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# POLLUTION AND AIR QUALITY 2

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Environmental protection

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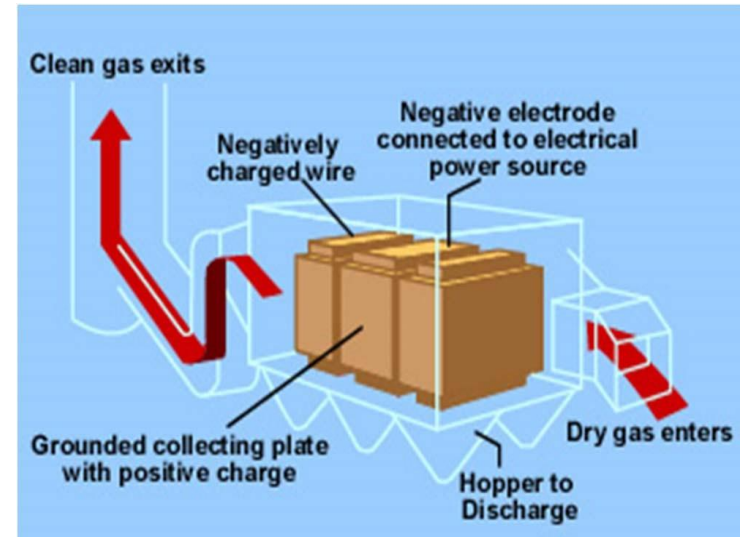
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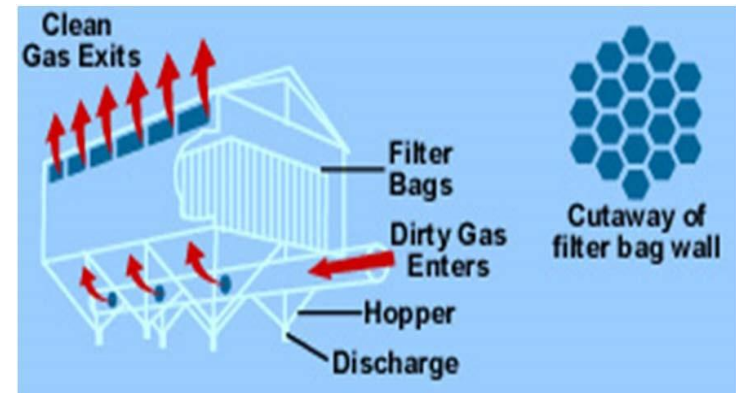
# EMISSIONS CONTROL

- **STATIONARY SOURCES:**  
**Particles**
- **1) Particles - electrostatic precipitators (ESP)**
- An ESP is a device that uses electrical forces to separate particles from a gas stream
- ESP places electrical charges on particles, causing them to be attracted to oppositely charged metal plates



Electrostatic precipitator

- **2) Particles - Fabric filters**
- Fabric filters, or bags, remove dust from a gas stream by passing a stream of flue gases/gases through a porous fabric
- A fabric filter is effective at removing fine particles and can be as high as 99% efficient.
- Disadvantage: high-temperature gases often have to be cooled before contacting the filter medium



Fabric filter (baghouse) components

# HEPA AND ULPA FILTERS

## Choosing The Best Air Filter for Your Application

Choosing the right filter for your application depends on containment regulations and standards in your facility.

### Difference Between A HEPA and ULPA Filter

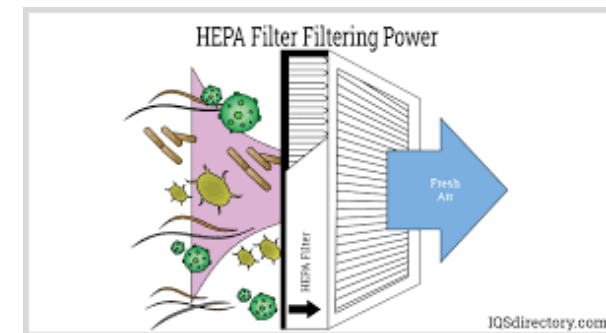


### HEPA Filters

- 99.97% effective for eliminating particulate matter of 0.3-micron diameter or larger
- A variety of HEPA filters are available
- Can be combined with pre filters to trap larger particles before they come into contact with the main filter
- Lifespan of up to 10 years

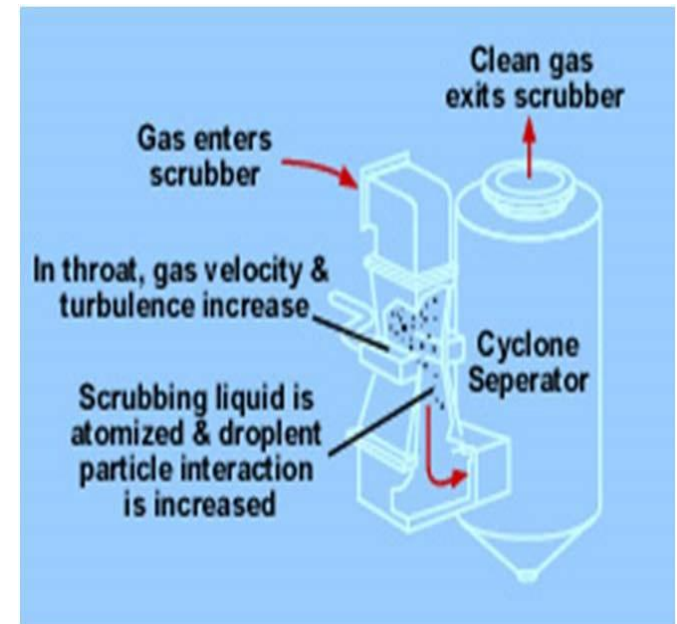
### ULPA Filters

- 99.999% effective for eliminating particulate matter of 0.12-micron diameter or larger
- Reduced airflow caused by the dense filter material
- Requires more power to move air
- Usually less effective at reducing the overall particulate concentration in a typical room
- Lifespan ranges from 5 to 8 years



