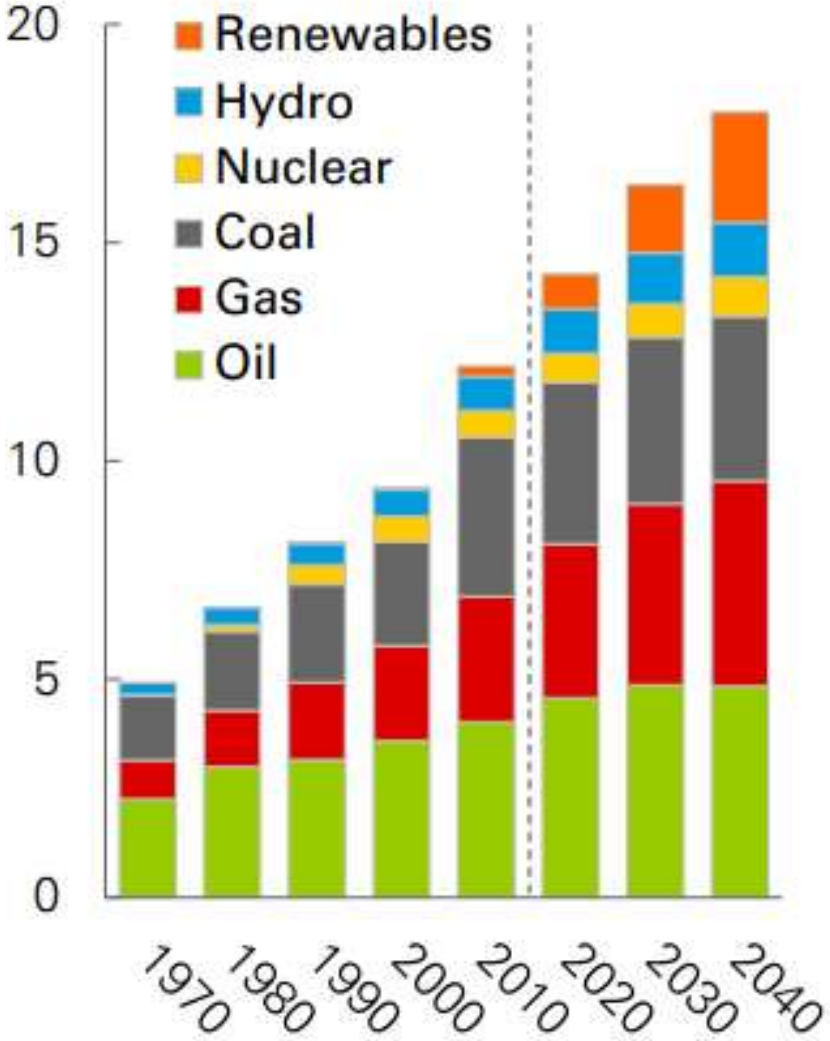
OIL, Plastic, Pollution

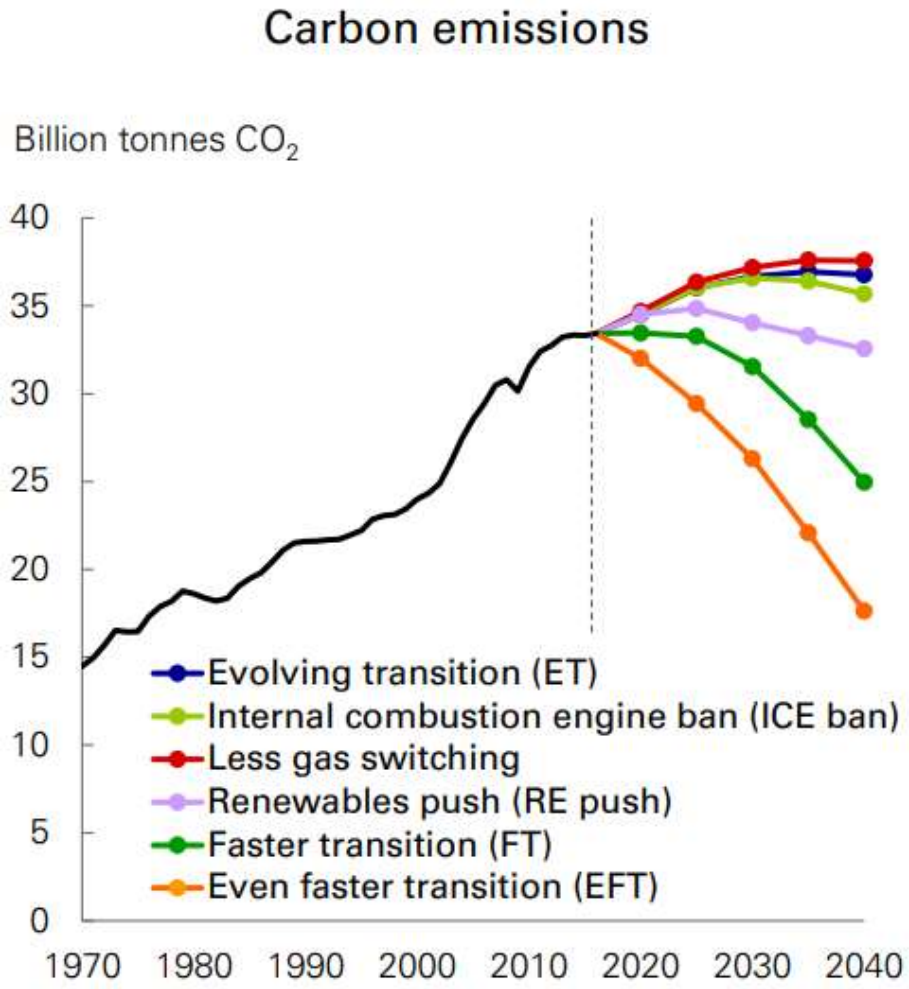
Indian Context

Sub topics

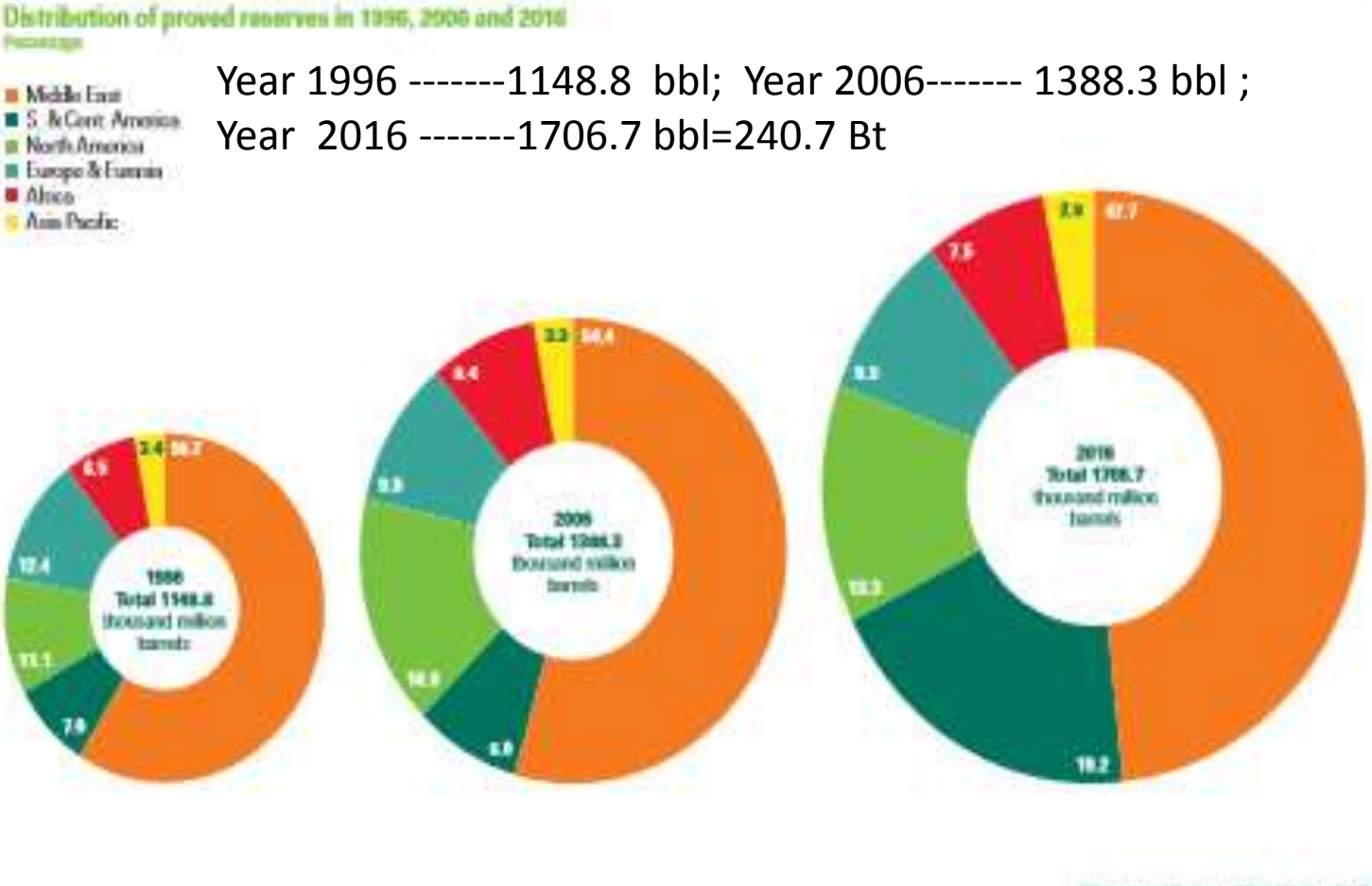
- World Energy Mix, Oil Scenario and pricing
- India s energy mix ,forecast ,Oil Scenario,
- Science of OIL
- Plastics … Science ,types of plastics and usages
- Pollution

