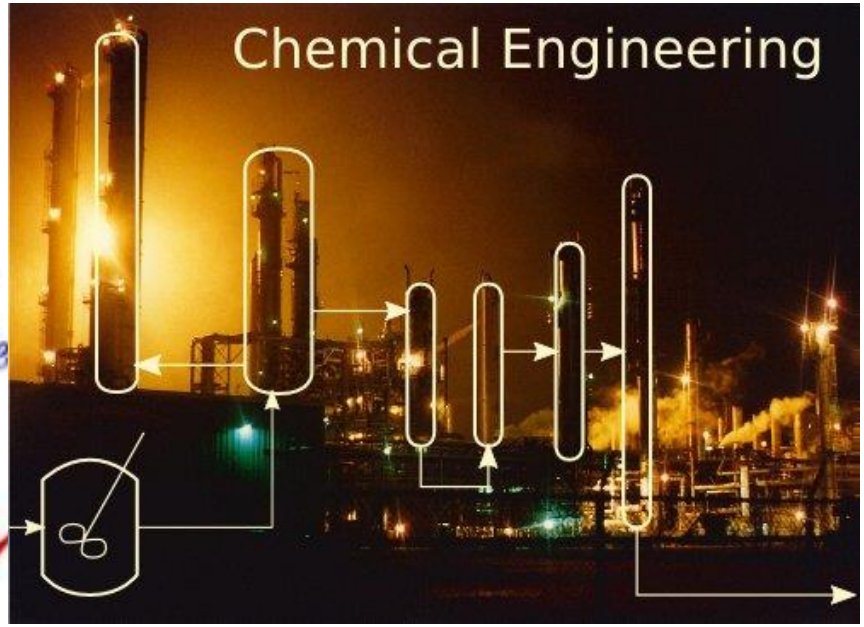
Introduction
to
Chemical Engineer Profession


Chemical Engineer

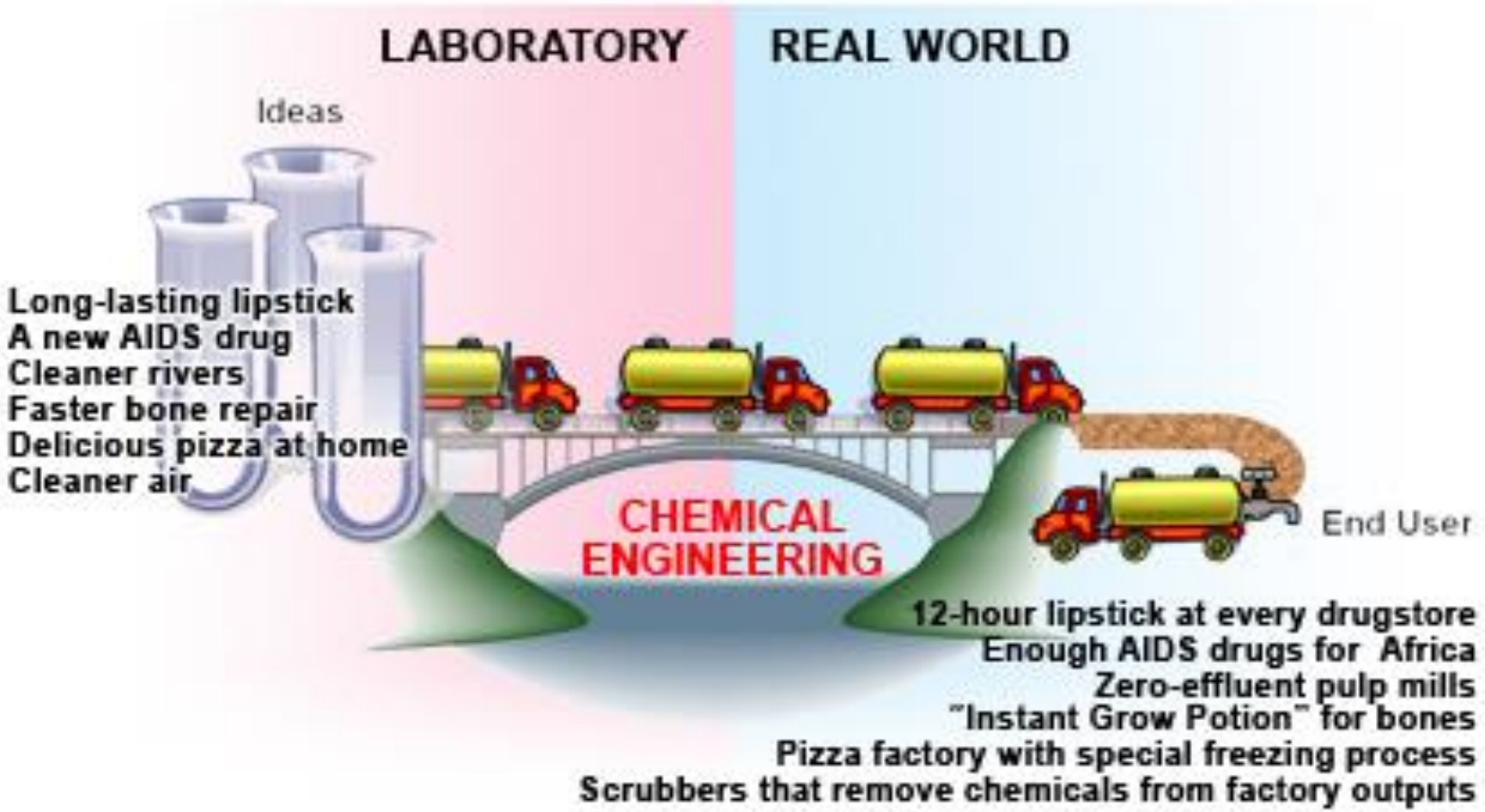

GALEN
HOLDINGS
Seagate
ExxonMobil
SCIENTIFIC AMERICAN
MERCK
The miracles of science
LOCTITE
Procter&Gamble
ANDERSEN
BNFL
Unilever
GUINNESS
BOMBARDIER
Nestlé
Cadbury
gsk
Pfizer
L'ORÉAL
Lilly
bp
Coca-Cola
Schlumberger
intel
KINGSMILL
BUSHMILLS
Bristol-Myers Squibb Company
Mars
THE BOC GROUP
Boxmore
International PLC
FOSTER WHEELER


Chemical Engineering

What are Chemical Engineers?

“Chemical engineers” use math, physical sciences (physics, chemistry), life sciences (biology, microbiology and biochemistry), and economics to solve practical problems. The difference between chemical engineers and other types of engineers is that they apply a knowledge of chemistry in addition to other engineering disciplines. Chemical engineers may be called “universal engineers” because their scientific and technical mastery is so extensive.