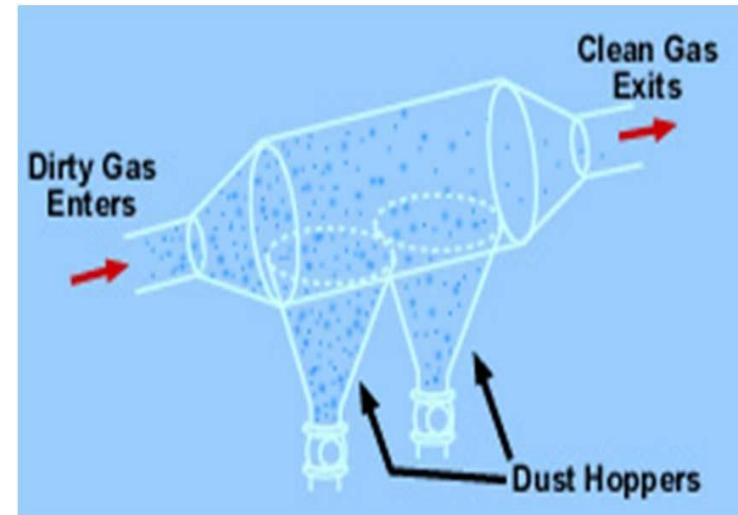
*These complex **HEPA filters** exceed the typical MERV scale of rating, making them the **most effective and popular option** for many industries.*

- **3) Particles - Venturi Scrubbers**
- Venturi cleaners use a stream of liquid to remove solid particles
- A gas filled with particles passes through a short tube with widened ends and a narrowed middle → the gas flow accelerates
- The water jet is directed into the gas jet
- The difference in velocity and pressure resulting from the constriction causes the particles and water to mix → the reduced velocity at the widened part of the throat allows the water droplets containing the particles to fall out of the gas stream
- Effective in removing small particles (removal efficiency up to 99%)
- Disadvantage: waste water production



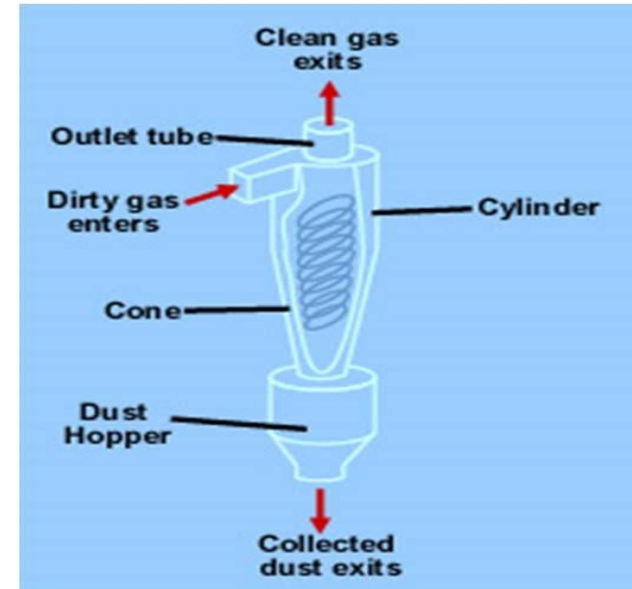
Venturi scrubber components

- **4) Particles - deposition chambers**
- Settling chambers use the force of gravity to remove solid particles
- The gas stream enters the chamber - large particles fall out of the chamber
- Effective in removing only larger particles
- They are used in combination with a more efficient control device



Settling chambers

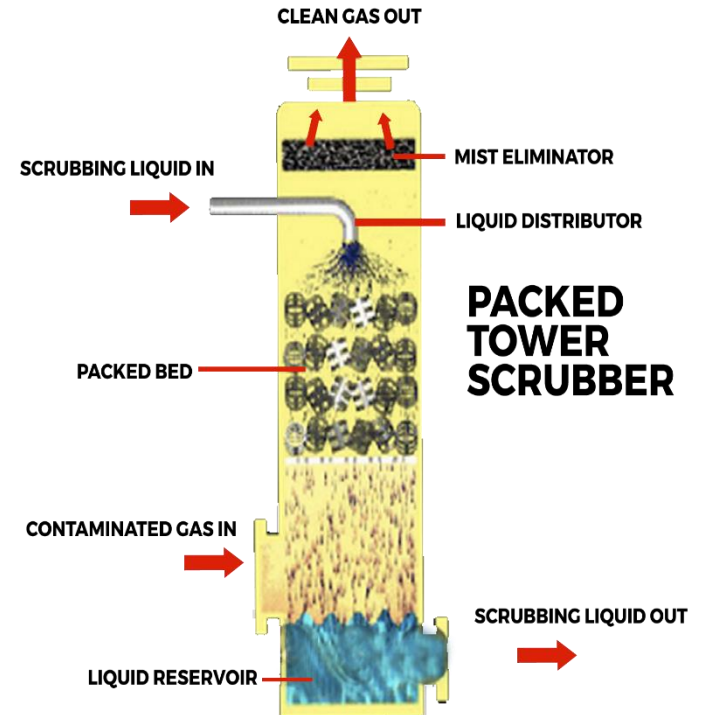
- **5) Particles – Cyclones**
- Cyclones are an inexpensive method of removing larger particles from the gas stream with low maintenance costs
- The general principle is separation by inertia
- The particle-laden gas is forced to change direction. As the gas changes direction, the inertia of the particles causes them to continue moving in their original direction and separate from the gas stream.
- Particles are collected in a tank; Cleaner air leaves the cyclone through the top of the chamber
- Effective in removing large particles; they are not effective with smaller particles
- They are used with other particulate control devices



