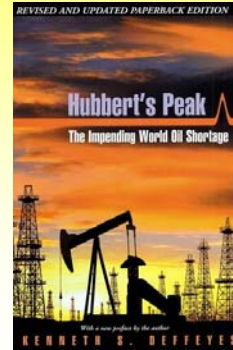
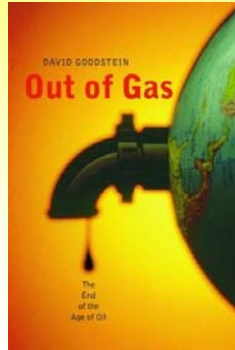



How do we use C?
Will we have enough?



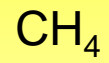
quiz time

Sources (& Destinations)

- Lecture notes & [addenda](#) on web
 - C sources? (suggest 3)
 - C destinations?
- 

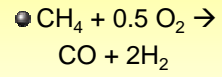
We obtain C from petroleum, coal, natural gas, and plants (perhaps one day we will obtain C from methane hydrates, but this is only a pipe dream at present). Only plants are renewable source of C. And only plants remove CO₂ from atmosphere, but can we justify converting food production to “C production”?

What do we do with C?



- from Nat. gas (85-90%)

- Energy source



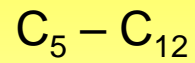
NH₃

fuel



Linde "Synthesis Gas" Plant

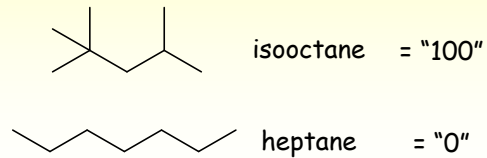
Natural gas is almost entirely (85-90%) methane. Natural gas is mainly used to make ammonia (for fertilizer) and for fuel.



- from Crude Oil (15-20%)

- "Octane" rating

 - Engine knocking



Petroleum provides heavier alkanes. The C_5 - C_{12} fraction comprises only 15-20% of petroleum. The so-called "octane" rating of a gasoline is actually based on 2,2,4-trimethylpentane ("isooctane"). A gasoline that creates the same amount of engine knocking as pure isooctane has an "octane rating" of 100.

Cheap Oil Has Many Uses

Antihistamines, Antiseptics, Artificial Hearts, Aspirin, Audiocassettes
Baby Strollers, Balloons, Bandages, Blenders, Cameras, Candles, CD Players
Clothing, Compact Discs, Computers, Containers, Crayons, Credit Cards
Dentures, Deodorant, Diapers, Digital Clocks, Dinnerware, DVDs, Dyes
Eyeglass Frames, Fertilizers, Food Preservatives, Food Storage Bags
Footballs, Foul Weather Gear, Furniture, Garbage Bags, Glue, Golf Balls
Hair Dryers, Hang Gliders, Heart Valve Replacements, House Paint
Infant Seats, Ink, Insecticides, Life Jackets, Lipstick, Luggage
Medical Equipment, Nylon Rope, Pacemakers, Pantyhose, Patio Screens
Perfumes, Photographic Film, Photographs, Piano Keys, Roller Blades
Roofing, Safety Glass, Shampoo, Shaving Cream, Shower Curtains, Slippers
Soft Contact Lenses, Sunglasses, Surfboards, Surgical Equipment, Syringes
Telephones, Tents, Toothpaste, Toys, Umbrellas, Vitamin Capsules

American Petroleum Institute (http://api-ec.api.org/filelibrary/oilfacts_rgb.pdf)

C (mainly from petroleum) gets turned into an amazingly diverse set of products. Giving up these products would require very fundamental changes in our lifestyles.

If you look at the postnotes for lecture #1, you will see that synthetic materials are obtained from petroleum by a multi-step process. Petroleum is first converted into very simple compounds, like ethylene, propene, and so on, and these compounds are then recombined into more complicated structures.

Not All Uses Are Equal

- 43% gasoline
- 41% other fuels (diesel, jet, ship, ...)
- 3.1% asphalt
- 2.5% feedstock
- 1.1% lubricants

American Petroleum Institute

Only 3-4% of petroleum is converted into the various synthetics shown on the previous slide. Most of it is used for fuel.