From Test Tube to Truckload



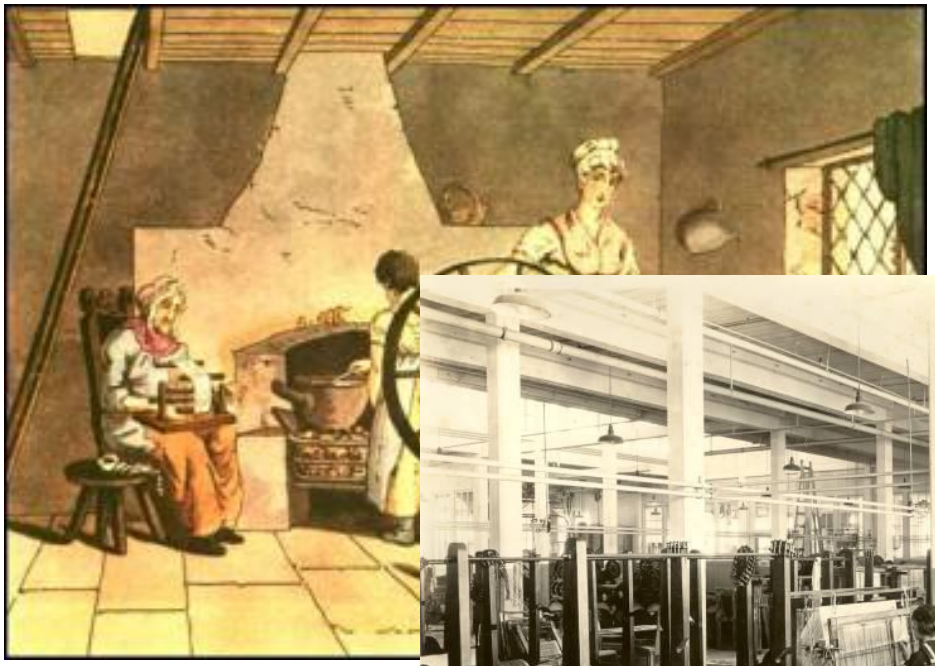
History of Chemical Engineering

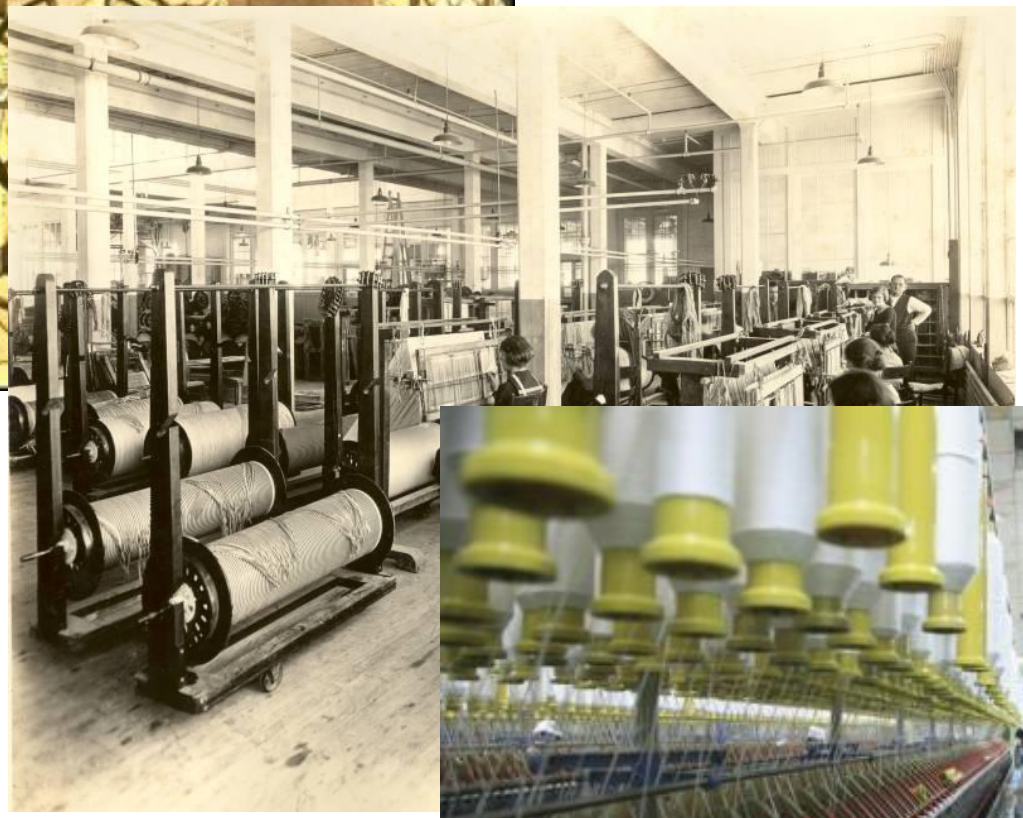
Before 18th Century:

Industrial chemicals were mainly produced through ***batch processing***.

Industrial Revolution (1700-1800):

Industrial production shifted from batch to ***continuous processing***.





History of Chemical Engineering

ChE Principles:

1805 - John Dalton published Atomic Weights, allowing chemical equations to be balanced and the basis for chemical engineering ***mass balances***.

1824 - Sadi Carnot was the first to study the ***thermodynamics*** of combustion reactions.

1850 - Rudolf Clausius applied the principles developed by Carnot to ***chemical systems*** at the atomic to molecular scale.

History of Chemical Engineering

ChE Principles:

1873 to 1876 - Josiah Willard Gibbs developed a ***mathematical-based***, graphical methodology, for the study of chemical systems using the thermodynamics of Clausius.

1882 - Hermann von Helmholtz showed that measure of chemical affinity is determined by the measure of the free energy of the ***reaction process***.

1883 - Osborne Reynolds defines the dimensionless group for ***fluid flow***, leading to practical scale-up and understanding of flow, ***heat and mass transfer***

History of Chemical Engineering

ChE Education:

1882 – a course in "Chemical Technology" is offered at University College London.

1885 –a course in "chemical engineering" is offered at Central College (later Imperial College), London.

1888 –a new curriculum at Massachusetts Institute of Technology (MIT) started: Course X, Chemical Engineering.

Course X at MIT: "to meet the needs of students who desire a general training in mechanical engineering, and at the same time to devote a portion of their time to the study of the applications of chemistry to the arts, especially to those engineering problems which relate to the use and manufacture of chemical products."

History of Chemical Engineering

ChE Institutes:

1908 – the American Institute of Chemical Engineers (AIChE) is founded.

1922 – the UK Institution of Chemical Engineers (IChemE) is founded.

1996 – the Thailand Institute of Chemical Engineering and Applied Chemistry (TiChE) is founded.

A Century of ChE Profession

What are the great accomplishments do we come up with?