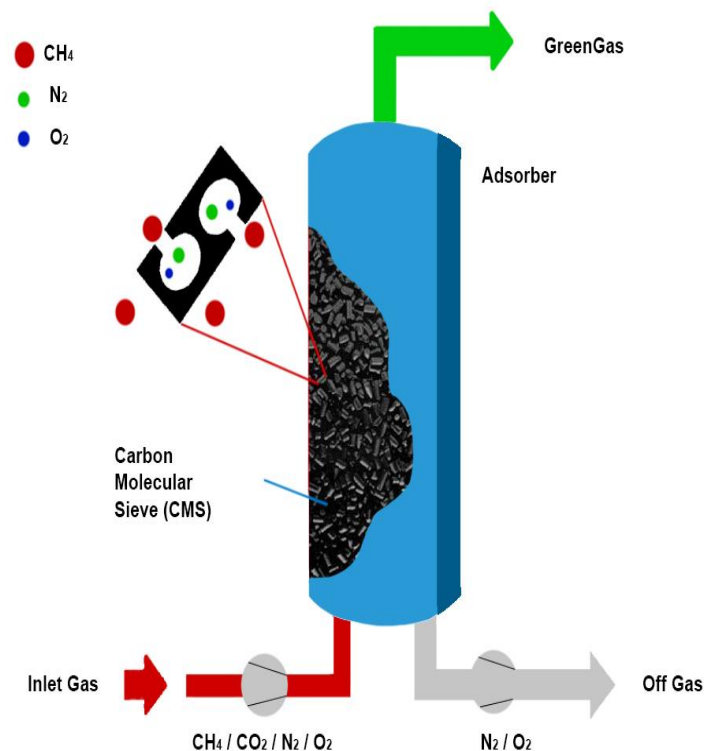
Cyclone collector

## STATIONARY SOURCES: gaseous pollutants

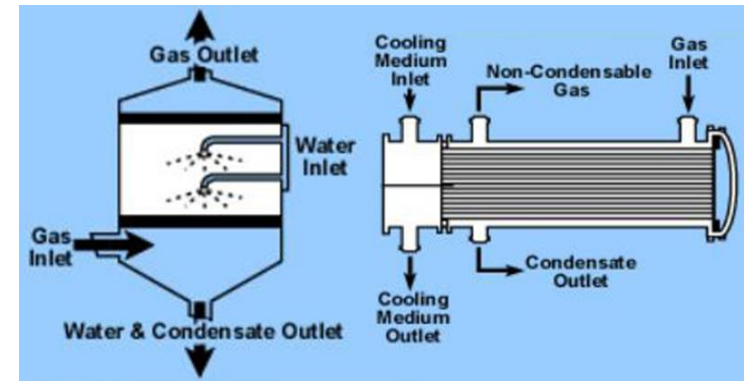
- 1) Gaseous pollutants – absorption
- The removal of components from the gas mixture by absorption is probably the most important operation in controlling the emission of gaseous pollutants
- Absorption: the gaseous pollutant is dissolved in a liquid (most often water)
- As the gas passes through the liquid, the liquid absorbs the gas
- Absorption is commonly used to purify gas streams with high concentrations of organic compounds
- The most common type of gas absorption equipment is the so-called charged column
- The column is filled with an inert (non-reactive) substance, such as plastic or ceramic, which increases the surface area of the liquid for the liquid/gas interface
- Efficiency greater than 95%



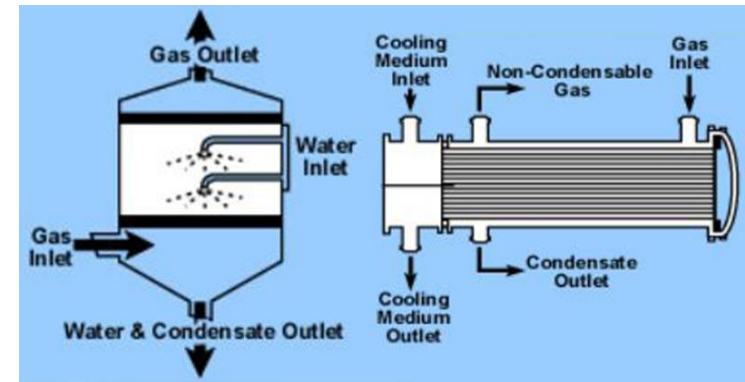
- **2) Gaseous pollutants – adsorption**
- When a gas or vapor comes into contact with a solid, some of it is taken up by the solid. Molecules that disappear from the gas either enter the interior of the solid, or remain externally attached to the surface. The first phenomenon is called absorption, and the second is called adsorption
- Adsorption is the binding of molecules or particles to a surface
- Common industrial adsorbents are activated carbon, silica gel, alumina (because they have huge surface areas per unit weight)
- Activated carbon is used for purification and removal of traces of organic pollutants from liquid and steam streams. The gas is attracted and adheres to the porous surface of the activated carbon. Removal efficiency = 95-99%