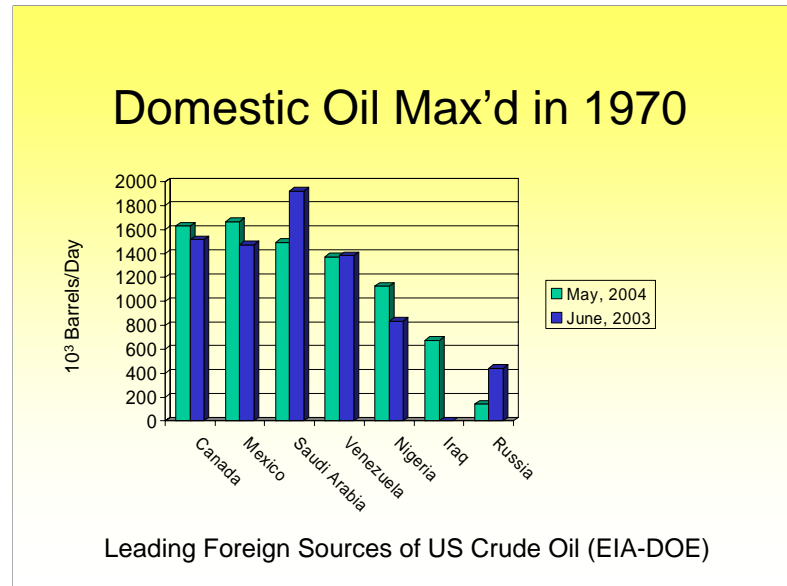
Ecological Footprint

- Lifestyle supported by

- natural resources
- spread over a portion of the globe
- personal portion → “footprint”

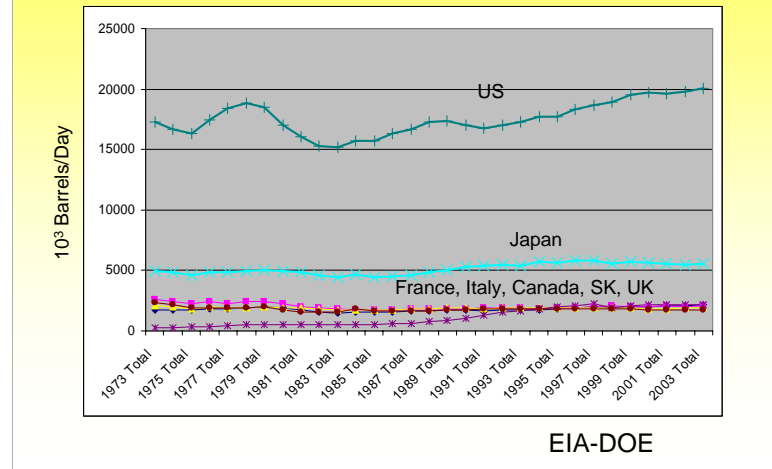
- <http://myfootprint.org>

If we are going to wean ourselves away from fossil fuels, we'll have to make some fundamental choices about how to live. This web site will introduce you to some of the difficult choices that await us in the next 10-100 years.



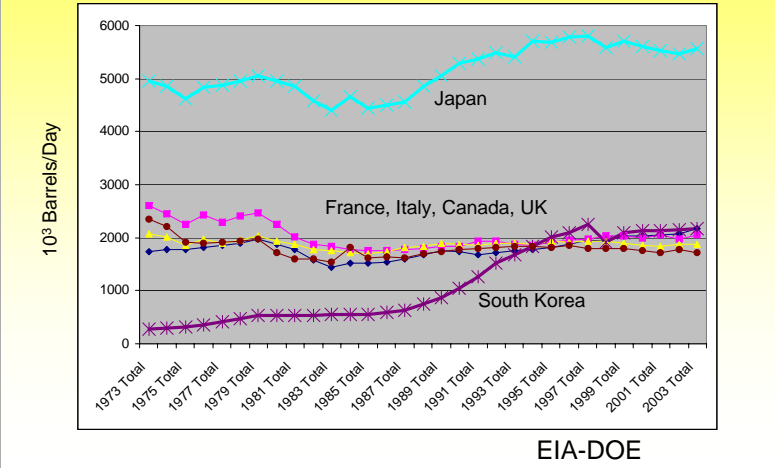
US oil production peaked in 1970 and has been in decline ever since (but we still produce large amounts of oil). We now obtain oil from several different countries, many of whom have problematic political climates (and problematic relationships with the developed world).

But Consumption is Rising Here



Declining and problematic sources might be a sign that we need to control our dependence on oil, but our behavior is going in the opposite direction. US oil consumption has risen steadily since the early 1980's (the last oil shock).

And Abroad (SK)



Japan and South Korea and China (not shown) also have seen increases in oil consumption. Global **competition** for these precious resources will soon be the name of the game (if it isn't already).