Climate Recon 2050
Industry Webinar

négaWatt scenario
2017-2050

A sufficiency, efficiency and substitution approach, a sustainable trajectory for the French industry

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Association négaWatt
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Supported by Fondation Charles Léopold Mayer pour le progrès de l’Homme
The négaWatt association

- A think tank on energy and energy policies created in 2001
- A non-profit, independent group of experts and field-practitioners
- A core of ~ 25 “companions” + 25 “ambassadors”, 1200 members
- Producing sustainable energy scenarios (latest in 2017) and proposing systemic policies and measures

- Subsidiary created in 2009
- Operational branch of the association
1. The “negaWatt approach”

2. From consumption goods to raw materials

3. Demand reduction and circular economy

4. Energy efficiency
A change of paradigm

3. Substitution

Develop **flow-based** renewables to replace **stock-based** fissile and fossils

2. Efficiency

Reduce the **losses**, i.e. the need of primary resources to serve end-uses

1. Sufficiency

Prioritize energy end-uses in terms of individual/collective energy services

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Production losses

Transport and distribution losses

Consumption losses

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Primary Energy

Energy Carriers

Final Energy

Energy Services

SUPPLY

DEMAND
The négaWatt approach applied to industry

**PRODUCTION**

- Mt

**ENERGY INTENSITY**

- \( \times \)

- MWh/t

- =

- TWh

**EFFICIENCY**

- Improved processes:
  - Combined heat and power
  - Engines
  - Energy recovery
  - SMC, heat pumps
  - Induction furnaces
  - Processes
  - Best available technologies

**SUFFICIENCY**

- Reduction of consumption
- Robust and reparable goods
- Service economy

**RENEWABLES**

- Biomass
- Solar (thermal)
- Electric renewables

**RECYCLING**
1. The “negaWatt approach”

2. From consumption goods to raw materials

3. Demand reduction and circular economy

4. Energy efficiency
Which and how much materials by 2050?

Materials production in official scenarii

<table>
<thead>
<tr>
<th></th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mtons</td>
</tr>
<tr>
<td>Steel</td>
<td>21,00</td>
</tr>
<tr>
<td>Aluminium</td>
<td>0,51</td>
</tr>
<tr>
<td>Ethylène</td>
<td>2,30</td>
</tr>
<tr>
<td>Chlorine</td>
<td>1,10</td>
</tr>
<tr>
<td>Ammoniac</td>
<td>1,03</td>
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<tr>
<td>Clinker</td>
<td>14,90</td>
</tr>
<tr>
<td>Glass</td>
<td>4,60</td>
</tr>
<tr>
<td>Paper</td>
<td>8,80</td>
</tr>
<tr>
<td>Sugar</td>
<td>4,60</td>
</tr>
</tbody>
</table>

No real analysis about the amount of raw materials until 2050.
Raw materials and goods chain

Fossils 12,4 Mt
- Bitumen, oil 4,1 Mt -> Roadway, mechanical, transportation
- Chemistery 15,1 Mt -> Detergents, fertilizers, paints, pharmacy, etc.
- Plastics 6,5 Mt
  - Steel 14 Mt
  - Other metals 2 Mt
  - Silicon 8 kt
- Wood 8,9 Mt
  - Lumber 6,9 Mt
  - Paper 8,5 Mt
- Minerals 24,1 Mt
- Cement 26,2 Mt

Consumption and equipment goods: Mechanical, tools, heating, electricity, electronic, appliances, transportation, textile, leather, furniture, sport, toys, jewellery, diverse...

Construction, civil engineering

Materials production in France
National energy consumption and footprint

Fossils 12,4 Mt
- Bitumen, oil + 7%
- Chemistry + 44%
- Plastics + 43%
  - Steel + 30%
  - Other metals + 48%
  - Silicon + 210%

Wood 8,9 Mt
- Lumber + 3%
- Paper + 13%
- Minerals + 6%
- Cement + 8%

Roadway, mechanical, transportation
- Detergents, fertilizators, paints, pharmacy, etc.

Consumption and equipment goods:
- Mechanical, tools, heating, electricity, electronic, appliances, transportation, textile, leather, furniture, sport, toys, jewellery, diverse...

Construction, civil engineering

Raw materials consumption consumed for footprint
Electronical industry’s footprint

**COMPUTERS**
- Production: 30,000
- Consumption: 8 millions!

**MOBILE TELEPHONES**
- Production: 0
- Consumption: 24 millions!

**ELECTRONIC APPLIANCES**
- Production: 8 millions units
- Consumption: 79 millions units!

Manufacture energy required for:
- Devices produced in France: 30 TWh
- Devices consumed in France: 220 TWh
Relation between goods and materials

Materials production: Biomass, wood, steel, non-ferrous metals, cement, earth, sand and stone, glass, fossils for non-energetical use, basic chemical products, plastics, papers and cartons

Goods consumption:
- Food
- Construction
- Chemical products
- Mechanical, electricity
- Appliances
- Electronic
- Transportation, paper
- Packaging, others

National Demand + Stock variation at year n =
Production + Importations - Exportations

(available for goods and materials)
Evolutions algorithms depend on **hypothyses** for each section:

- Population growth
- **Consumption per capita** (sufficiency or growth)
- **Specific calculation modules** for construction, transportation, packaging, renewable energies
- Potential changes of **import/export rates**
Prospective energy material: scenarisation of industrial production levels until 2035 - 2050
1. The “negaWatt approach”

2. From consumption goods to raw materials

3. Demand reduction and circular economy

4. Energy efficiency
The prospective parameters for goods and materials demand

- Population growth
- Strong growth of digital technologies
- Products Sustainability
  - End of planned obsolescence (law LTECV)
  - To Reduce: to stop the disposable products
  - To Reuse: second hand market development
  - To Repair: better after sales guarantee
  - To pool: leasing and sharing products