- **3) Gaseous pollutants – condensation**
- Condensation is the conversion of a gas or vapor into a liquid. Any gas can be reduced to a liquid by lowering the temperature and/or increasing the pressure. The most common technique is to reduce the temperature of the gas stream (as increasing the gas pressure can be expensive)
- Condensers are simple, relatively inexpensive devices that usually use water or air to cool and condense a stream of steam
- Capacitors used for pollution control are contact capacitors and surface capacitors. In a contact condenser, the gas comes into contact with a cold liquid. In a surface condenser, the gas comes into contact with a cooled surface in which the cooled liquid or gas circulates. Removal efficiency: 50-95%

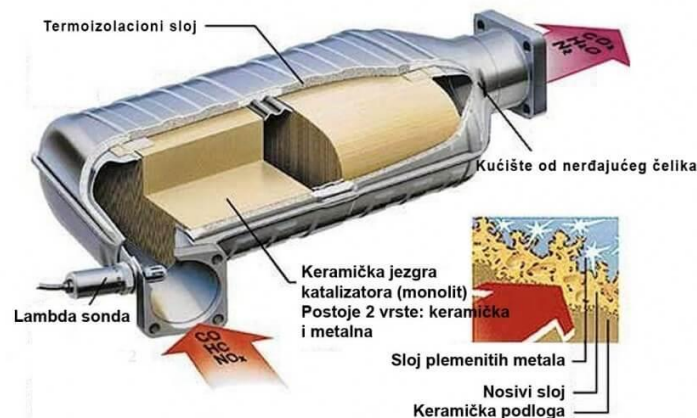


- **4) Gaseous pollutants – incineration**
- Incineration (also known as combustion) is most commonly used to control emissions of organic compounds from process industries.
- Rapid oxidation of substances. When combustion is complete, the gaseous stream turns into carbon dioxide and water vapor. Incomplete combustion will result in the release of some pollutants into the atmosphere.
- Smoke is one of the indicators of incomplete combustion.

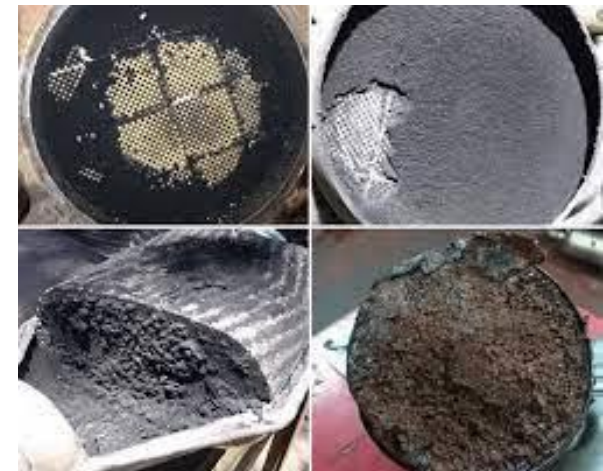
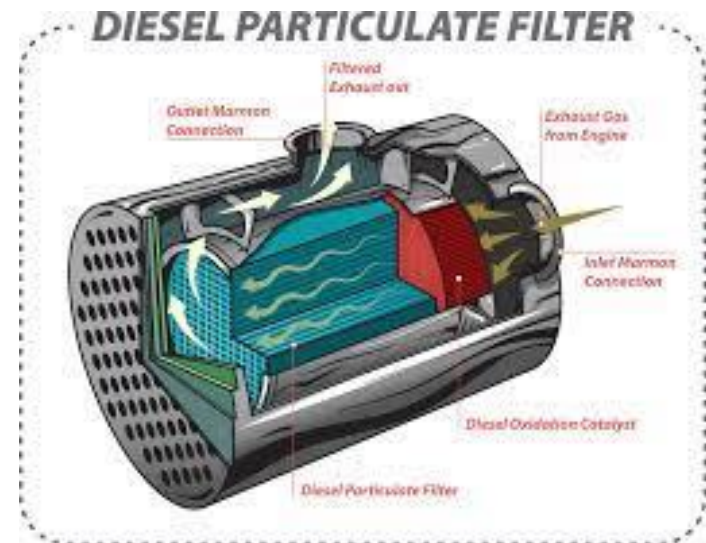


## MOBILE SOURCES: gaseous pollutants

- A catalytic converter is an anti-pollution device located between a vehicle's engine and the exhaust pipe. Catalysts - chemical reactions - convert exhaust pollutants such as carbon monoxide and nitrogen oxides into normal atmospheric gases such as nitrogen, carbon dioxide and water