TOP 10 Chemical Engineering Contribution to Society

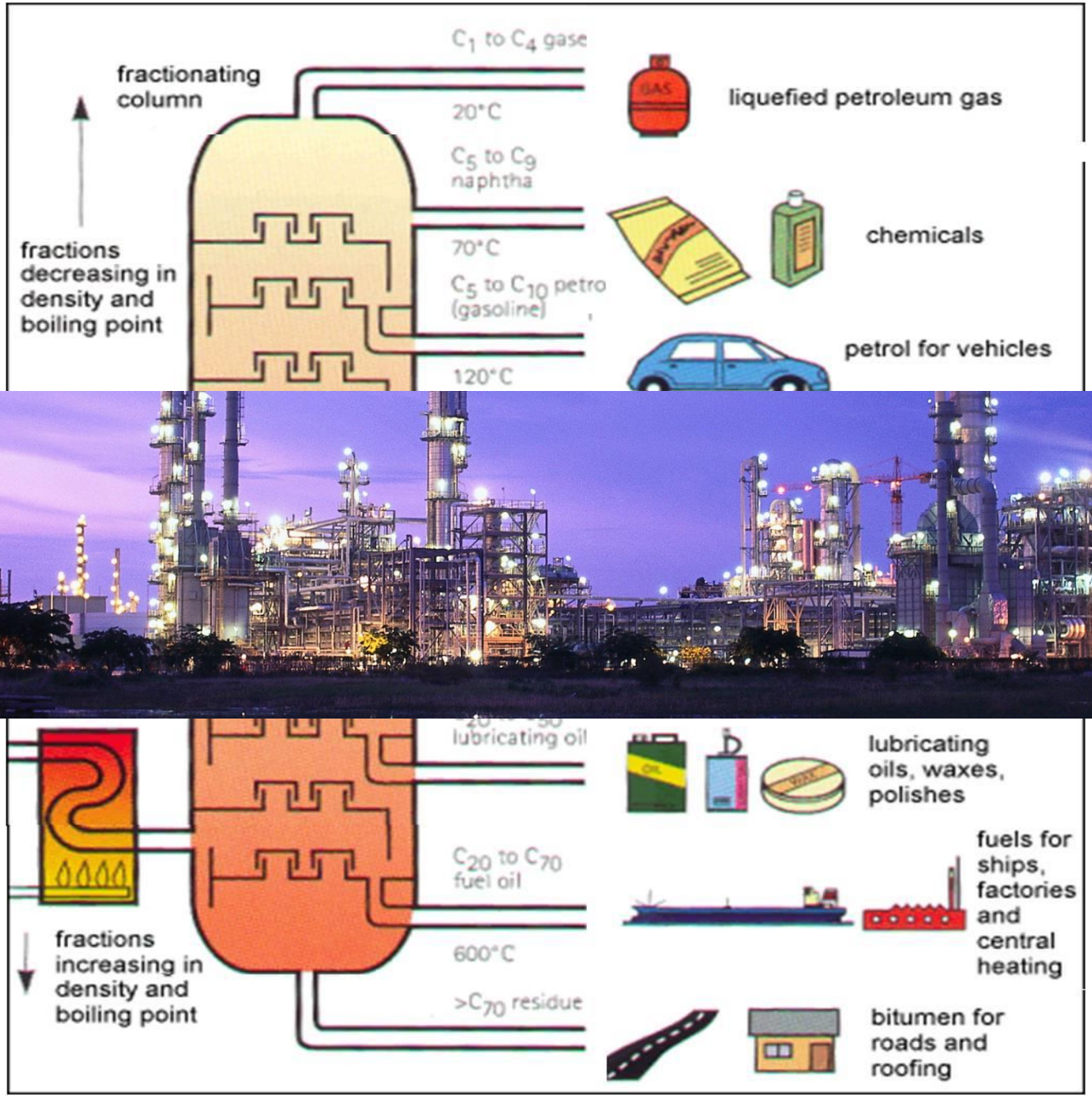
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, 2010

TOP 10 Chemical Engineering Contribution to Society

1. FUELING THE WORLD'S ECONOMIES

- The world's economy needs energy to keep it moving.
- Chemical engineers stretch fossil fuels into various energy supplies, e.g. gasoline, diesel, jet oil, etc.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, 2010


fractionating column
fractions decreasing in density and boiling point
C_1 to C_4 gase
20°C
C_5 to C_9 naphtha
70°C
C_5 to C_{10} petro (gasoline)
120°C
lubricating oil
C_{20} to C_{70} fuel oil
600°C
>C_{70} residue
fractions increasing in density and boiling point
liquefied petroleum gas
chemicals
petrol for vehicles
lubricating oils, waxes, polishes
fuels for ships, factories and central heating
bitumen for roads and roofing

TOP 10 Chemical Engineering Contribution to Society

2. CREATING CLEANER ENERGY

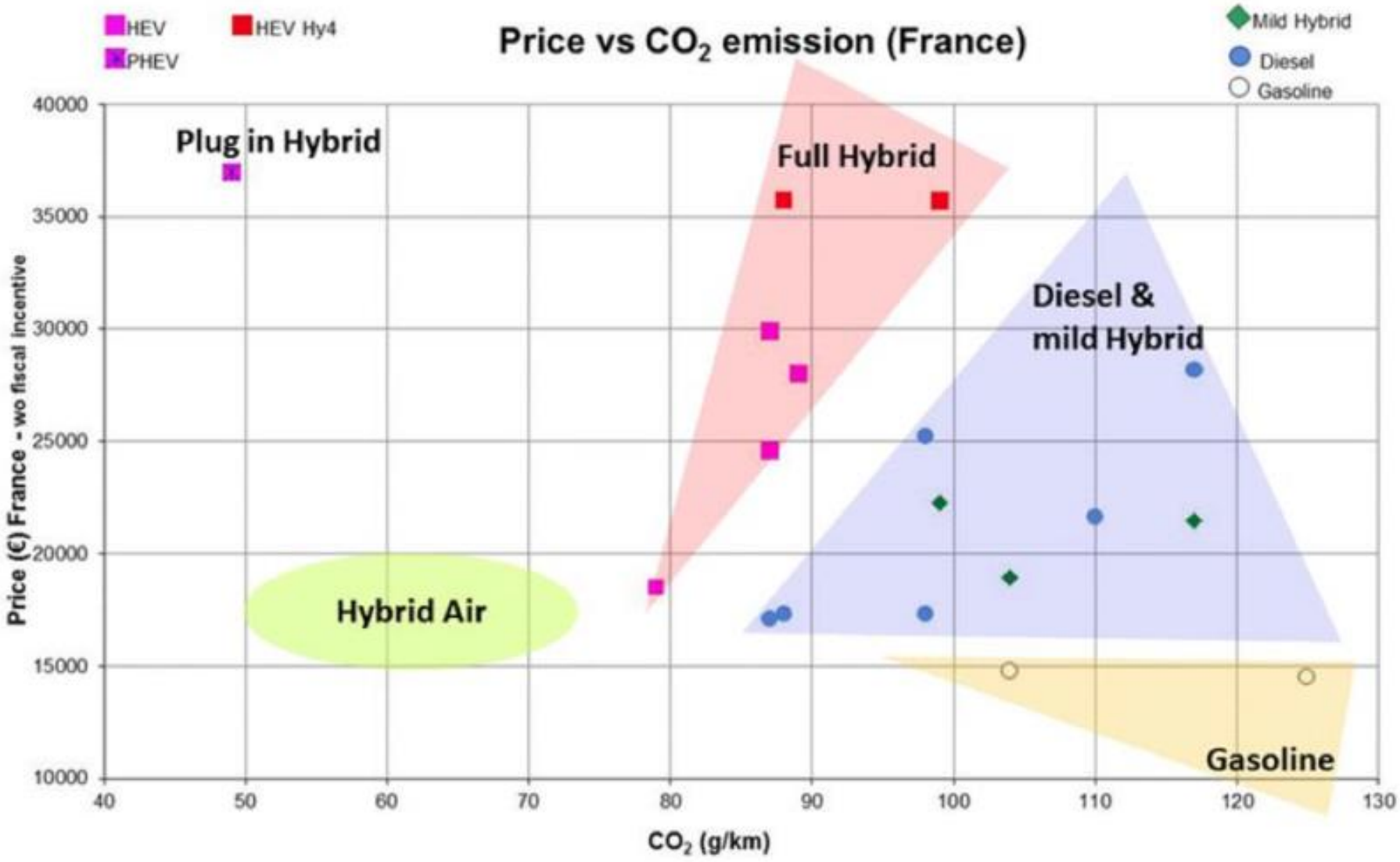
Chemical engineers are creating a new generation of clean energy technologies.

