The chemistry of renewable sources and its contribution to solving the problem of climate change

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Renewable sources: the contribution of chemistry to sustainability
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FEDERCHIMICA is:

- CONFINVIDIA
- CEFIC

17 Sector Associations

40 Product Groups
Chemistry as a tool to counteract the climate change

- Using Renewable Energy
- Production of Biofuels
- Renewable products for Industry
- Materials from renewable raw materials
- Innovative solutions for energy saving
Using Renewable Energy

- BIOMASS
- WIND
- GOETHERMAL
- HYDRO
- WASTE
- SOLAR

(BIO) FUELS

ELECTRIC POWER (RES)

CHEMICAL INDUSTRY
Energy Consumption in the Chemical Industry (Italy-2007)

- **Electric Power**: 32%
- **BIO-FUELS**: 68%
- **Energy**: ~26%
- **Chemical Sector**: ~42%

*SOURCE: from the draft version of the “16° Rapporto Annuale Responsible Care®*
Chemistry and Production of Biofuels

BIOMASS → CHEMICAL INDUSTRY → ALCOHOLS, ETHERS ESTERS → BIO-FUELS
The chains for Bio-Components and Biofuels production

- **Sources**
  - Direct
    - Biomass
      - Ethanol
        - Converted
          - Bioethers
            - Biofuels
              - Gasoline
              - Diesel
          -Bioesters
            - Bio-HCs
Italian Production Capacity
Ether-Fuels (KT/Y)

Refinery
Ether-Fuels Production

Sarroch
Sannazzaro
Ravenna
Milazzo
Gela
Priolo

41
41
237
150
65
45
45
45
Italian Production Capacity Bio-Diesel (KT/Y)
Chemicals (examples) for a Renewable Generation Industry

- **CHEMICAL INDUSTRY**
  - HDPE
  - Na & K Nitrate
  - Carbon Nanotubes

- **MOLTEN SALT RECEIVER**
  - Piping for Bio-Gas

- **SOLAR**
  - Solar Energy

- **WIND**
  - Wind Energy
  - Wind Blades

- **RENEWABLE ENERGY**
  - Bio-Gas
Chemistry at the Center of Energy Challenge

CONVERSION
WIND (Carbon Nano-Tubes for Blades, ...)
SOLAR (Polymer Films, ..)
FUEL CELLS (Polymer Electrolyte Membranes, ..)
BIOMASS (Biochemistry, Thermochemistry, Oleochemistry, ..)
HYDROGEN (Semipermeable membranes, chemical bond CO₂, ..)

STORAGE
BATTERIES (Li-Ion, ..)
SUPER-COPACITOR (NTC, Metal Oxides, ..)
HYDROGEN (Hydrides, composites x tanks, ..)

TRANSPORT
SUPER-CONDUCTORS (Nb-Sn, Mg(BH₄)₂, Oxopnictides, ..)
INSULATON (Polyurethane, Polystyrene, ..)

EFFICIENT USE
LIGHT MATERIALS (Polymers for the automotive sector, ..)
RESISTANCE AND FRICTION REDUCTION (Additives, Lubricants, ..)
Materials from renewables raw materials

- BIOMASS
- CHEMICAL INDUSTRY
- CHEMICALS
- FIBRES
- POLYMERS
“Life cycle analysis of CO2 proves that the chemical industry makes possible significant net reduction in the GHGs emissions, and therefore that the use of its products allows a higher reduction of gas emissions compared to those related to production processes”

*Fonte: “Innovations for GreenHouse Gas Reduction” - McKinsey & Company ©*
**CO₂ Impact in Chemical Applications: Significant Net Reduction!**

**Net reduction in 2005 (World)**
MtCO₂e

- Insulation
- Lighting
- Packaging
- Marine antifouling
- Synthetic textile fibers
- Weight vehicles
- Low temperature detergents
- Engines efficiency
- Pipelins
- Wind
- Heating
- Tyres
- Solar
- Other

### Amount of Net Reduction per Chemical Application

- Subtotal: 4,410
- Fertilizer and pesticides: 1,600
- Total: 6,010

### Cases / areas not included
- 1 : 1

### No realistic alternative
- 0 : 1

### Net value
- Without fertilizer and pesticides

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LCA Emissions: Contribution from the Chemical Industry (World-2005)

Emissions from the Chemical “Chain”

- Extraction: 0.3
- Production: 2.1
- Disposal: 0.5
- GHGs: 0.4
- Total: 3.3

Net Savings Emissions

Emissions from the Alternative Non-Chemical “Chain”

CO₂e (Gt/Y)

Extraction  Production  Disposal  GHGs  Total  Gross Savings  Net Savings

-10  -8.46  -5.16

• In the face of increased production by almost 10%, the chemical industry has reduced emissions of greenhouse gases in the atmosphere of 50.3%, amounting to 14.5 million tonnes, representing over 43% of Italy required target under the Kyoto Protocol.

• For every ton of CO$_2$ emitted by the chemical industry, downstream sectors that use chemicals can save up to three tons of emissions.

Source: 15° Rapporto Annuale Responsible Care®
New entry in FEDERCHIMICA:

17 Sector Associations

40 Product Groups

Renewable Sources
## Presented Activities

### Renewable Sources

<table>
<thead>
<tr>
<th>Energy use</th>
<th>Non-energy use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biofuels Production</strong> (and bio-components for biofuels)</td>
<td><strong>Conversion of renewables raw materials</strong></td>
</tr>
<tr>
<td>[bio-alcohols (ethanol, butanol)]</td>
<td>- Additives, Chemical intermediates</td>
</tr>
<tr>
<td>[bio-ethers (ETBE, TAEE)]</td>
<td>- Starch and derivatives</td>
</tr>
<tr>
<td>[bio-esters (FAME, FAEE)]</td>
<td>- Biorefineries</td>
</tr>
<tr>
<td>[BTL (Biomass to Liquid)]</td>
<td>- Oleochemical industry</td>
</tr>
<tr>
<td>Complementary production of Energy Renewable Sources</td>
<td>- Polymers</td>
</tr>
<tr>
<td>Vegetable oils</td>
<td>- Bio-cosmetic products</td>
</tr>
<tr>
<td>Biogas</td>
<td></td>
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</tbody>
</table>
CONCLUSIONS

- The chemical industry is absolutely essential to all aspects and all areas of renewable energy.
- Chemistry is fundamental to reducing emissions of GHGs and the fight against climate change.
- Federchimica decided to structurally represent this key industry in the indispensable renewable energy sector.