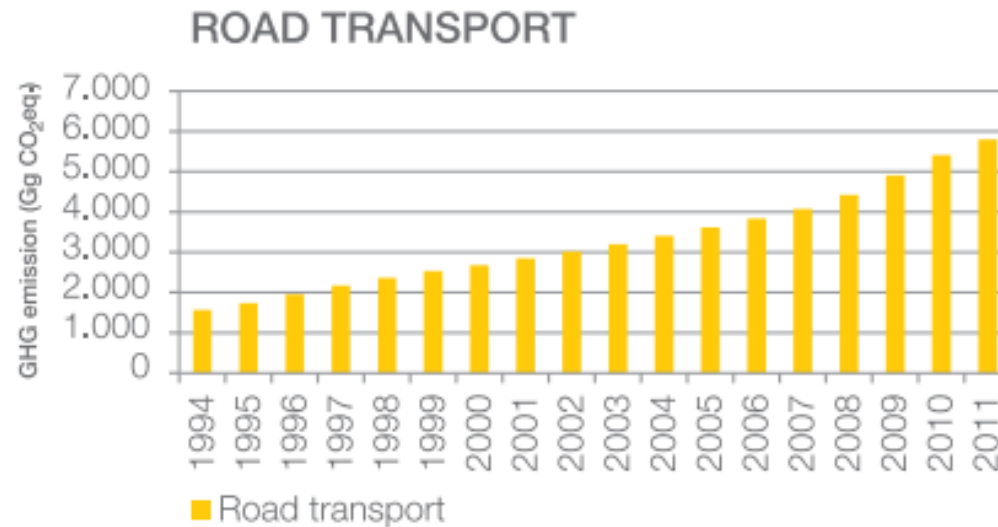
- The transport sector is the second consumer of energy in Lebanon, totally dependent on fossil fuels.



Source: MoE/UNDP/GEF, 2015b

# Transportation sector in Lebanon

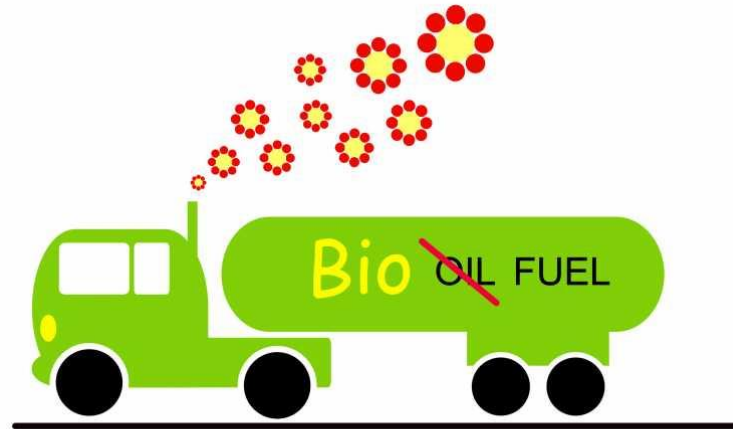
- GHG emissions from the road transport sector increased since by a factor of 3.7 reaching 5.8 million tonnes CO<sub>2</sub> eq. in 2011



Source: MoE/UNDP/GEF, 2015b

# Renewable Energy in transport

- Biomass can be converted directly into liquid fuels - biofuels - for our transportation needs (cars, trucks, buses, airplanes, and trains).
- Two most common types of biofuels are **ethanol** and **biodiesel**.





# Complete Solution

- In the absence of a clear strategy to solve the transport sector problem, IPTEC and USEK (FE, Green committee, ACIE...) with the support of the UNDP join efforts to recycle household waste cooking oil (WCO) for sustainable biodiesel production



# Complete Solution

- Why USEK-IPTEC?
  - Close Mission & Vision
  - Strategical cooperation:
    - Logistics
    - Test the Model
    - Awareness, private residential segments
  - Large Community:
    - USEK:
      - 7000 Students & more than 1000 employees
    - IPTEC:
      - Large and wide geographic coverage
      - Fidelity programs



# Vision and Goals



Offer biofuel with the same performance as that of conventional diesel, at competitive price and ecologically safe

- ✓ Sustainable transportation
- ✓ Supply security
- ✓ Increase the participation of renewable energy sources in energy consumption
- ✓ Awareness
- ✓ Create new Job opportunities