- Nuclear power plant
- NiMH battery
- Alternative energies such as Air , Wind, Water, Solar, etc.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, 2010

NiMH battery for vehicles

Air for vehicles


HEV
HEV Hy4
PHEV
Price vs CO_2 emission (France)
Mild Hybrid
Diesel
Gasoline
Plug in Hybrid
Full Hybrid
Diesel &
mild Hybrid
Hybrid Air
Gasoline
Price (€) France - wo fiscal incentive
40000
35000
30000
25000
20000
15000
10000
40
50
60
70
80
90
100
110
120
130
CO_2 (g/km)

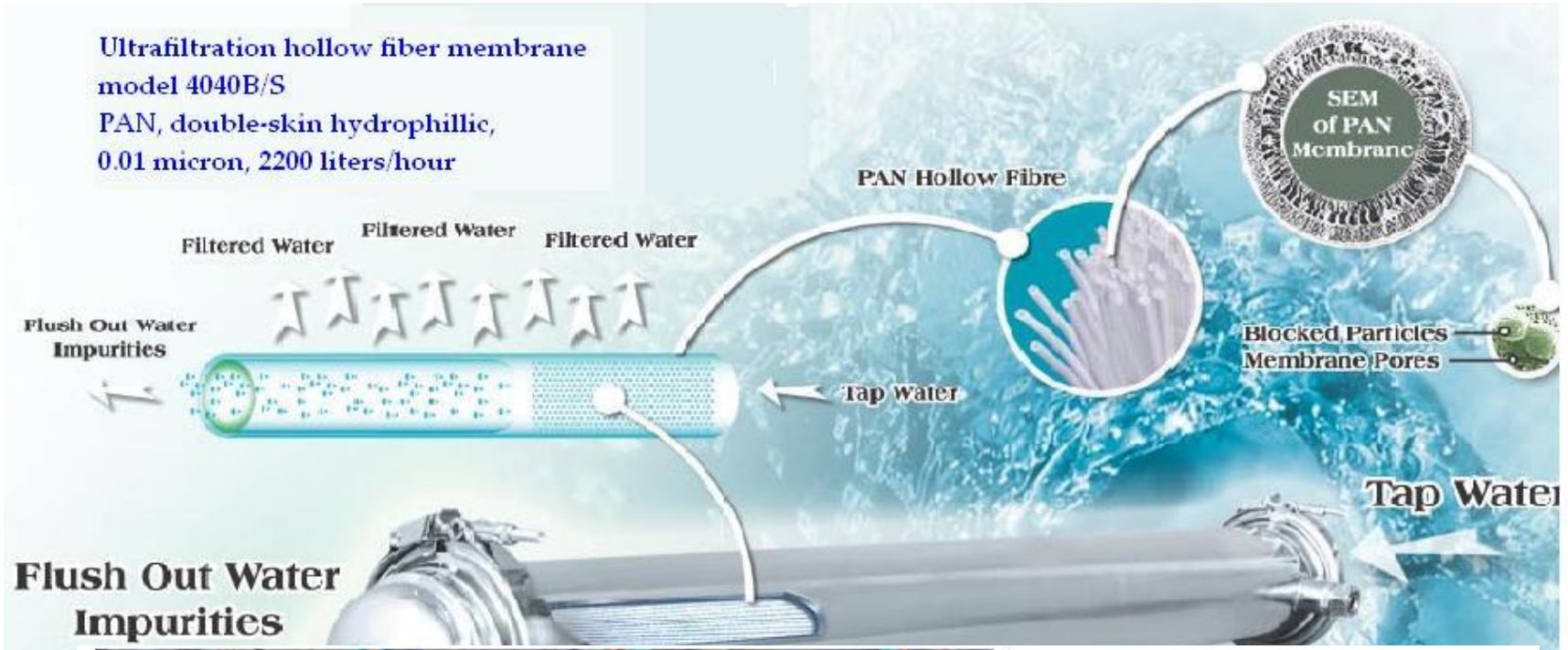
TOP 10 Chemical Engineering Contribution to Society

3. PRODUCTS FOR GROWING POPULATIONS

- Water purification
- Water desalination
- GMO foods
- Green productions

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, 2010

Ultrafiltration hollow fiber membrane
model 4040B/S
PAN, double-skin hydrophillic,
0.01 micron, 2200 liters/hour



TOP 10 Chemical Engineering Contribution to Society

4. REMOVING HARMFUL SULFUR FROM FUELS

- Catalytic converter for car's exhausted gas
- Unleaded gasoline → gasohol
- Air pollution control

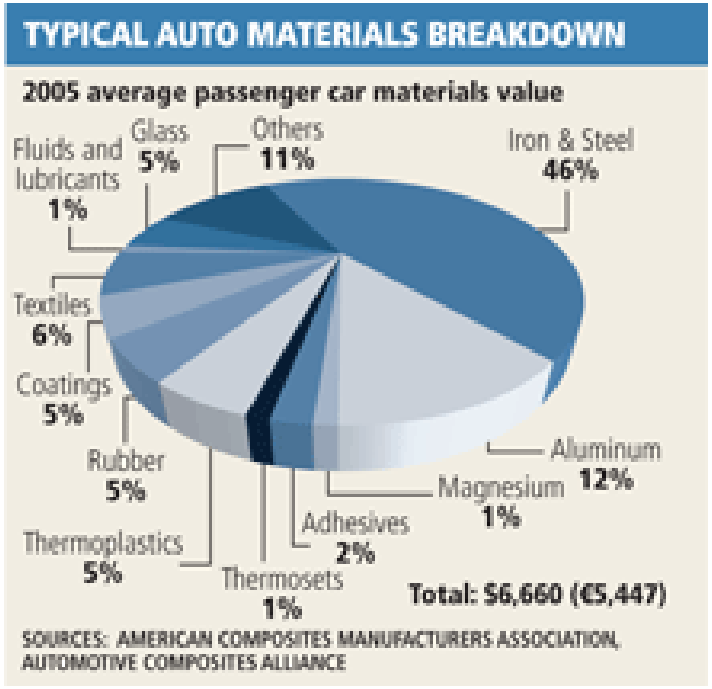
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, 2010