World Energy Mix



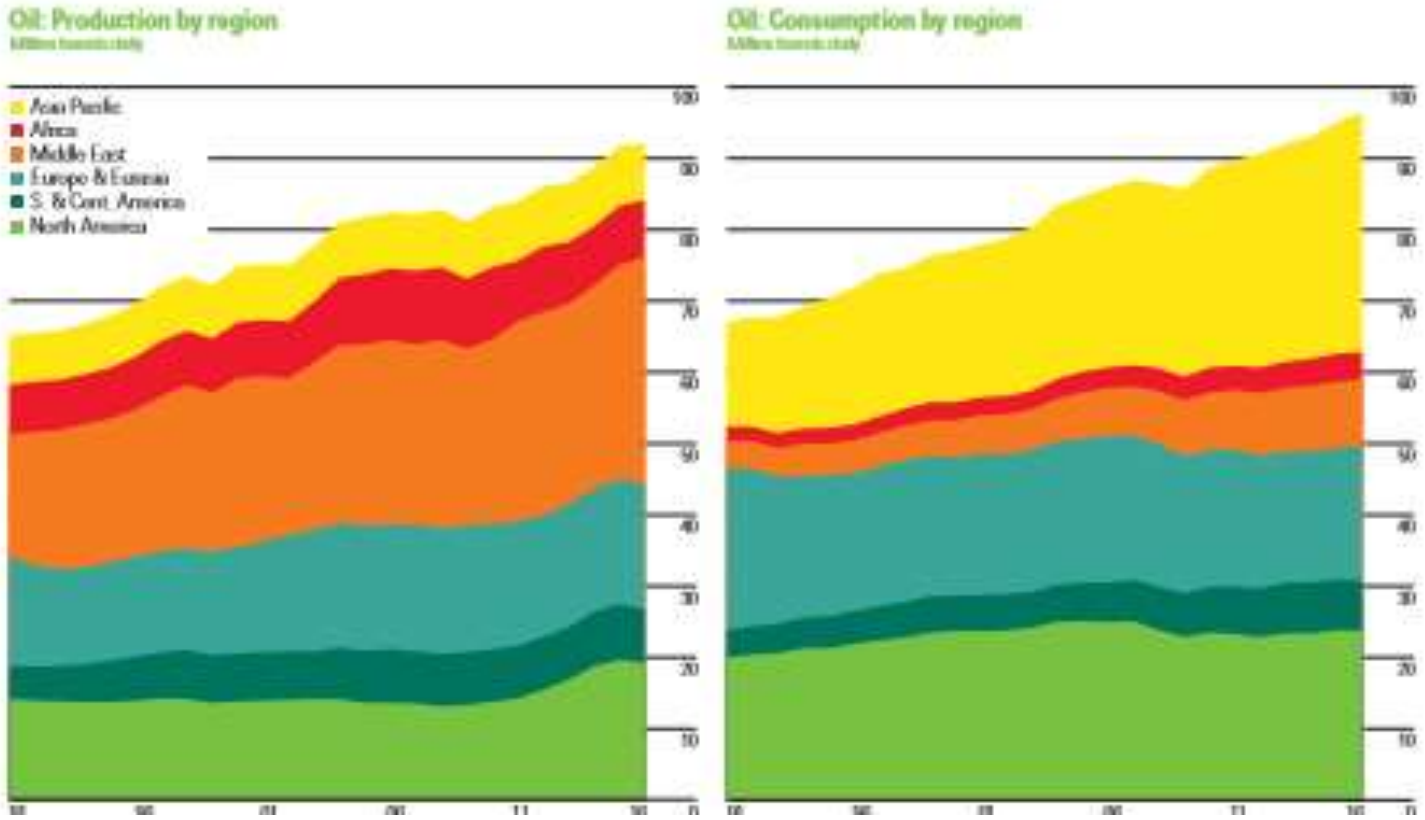


World Oil Reserves



Year 1996 -------1148.8 bbl; Year 2006------- 1388.3 bbl ;