# The Solution

Biodiesel is the best solution

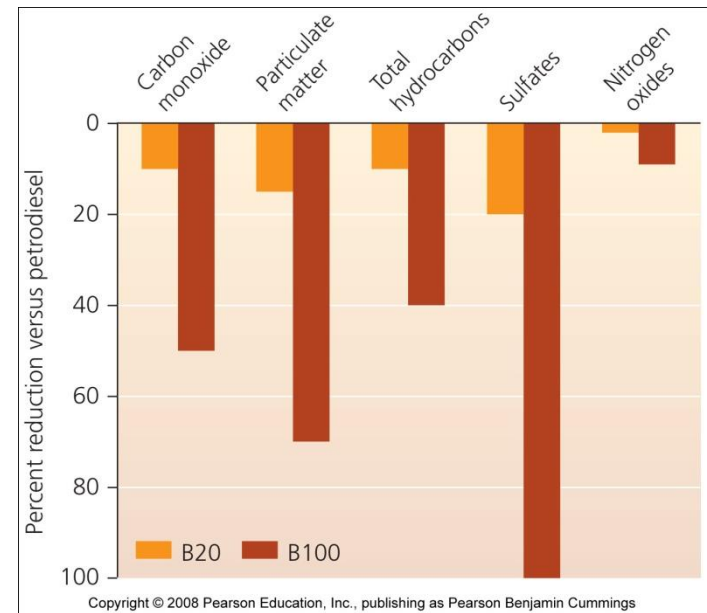
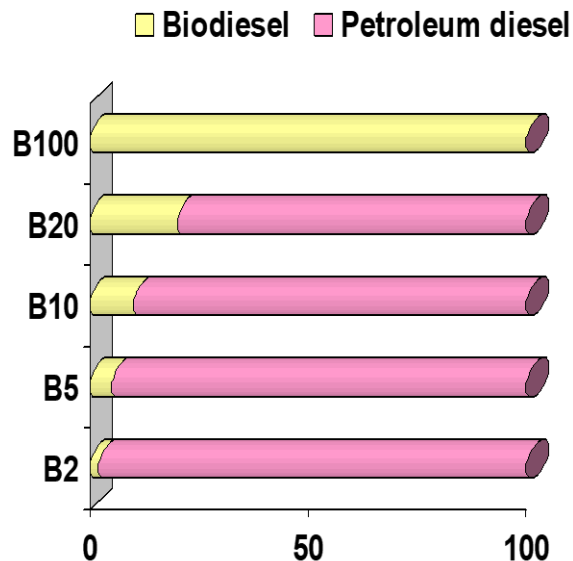
Why...?

Because of:

- Similar properties as diesel
- Produce less emission and it is successfully implemented on existing systems (cars).
- Its fuel economy is almost as good and costs slightly more than gasoline

# Biodiesel Blends & Pollution

- Biodiesel: Can be used alone or mixed in any ratio with petroleum diesel fuels.