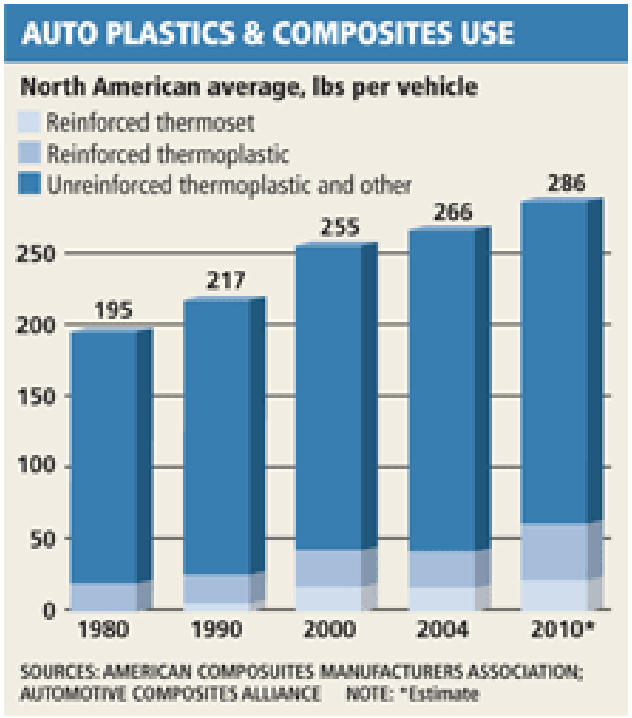
TOP 10 Chemical Engineering Contribution to Society

5. BETTER LIVING THROUGH CHEMISTRY

Chemical engineers have made plastics possible.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, 2010





http://www.bmw-security-vehicles.com

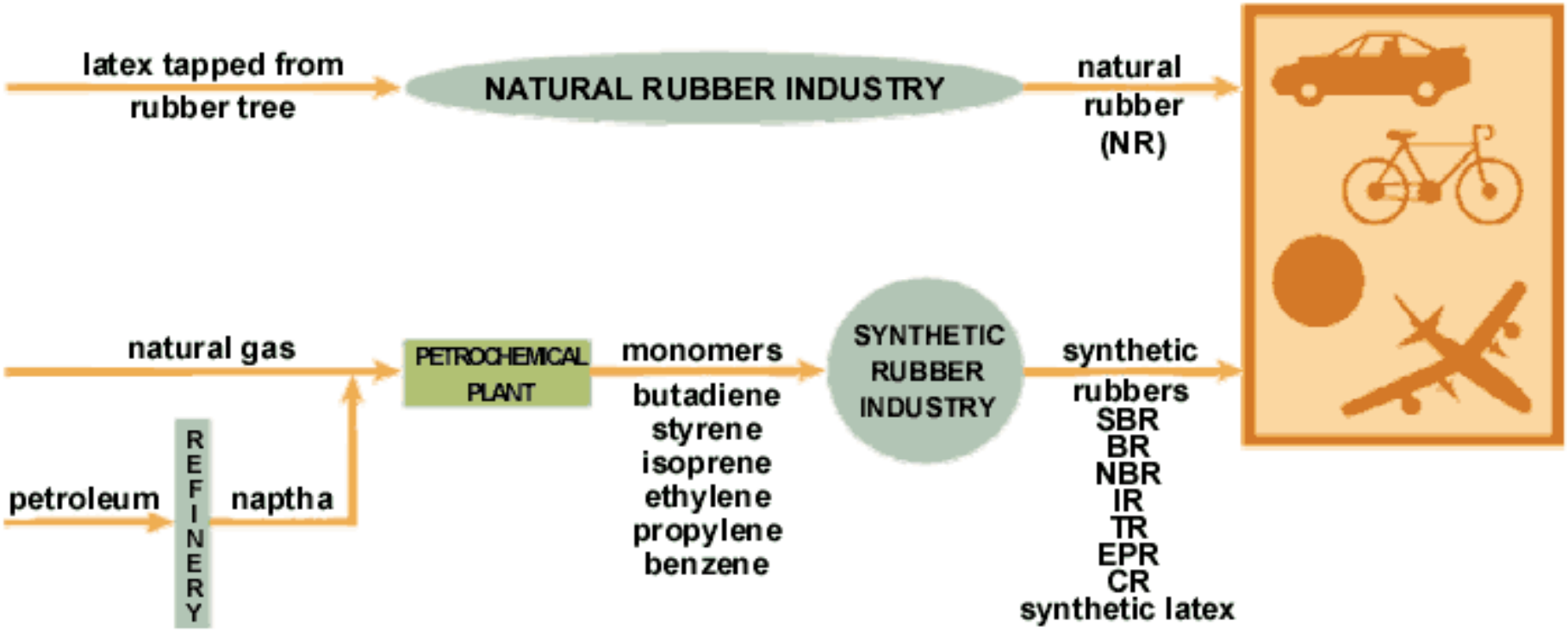
TOP 10 Chemical Engineering Contribution to Society

6. STRETCHING NATURAL RESOURCES

Chemical engineers make innovative materials.

- Synthetic rubbers
- Bio-plastics
- Kevlar
- etc.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, 2010


latex tapped from
rubber tree
NATURAL RUBBER INDUSTRY
natural
rubber
(NR)
natural gas
PETROCHEMICAL
PLANT
monomers
butadiene
styrene
isoprene
ethylene
propylene
benzene
SYNTHETIC
RUBBER
INDUSTRY
synthetic
rubbers
SBR
BR
NBR
IR
TR
EPR
CR
synthetic latex
petroleum
REFINERY
naptha

Kevlar Vests

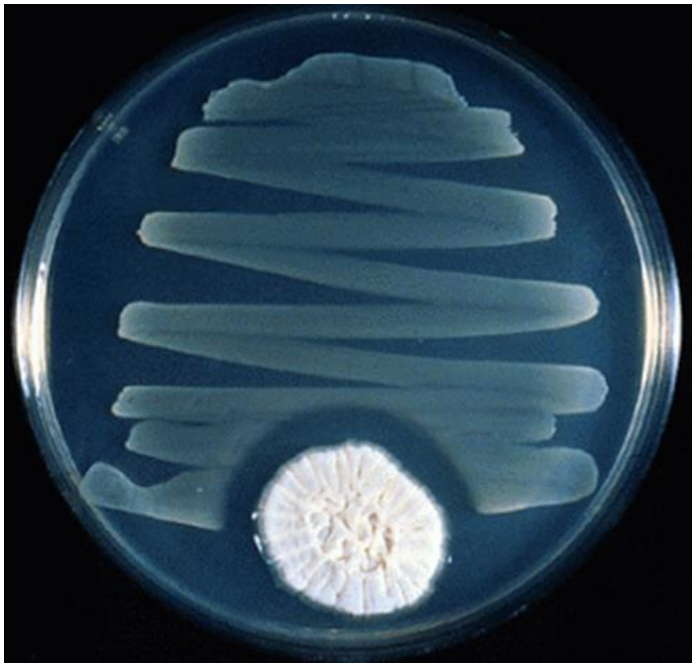
TOP 10 Chemical Engineering Contribution to Society