Year 2016 -------1706.7 bbl=240.7 Bt

Production VS Consumption



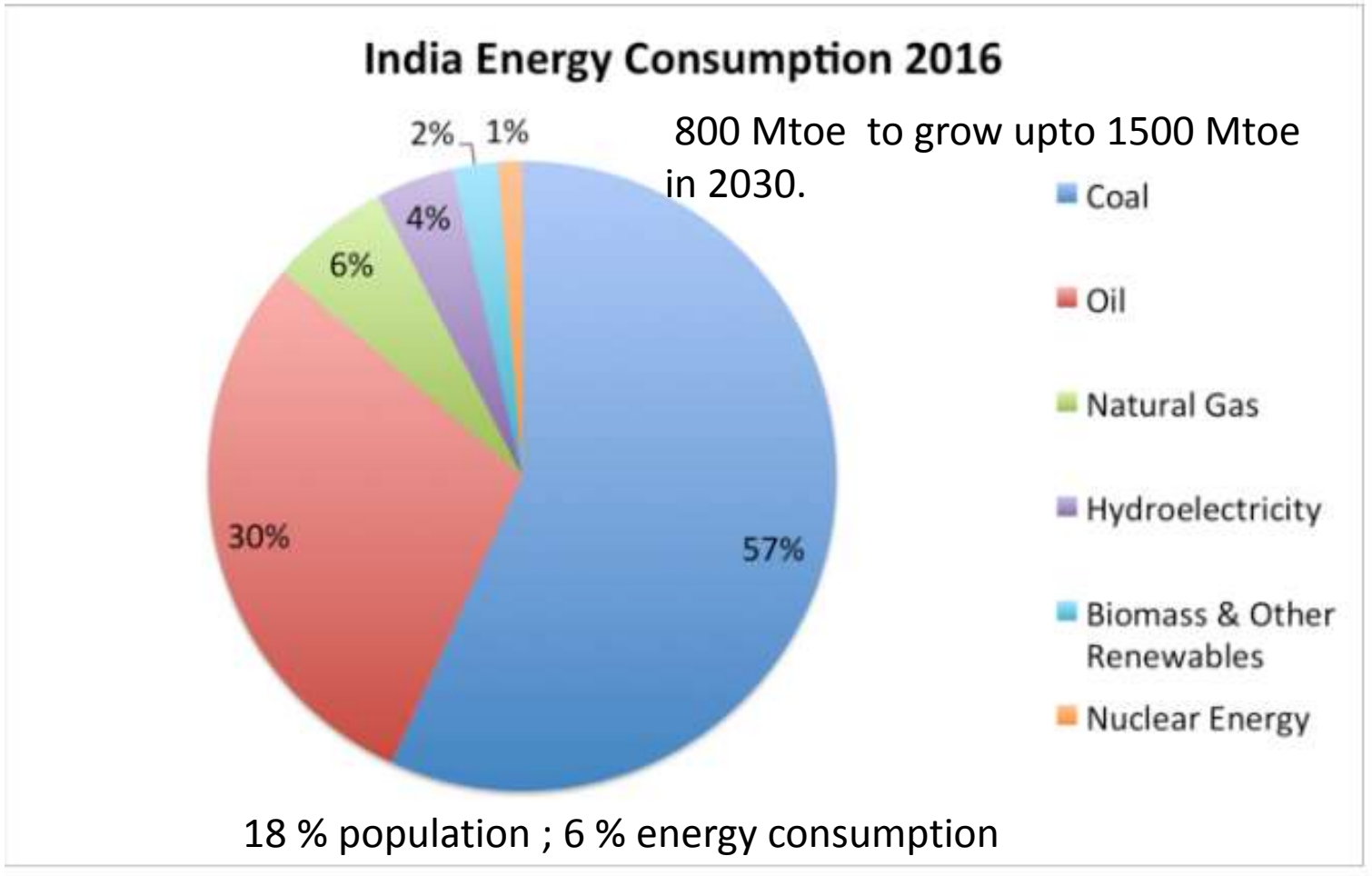
World oil production grew by only 0.4 million b/d in 2016,