- Recycling materials
An example of virtuous charter

The commitments of company SEB

- 95% of repairable products
- 5,7 millions of spare parts
- -30% for spare parts price
- Availability for ten years
Recycling

**Left bar:** primary = from the raw material

**Right bar:** secondary = from the recycled material

- **Steel**
- **Aluminium**
- **Glass**
- **Plastics**
- **Paper**

- kWhep/t

Legend:
- Blue: Elec
- Orange: Fuel
## Increased collecting and recycling

<table>
<thead>
<tr>
<th>Material</th>
<th>Collection rate</th>
<th>Recycling rate in France</th>
<th>Recycling rate in other countries</th>
<th>Forecast Recycling rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2015</td>
<td>2015</td>
<td>2015</td>
<td>2015 nW 2050</td>
</tr>
<tr>
<td>Steel</td>
<td>74%</td>
<td>57%</td>
<td>Italy</td>
<td>81%</td>
</tr>
<tr>
<td>Aluminium</td>
<td>26%</td>
<td>53%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>42%</td>
<td>45%</td>
<td>Belgium</td>
<td>95%</td>
</tr>
<tr>
<td>Plastics</td>
<td>15%</td>
<td>10%</td>
<td>Germany</td>
<td>38%</td>
</tr>
<tr>
<td>Paper / cartons</td>
<td>74%</td>
<td>59%</td>
<td>UK</td>
<td>85%</td>
</tr>
<tr>
<td>Oils</td>
<td></td>
<td>30%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tires</td>
<td></td>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bitumina</td>
<td></td>
<td>4%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results: nW scenario

- New buildings construction with stabilised cohabitation rate
- All buildings renovated until 2050
- Roads construction reduced (-13% in 2035, -25% in 2050)
- PCV reduction and growth of biosourced materials
Materials production for renewable energy

2014

2050

* Excluding foundations
Materials footprint for renewable energy

2014

- Concrete
- Aggregate
- Steel

2050

- Concrete
- Aggregate
- Flat glass
- Steel

Mt/yr
Materials demand for packaging

Packaging materials evolution (Mt)

Overwrapping elimination

Glass bottles return
Consumption of chemicals products

**Chemical products**

<table>
<thead>
<tr>
<th>Category</th>
<th>2035</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogenous fertilizers</td>
<td>-33%</td>
<td>-43%</td>
</tr>
<tr>
<td>Phytosanitary products</td>
<td>-20%</td>
<td>-30%</td>
</tr>
<tr>
<td>Cleaning products: detergents,</td>
<td>+8%</td>
<td>+15%</td>
</tr>
<tr>
<td>solvents, soaps, toiletries and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>perfumes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other products: paintings,</td>
<td>+8%</td>
<td>+15%</td>
</tr>
<tr>
<td>varnishes, adhesives, inks,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>explosives, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmaceutical products</td>
<td>+8%</td>
<td>+15%</td>
</tr>
<tr>
<td>Sector</td>
<td>Raw materials</td>
<td>Applications range</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Starch</td>
<td>Wheat, corn, rice</td>
<td>Wide</td>
</tr>
<tr>
<td>Sugar</td>
<td>Beetroot</td>
<td>Specific</td>
</tr>
<tr>
<td>Oil</td>
<td>Colza, sunflower</td>
<td>Wide</td>
</tr>
<tr>
<td>Lignocellulosic</td>
<td>Wood</td>
<td>Wide</td>
</tr>
<tr>
<td></td>
<td>Myscanthus, switchgrass...</td>
<td>Wide</td>
</tr>
<tr>
<td>Algae</td>
<td></td>
<td>Wide</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sector</th>
<th>Starch</th>
<th>Sugar</th>
<th>Oil</th>
<th>Cellulose</th>
<th>Algae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastics, rubber</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Solvents</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detergents</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Parachemistry</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Wood chemistry

Lignosulfites: ethanol, links
Terpènes: adhesives, parfumerie

Energy

Regeneration of cooking reagents and energy production

Black liquor: lignine

Proc. bisulfite

Bleaching

Cellulosic pulp + CO2 + H2O

Ethers: pharmacy, paintings, detergents

Esters: plastics, textiles

Debarked wood
40% Cellulose
30% Lignin
25% Hemicellulose
5% Extracts
1. The “negaWatt approach”
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3. Demand reduction and circular economy
4. Energy efficiency
Cross energy savings

- Energetical intensity KWh/t
  - Electricity
  - Fuels

Cross energy savings

Transversal Savings

- Driving force 72%
- Thermal 15%
- Others 13%

- Rooms heating 8%
- Cogeneration 5%
- Raw materials 31%
- Manufacturing 56%
Sectorial energy savings

Energetical intensity KWh/t

Electricity

Driving force 72%
Thermal 15%
Others 13%

Specific savings for each sector
Best Available Technologies

Rooms heating 8%
Cogeneration 5%
Raw materials 31%
Manufacturing 56%
Energy substitution

Energetical intensity KWh/t

Electricity

Driving force 72%
Thermal 15%
Others 13%

Substitution savings
Fuel -> electricity
- Steam mechanical compression
- Heat pumps
- Induction furnaces

Fuels

Rooms heating 8%
Cogeneration 5%
Raw materials 31%
Manufacturing 56%
Global results for the industry

Final energy consumption of the industry sector

- TWh
- Sufficiency
- Efficiency
- Renewable
- Fossils and fissile
- BAU
- Nw Scenario

330 TWh
57 TWh
-115 TWh
-43 TWh
180 TWh
3 TWh

2000 2010 2020 2030 2040 2050
More information

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www.decrypterlenergie.org