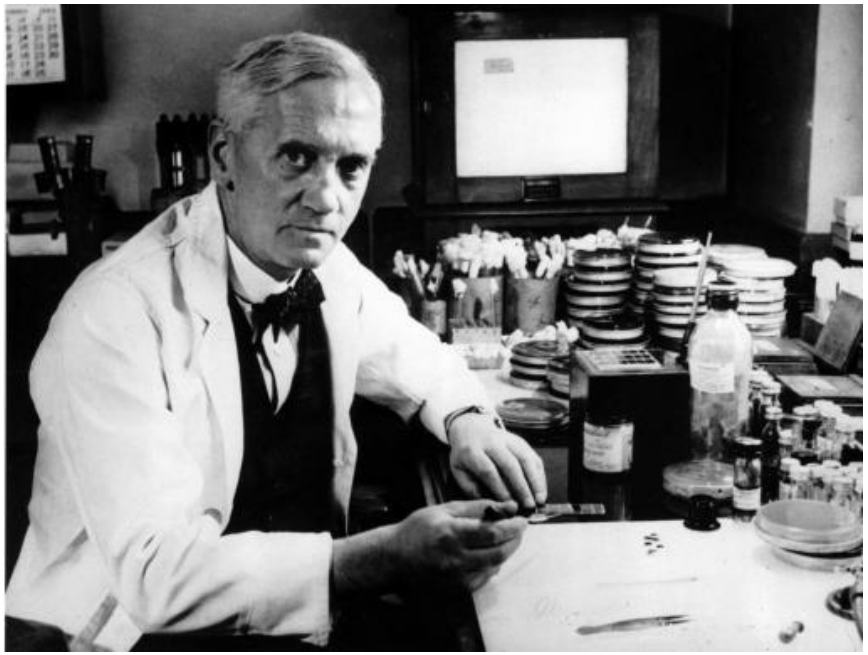
7. LARGE SCALE PRODUCTION ENGINEERING

Even if a product was created by a scientist, there is a good chance it was perfected and made practical by chemical engineers.

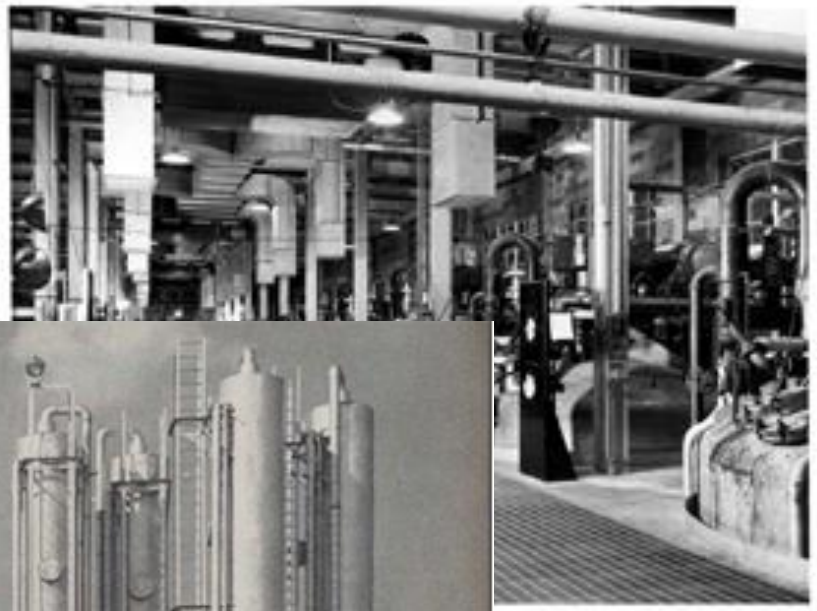
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, 2010

Penicillin Discovery

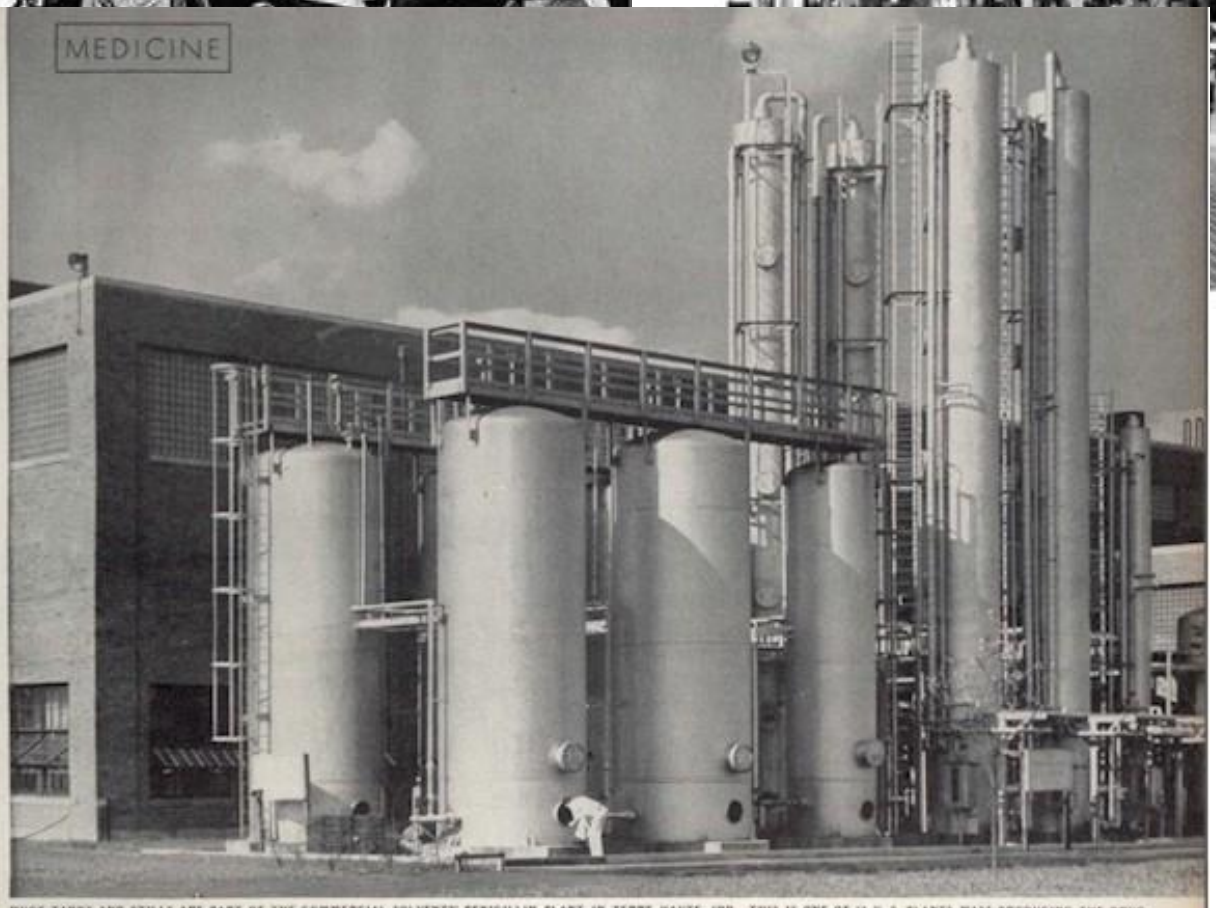




In 1929, Sir Alexander Fleming discovered a strain of mould that inhibit bacteria *Straphylococus* growth, called penicillin.



MEDICINE



HUGE TANKS AND STILLS ARE PART OF THE COMMERCIAL SOLVENTS' PENICILLIN PLANT IN TERRE HAUTE, IND. THIS IS ONE OF 11 U. S. PLANTS MASS-PRODUCING THE DRUG

PENICILLIN

MASS PRODUCTION OF DRUG REPLACES SLOW LABORATORY METHODS TO MEET MILITARY NEEDS AND PROVIDE A LIMITED CIVILIAN SUPPLY

TOP 10 Chemical Engineering Contribution to Society

8. CONVENIENT & ABUNDANT FOOD

When popping your favorite ready-to-eat meal in the microwave, thank chemical engineers!