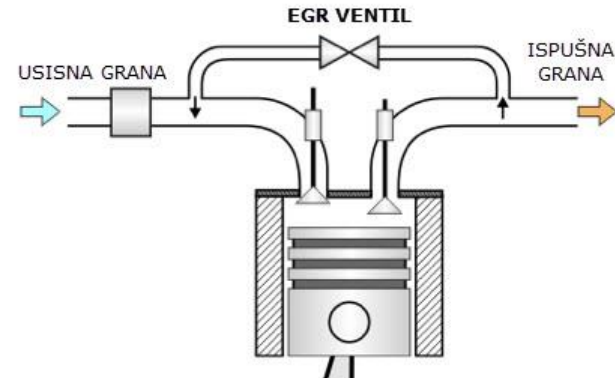


- **MOBILE SOURCES:** gaseous pollutants
- The DPF filter (fr. FAP) has the role of removing harmful emissions from car exhaust gases such as particles and soot as well as NOx compounds.
- Efficiency up to 95%.
- Composition: Composite materials resistant to high temperatures (ceramics) and metals that serve as catalysts (platinum and palladium).
- Cleaning: Soot is removed during combustion at temperatures over 600 °C and the process is called regeneration.
- Passive and active regeneration

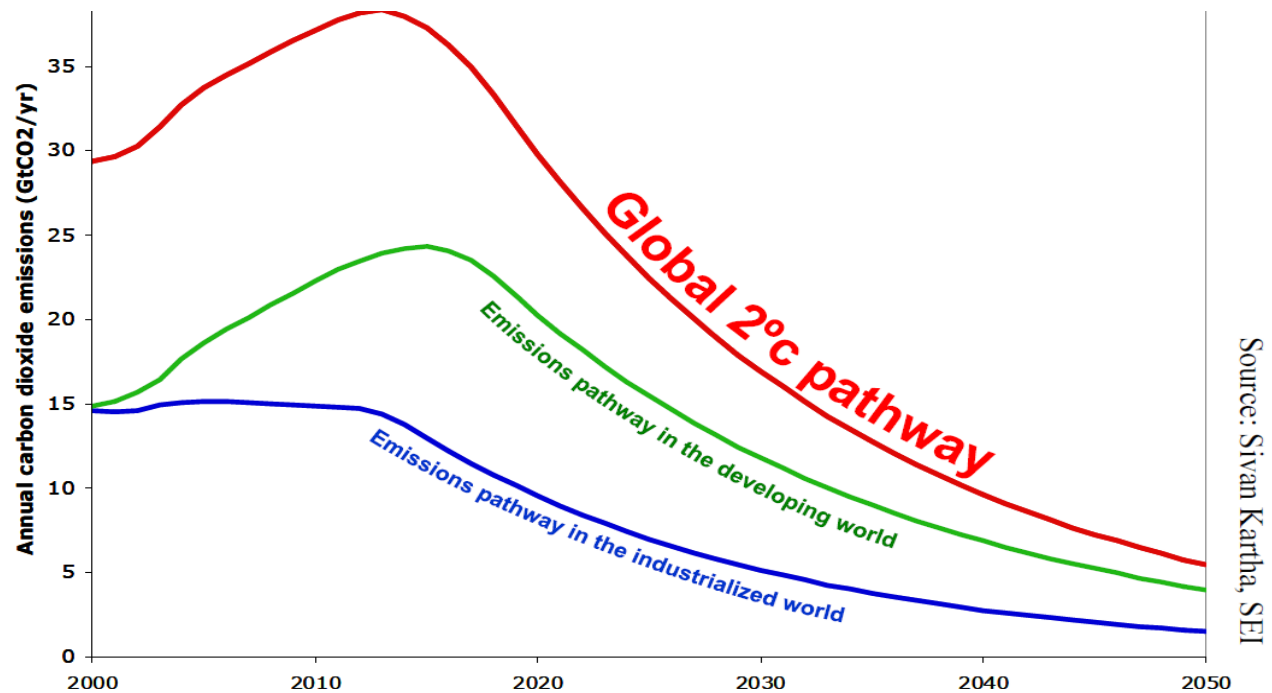


## MOBILE SOURCES: gaseous pollutants

- EGR
- EGR (Exhaust Gas Recirculation) represents the recirculation of exhaust gases.
- It is used by both gasoline and diesel engines.
- The EGR valve regulates the air-fuel mixture and helps maintain an efficient combustion temperature (below the nitrogen oxide formation threshold) by returning a portion of the exhaust gases to the combustion process, diluting the air-fuel mixture entering the engine.
- An optimal combustion temperature is maintained to reduce nitrogen oxide emissions that occur at high combustion temperatures.