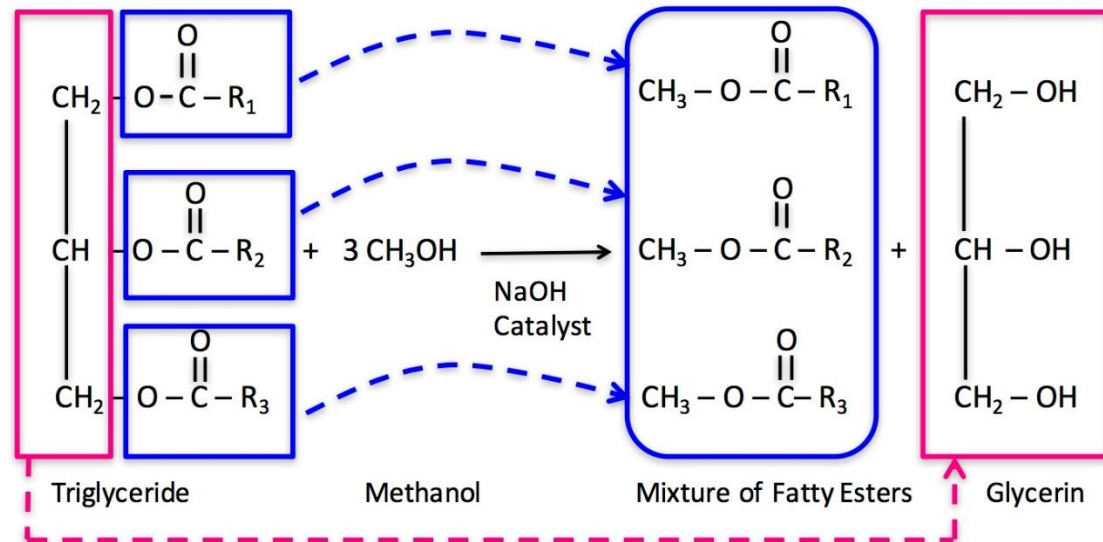


# Biodiesel Properties & Standards

- High Cetane (avg. over 50)
- Sulfur free
- Cold flow - B2 the same as #2 petroleum diesel
- Higher flash point (100°C minimum)
- Shows similar fuel consumption, horsepower, torque, and haulage properties as conventional diesel fuel
- Shows significant lubricity improvement over petroleum diesel fuel

**The Biodiesel standard: ASTM D6751**

# Biodiesel is produced from vegetable oil



- Products:
  - Fatty Esters or biodiesel
  - Glycerin used for making soap



# WCO as a feedstock

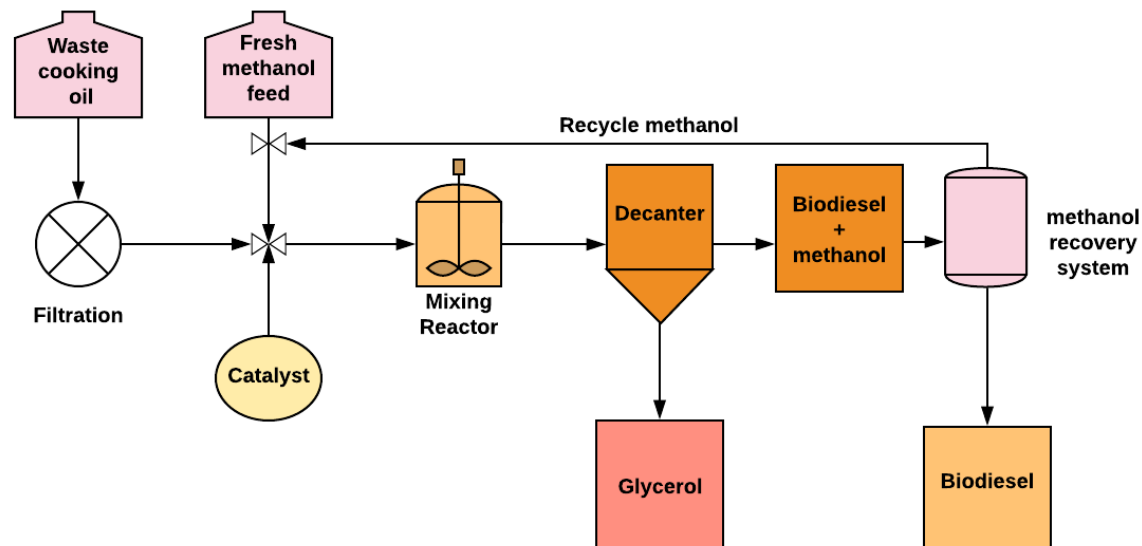
- Significant reduction in the cost of biodiesel production
- Raise public awareness about the importance of WCO recycling
- Develop an organized waste cooking oil disposal system





# WCO as a feedstock

- Conventional type of biodiesel process reactor face many challenges :
  - Reaction time is high
  - Operation cost is high
  - The required molar ratio of alcohol to oil is high



# Magnetic-impulse high-frequency cavitation processing

- Pretreatment step is not needed
- The required amount of alcohol and catalyst is minimal
- The time of ready biodiesel production reduces by several times:



# The Processing Cycle

- A: Disposal of WCO
- B: Quality detection of disposed WCO
- C: Processing cycle
- D: Separation of biodiesel and glycerol
- E: Biodiesel usage



# Conclusion

The major outputs of this project are :

- To offer an alternative fuel with the same performance as that of conventional diesel at competitive price and ecologically safe
- Raise public awareness about the importance of WCO recycling
- Reduce the greenhouse gas emissions
- Promote the use of biodiesel as a clean source of fuel in transportation sector
- Increase the participation of renewable energy sources in energy consumption
- Create new job opportunities.



**Thank you for your  
attention**