Total World R: P =50.6

China (400,000 b/d) and India (330,000 b/d) largest contributions to consumer growth

OIL Prices

- OPEC and Non OPEC countries deal to cut 1.8 mmbbld , of production ,squeezed out excess oil inventory.
- Economic melt down in Venezuela ,40% cut down in production.
- Global economy is picking
- US shale oil production is picking, not enough
- Iran sanctions and middle east crisis .
- Oil price likely to stay high atleast in the near future till OPEC and Russia decides to raise production.



800 Mtoe to grow upto 1500 Mtoe in 2030.

18 % population ; 6 % energy consumption

Source: BP Statistical Review of World Energy June 2017.

India s energy outlook 2040

- India s energy consumption to grow by ;
- 4.2% per year
- 165 % growth from 2016 , ie 2120 mmtoe
- share of global energy consumption rises to 11%
- India's energy mix evolves very slowly with fossil fuels meeting
- 82% of demand in 2040,
- down from 93% in 2016.
- The share of coal
- falls from 57% in 2016 to
- 50% by 2040,
- The share of renewables rises from 2% to 13%.
- Oil imports will rise by 175% and account for 65% of the increase in energy imports, followed by gas (+291%) and coal (+79%).
- By 2040 India's energy intensity of GDP is 37% lower than in 2016 while carbon intensity of energy use is down by 13%. Source :BP

India s Oil Scenario

- India s Oil reserves ; 560 MMT
- India s Oil Production ; 36 MMT
- R: P ratio ; 1; 15.5
- India s oil Consumption ; 212.7 MMT
- India s Refinery capacity ; 234 MMT (fy 2018)
- India may struggle to achieve 2022 target of 175 GW renewable energy: Experts
- CAD likely to go up by 25 to 50 US billion dollars, Rupee going down , inflation increases and slow down.