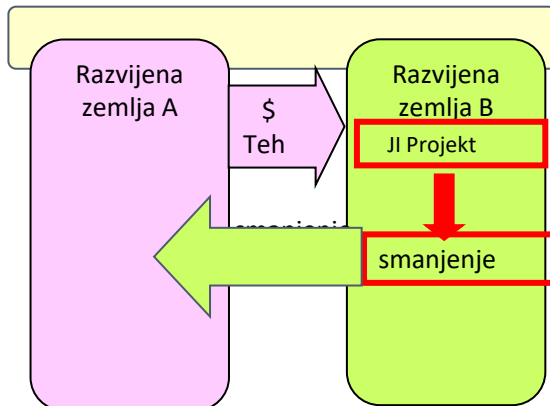
## The temporal dimension of climate change



# Flexible mechanisms of the Kyoto Protocol

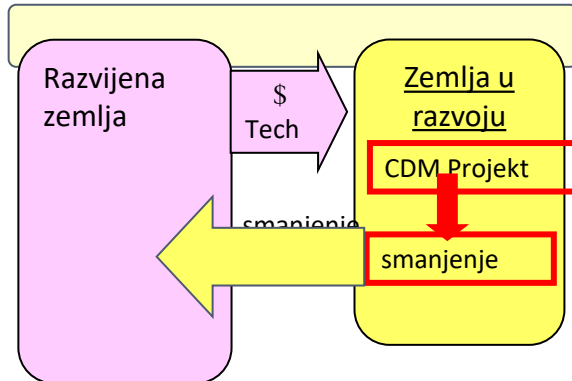
## Joint Implementation (JI)

JI allows developed countries to implement emission reduction projects in other developed countries. Investing developed countries can receive credit as a result of ERU projects.



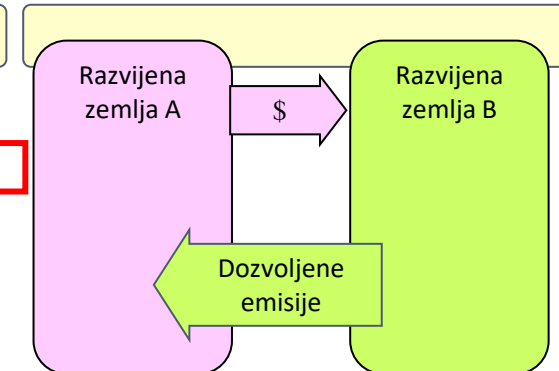
## Clean Development Mechanisms (CDM)

CDM allows developed countries to implement emission reduction projects in developing countries. Developed countries can get a credit to fulfill their obligations (CER).



## Emissions trading (ET)

ET allows developed countries to trade their emissions with other developed countries in order to meet their commitments

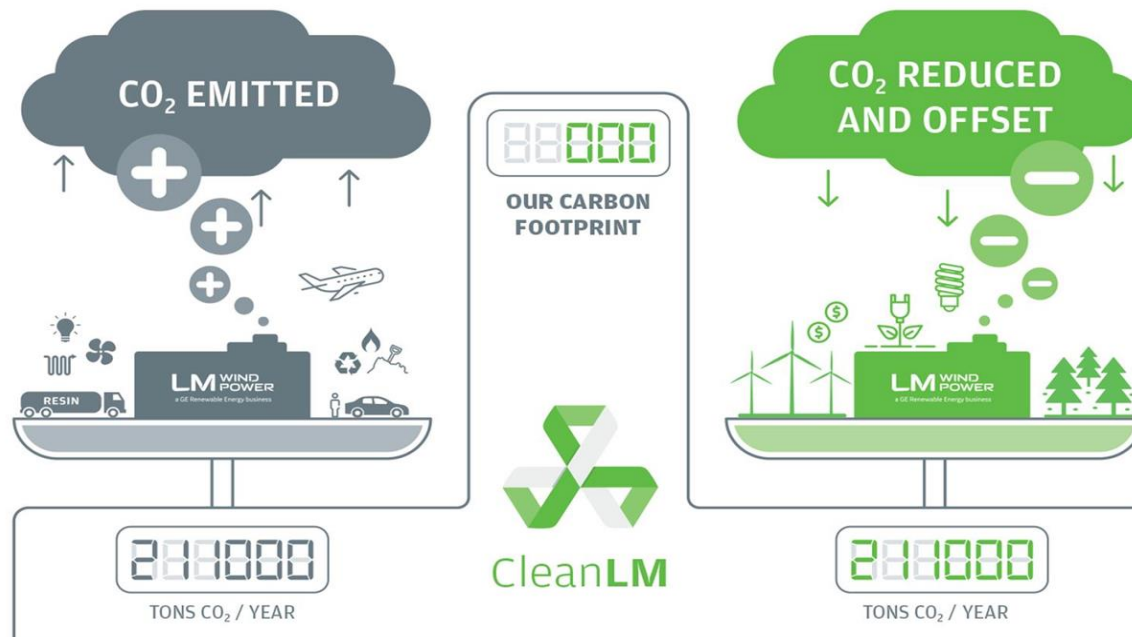


# Climate and energy policy of the EU (until 2030)

- Reduction of GHG emissions by at least 40% (compared to 1990) – agreed 55%
- The share of RES at least 32% in the final energy consumption
- Increase in energy efficiency by at least 32.5%