- Processed food, canned food
- Powder coffee, Powder milk
- Sterilized food

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, 2010

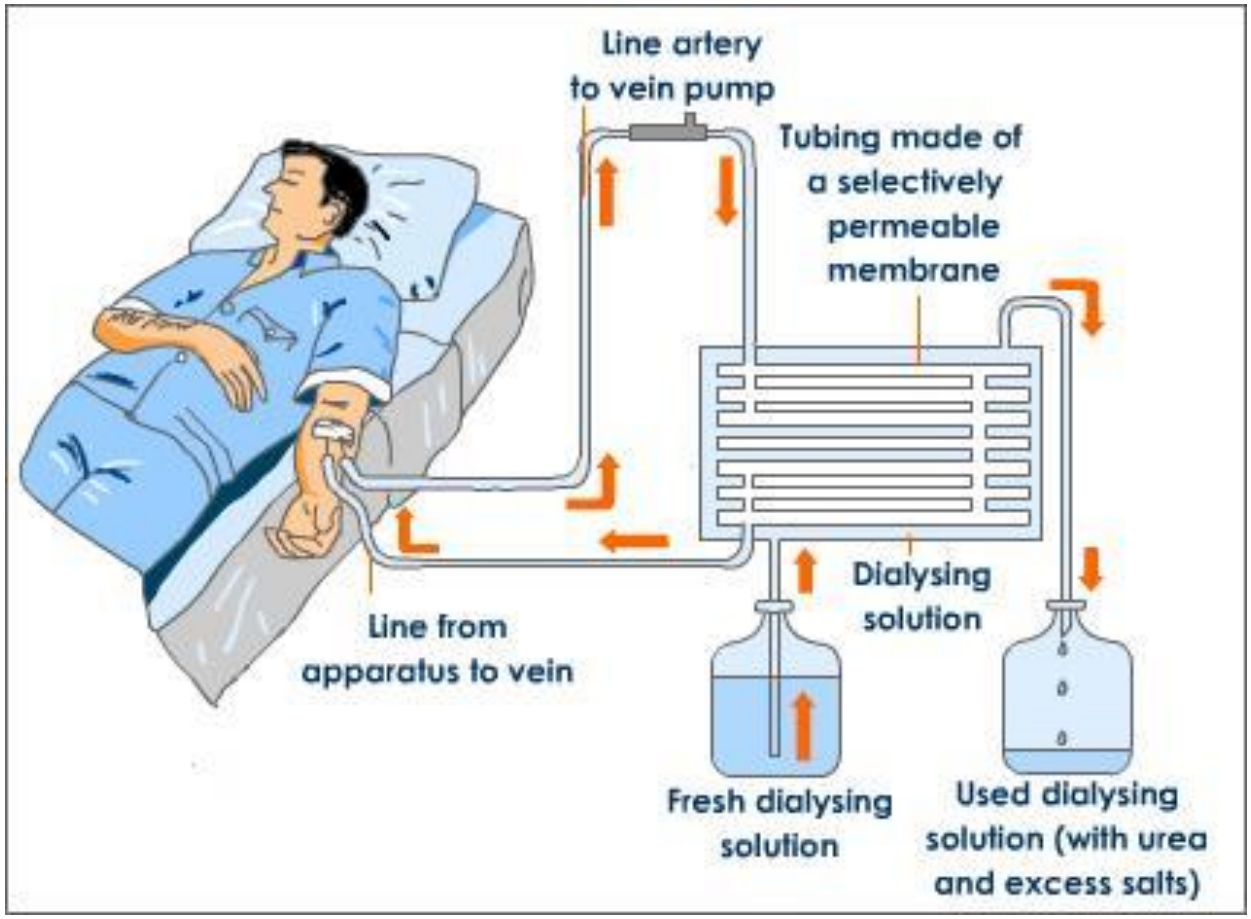
TOP 10 Chemical Engineering Contribution to Society

9. HEALING DISEASES & EXTENDING LIFE

Chemical engineering has advanced medical science, improving the quality of life and saving millions of lives.

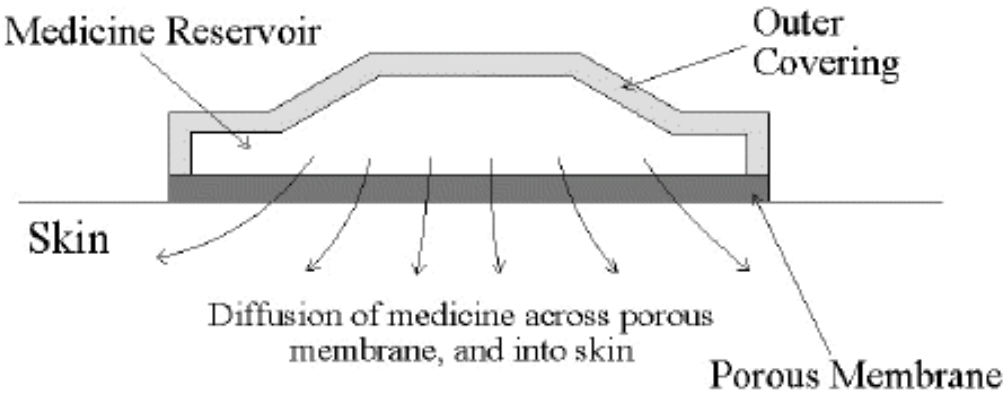
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, 2010

Dialysis (Artificial Kidneys)



www.kidneycaregroup.com

Transdermal Patch



TOP 10 Chemical Engineering Contribution to Society

10. POWERING THE PERSONAL COMPUTER

The tools chemical engineers use to improve computers may have long-winded names, but their advances make our gadgets all the more powerful.

- Germanium-based silicon chips that help your laptop perform faster.
- From thin-film liquid crystal displays to software that simulates complex industrial processes.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, 2010