COND

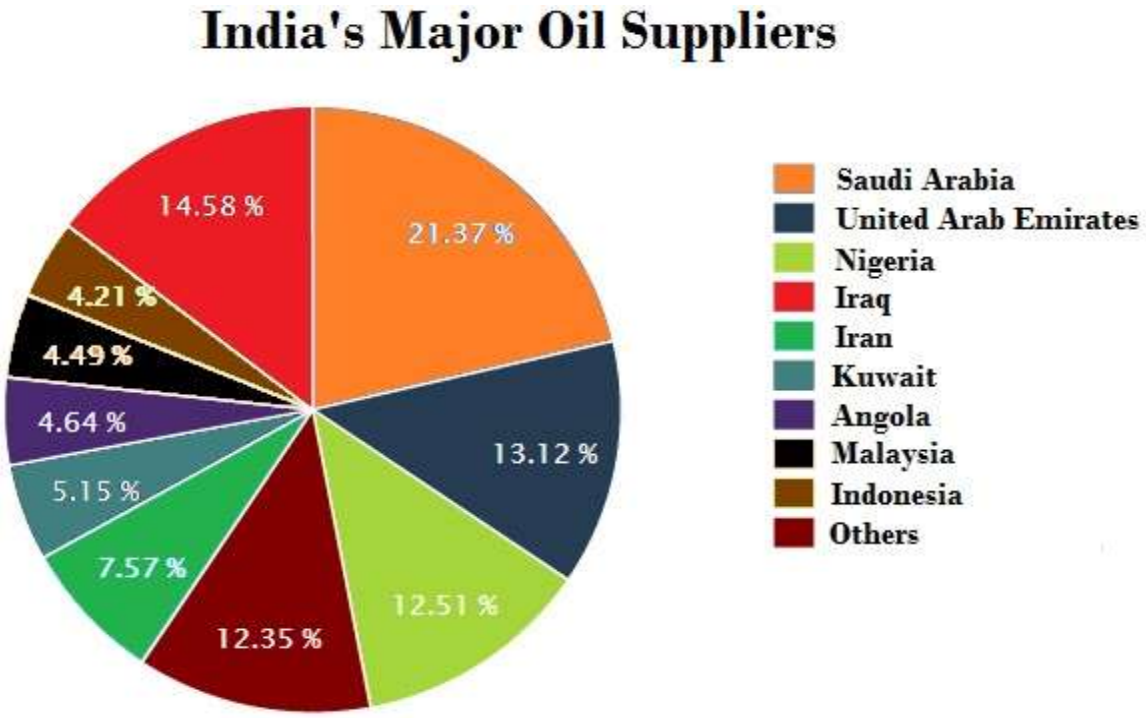
- India’s trade deficit widening to $13.72 billion in April 2018, from $13.69 billion in March
- The trade deficit widened last fiscal to $156.8 billion, from $108.5 billion in the previous year, mainly driven by a rising oil import bill.
- Rs going down to 68 per USD

Crude Oil sources

- India Domestic ……35.68mmt
- Assam ……..3.3 mmt
- Gujarat …….. 3.5 mmt
- Rajasthan…….12 mmt
- Bombay offshore……13 mmt.
- KG and Cauvery
- Arunachal
- Condensate ……. 3.0 mmt
- India’s domestic crude oil production is going down rapidly.

Crude Oil Imports

- Total imports 217 mmt of crude



OIL.....Science

- Oil is found in Sedimentary rocks deposited in Sedimentary basins .
- When Earth was formed ,molten lava could cool fast and solidified giving rise to smaller crystals or gradually in the surface or even deep in earths crust giving rise to larger crystals.
- Basalts are the major component of fast cooling and they form ocean floors and even basements.
- Granites are the result of slow cooling .These rocks when eroded forms sands capable of being a habitat for oil and gas

Sedimentary rocks

- Rock that forms through the deposition and solidification of sediment transported by water (rivers, lakes, and oceans), ice (glaciers), and wind.
- Sedimentary rocks are often deposited in layers, and frequently contain fossils eg are Shales, limestone and sandstones.
- Shale , is a fine grain sedimentary rock, accounting for roughly 70 percent of rock in the crust of the Earth.

contd

- Sand stone is a sedimentary rock consisting of sand or quartz grains cemented together, typically red, yellow, or brown in colour.
- Most limestones form in shallow, calm, warm marine waters ,tropical areas ;30deg N to 30deg S
- When animals die, their shell and skeletal debris accumulate as a sediment that might be lithified into limestone.
- Limestones can also form by direct precipitation of calcium carbonate from marine or fresh water.
- Lime Stones and Sandstones are the main habitats of Oil and Gas

cond

- Sedimentary rocks are therefore of two types:

- Clastic **sedimentary rocks** such as breccia, conglomerate, sandstone, siltstone, and shale are formed from mechanical weathering debris.