# Climate neutrality (until 2050)



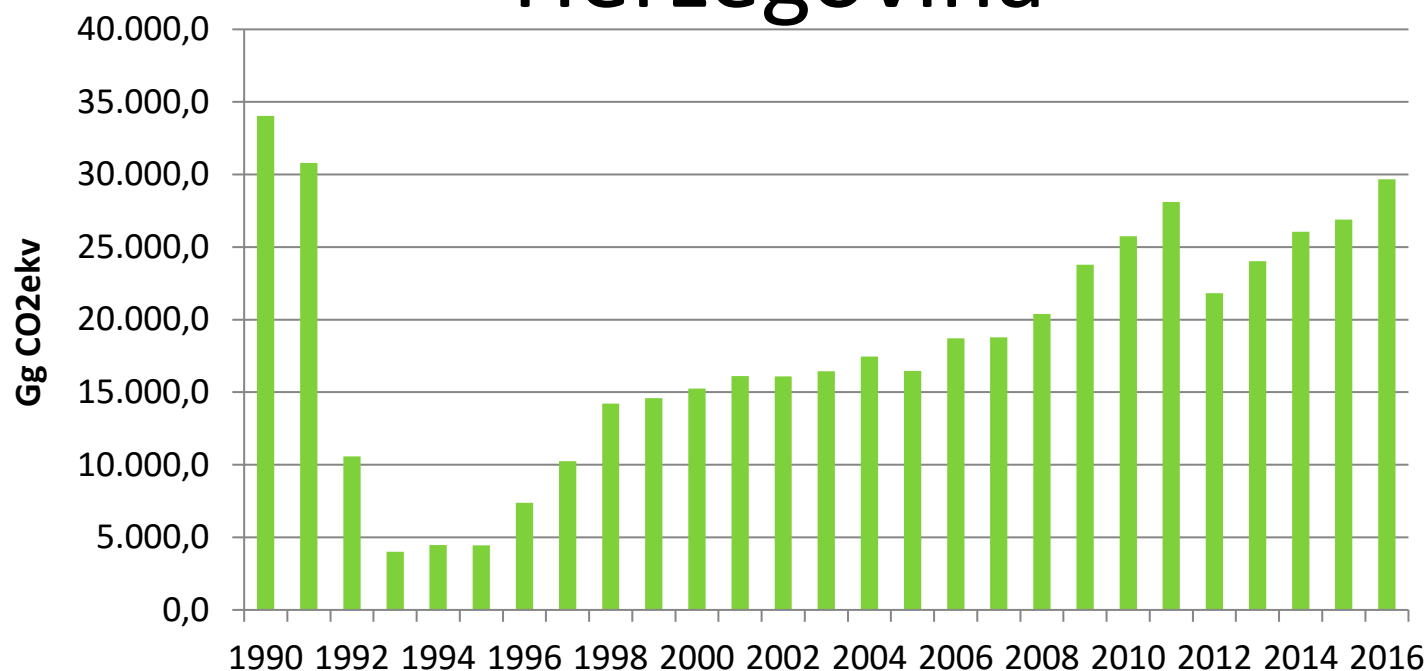
# Green agenda for the Western Balkans

***The region has committed to work towards making Europe climate neutral by 2050.***

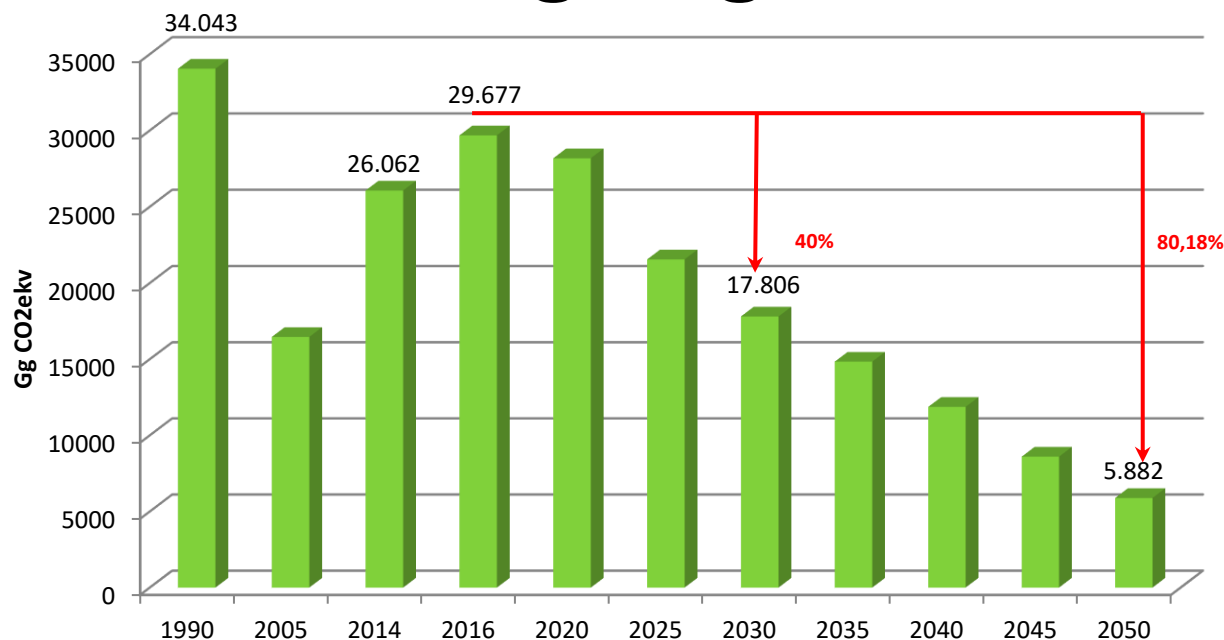
***Some of the measures:***

- *Alignment with the EU climate law after its adoption, which aims to make the EU climate neutral by 2050,*
- *Defining energy and climate goals until 2030 in accordance with the legal framework of the Energy Community and the EU acquis,*
- *Continuation of alignment with the EU Emissions Trading System (EU ETS), as well as the introduction of other models for taxation of emissions,*
- *Prioritizing energy efficiency and its improvement in all sectors;*
- *Increasing the share of renewable energy sources and providing the necessary conditions for investment, in accordance with the legal acquis of the EU and the Energy Community,*
- *Reduce and gradually abolish subsidies for coal, strictly respecting the rules of state aid,*
- *Actively participate in the Coal Regions in Transition initiative for the Western Balkans.*