Chemical Engineers in Action

1. Energy
2. Environment
3. Material Sciences
4. Semiconductor Manufacturing
5. Bio-medic
6. Food

Jobs Opportunity for ChE

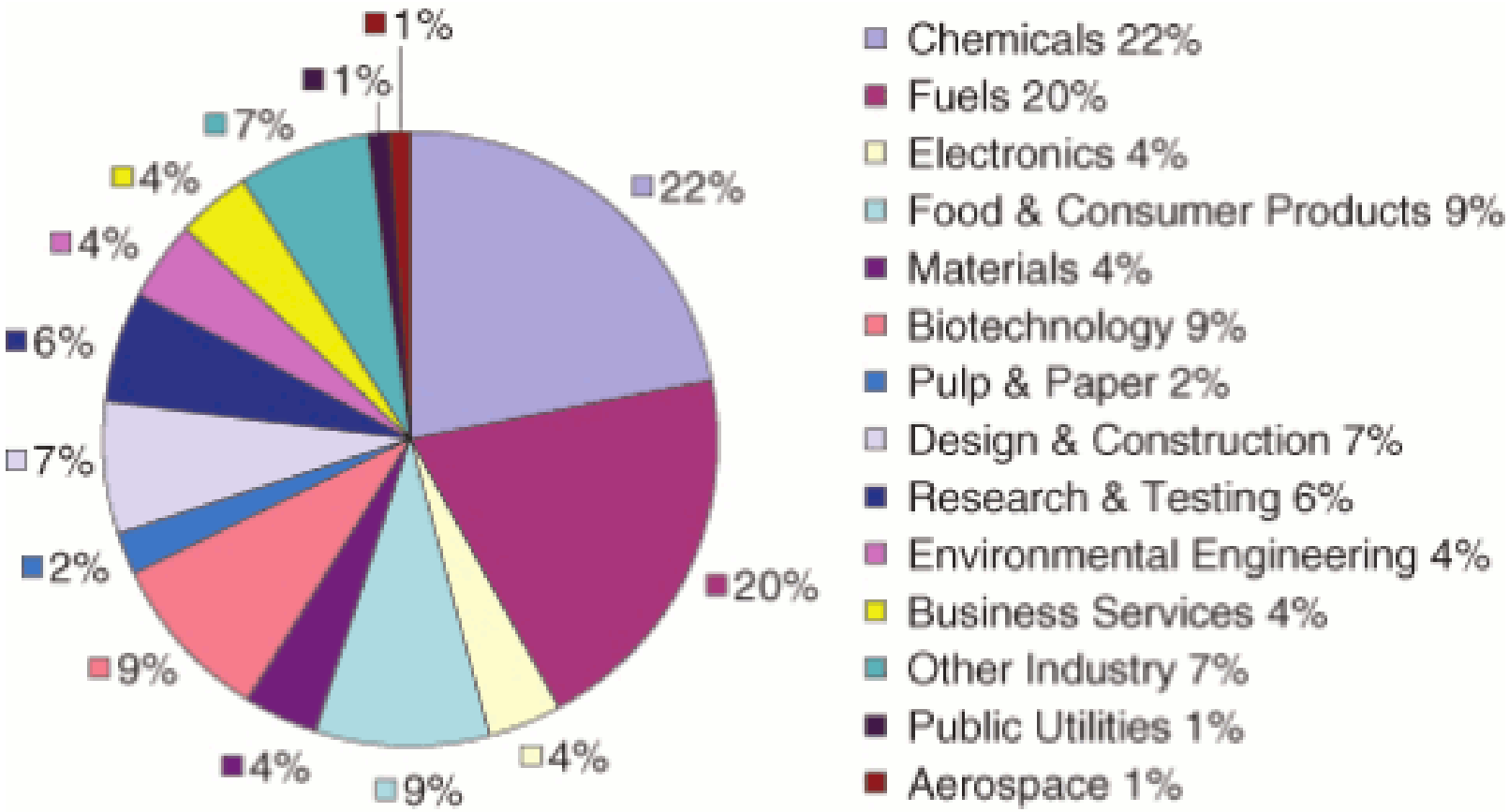
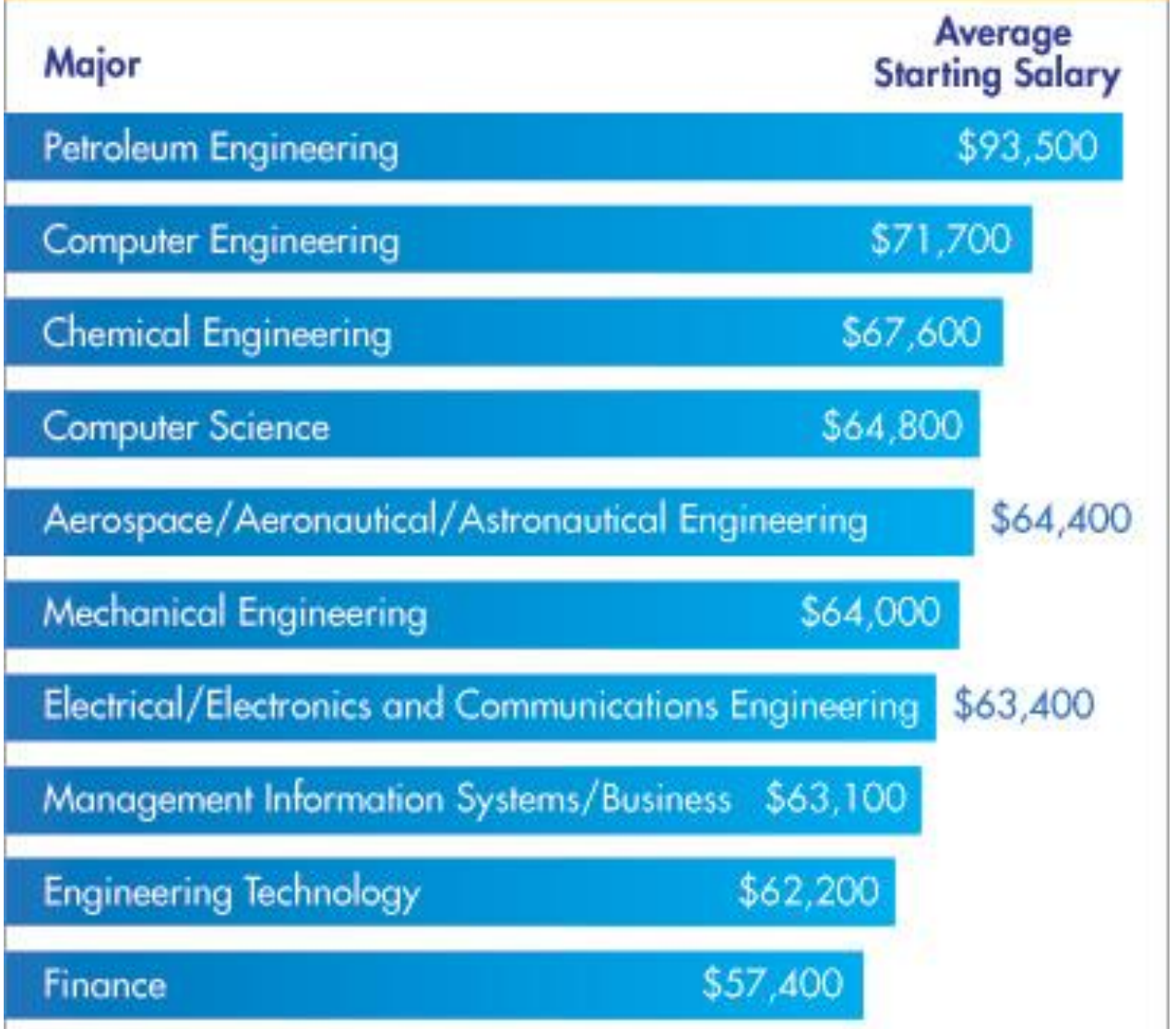


Figure 1: Top-Paying Majors for 2012-13 Bachelor's Degree Graduates



Source: April 2013 *Salary Survey*, National Association of Colleges and Employers

ChE Salaries Survey (by AIChE in 2013)

- Salaries vary with experience ($67,000 for chemical engineers with fewer than six years of experience to about $140,000 for those with more than 30 years).

- Other factors, including age, gender, education, job function, and industry, were also examined for their impact on chemical engineers' paychecks.

- The variables having the largest impact on salaries are years of work experience, time with current employer, and time taken off for family reasons.