- Bio - Chemical **sedimentary rocks**, such as **rock** salt, iron ore, chert, flint, dolomites, and limestones, form when dissolved materials precipitate from solution or when living things die, pile up, and are compressed and cemented to form **rock**.

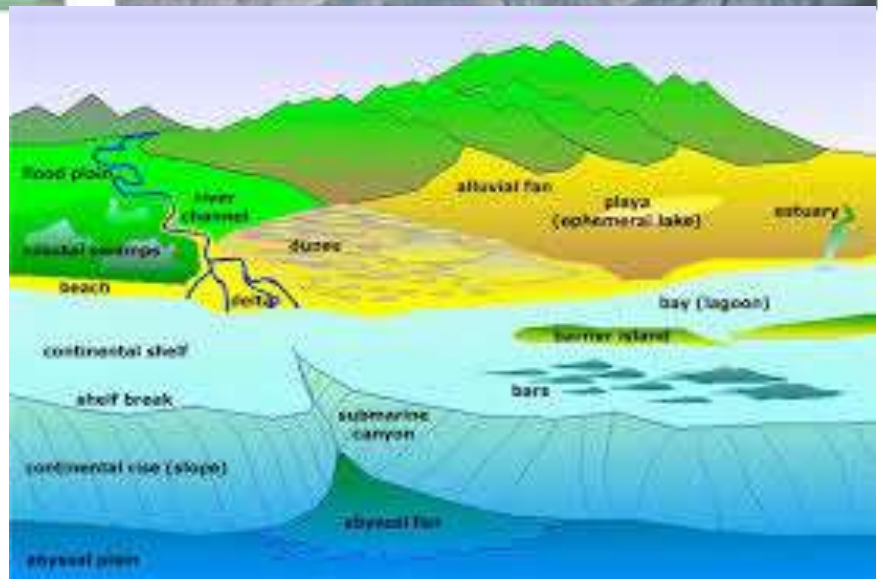
Continental Environments

- Fluvial deposits ;siliciclastic sediments
  - Alluvial Fans -..
  - Braided Rivers -..
  - Meandering Rivers - sinuous and migrate across the river basin.
  - Lacustrine (lakes) -
  - Swamps and marshes -
  - Eolian (deserts and near beaches) -
  - Glacial -.