# GHG emissions in Bosnia and Herzegovina



# GHG emission reduction targets – ongoing

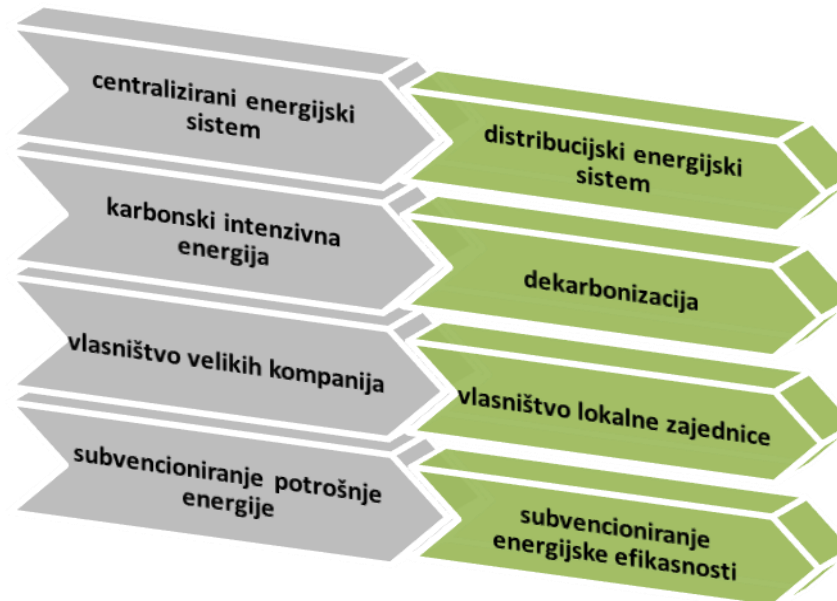


# Measures and technologies to reduce emissions

- Electric power (block closure in accordance with NERP, distributed production from RES)
- Growth in RES production - solar and wind power plants, hydropower plants, biomass
- Decarbonization and the growth of district heating
- Reduction of the use of fossil fuels in buildings (EE and OIE)
- Transport - volume growth with new technologies (synergy with decarbonization of the power industry)
- Agriculture - production and use of biogas
- Waste management - reduction, recycling and reuse

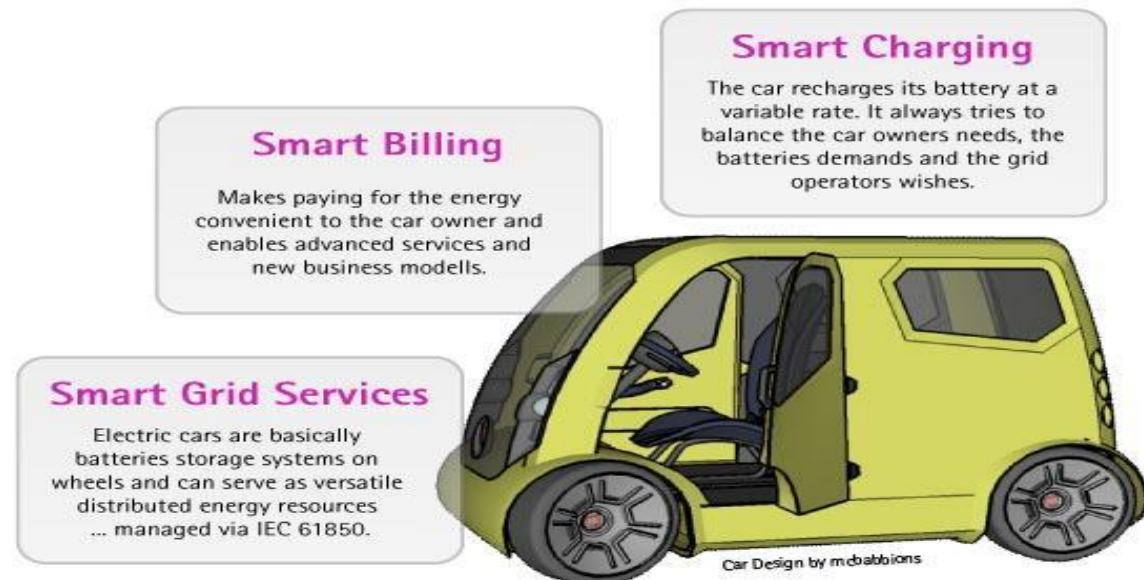


# Energy turnaround - "Energiewende"



# The energy system of a climate-neutral economy is a development opportunity for Bosnia and Herzegovina

1. RES
2. Energy "positive" buildings
3. New ways of energy storage
4. Smart grids and e-mobility



# Welcome to Mostar



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