Alluvial Fan

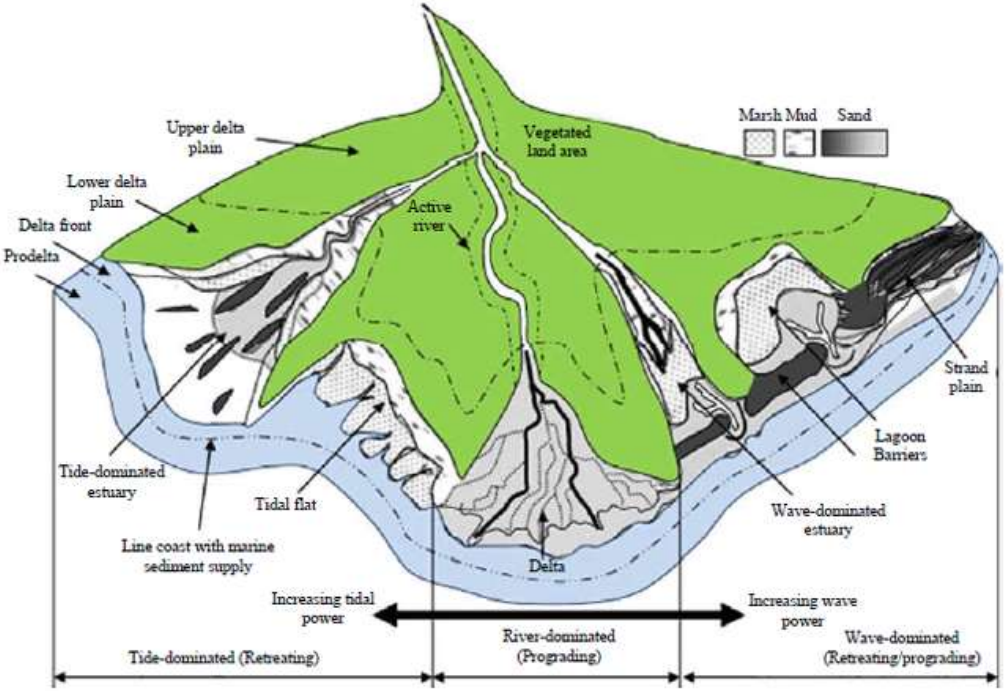

Braided River


Meandering river

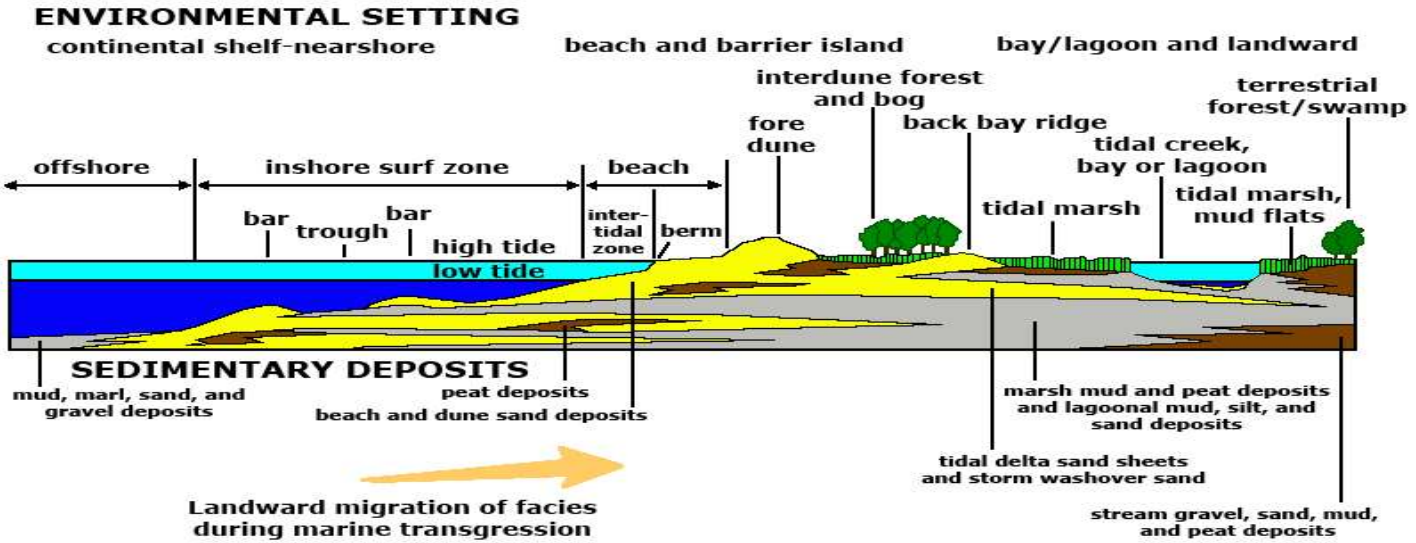

flood plain
river channel
alluvial fan
playa (ephemeral lake)
estuary
coastal swamps
dunes
beach
delta
bay (lagoon)
barrier island
continental shelf
bars
shelf break
submarine canyon
continental rise (slope)
abyssal fan
abyssal plain

Marine Deposits

  - Deltas -.
  - Beaches and Barrier Islands
  - Clastic shelf
  - - Carbonate shelves and platforms -
- Deep Marine
  - Pelagic -.
  - Turbidites -

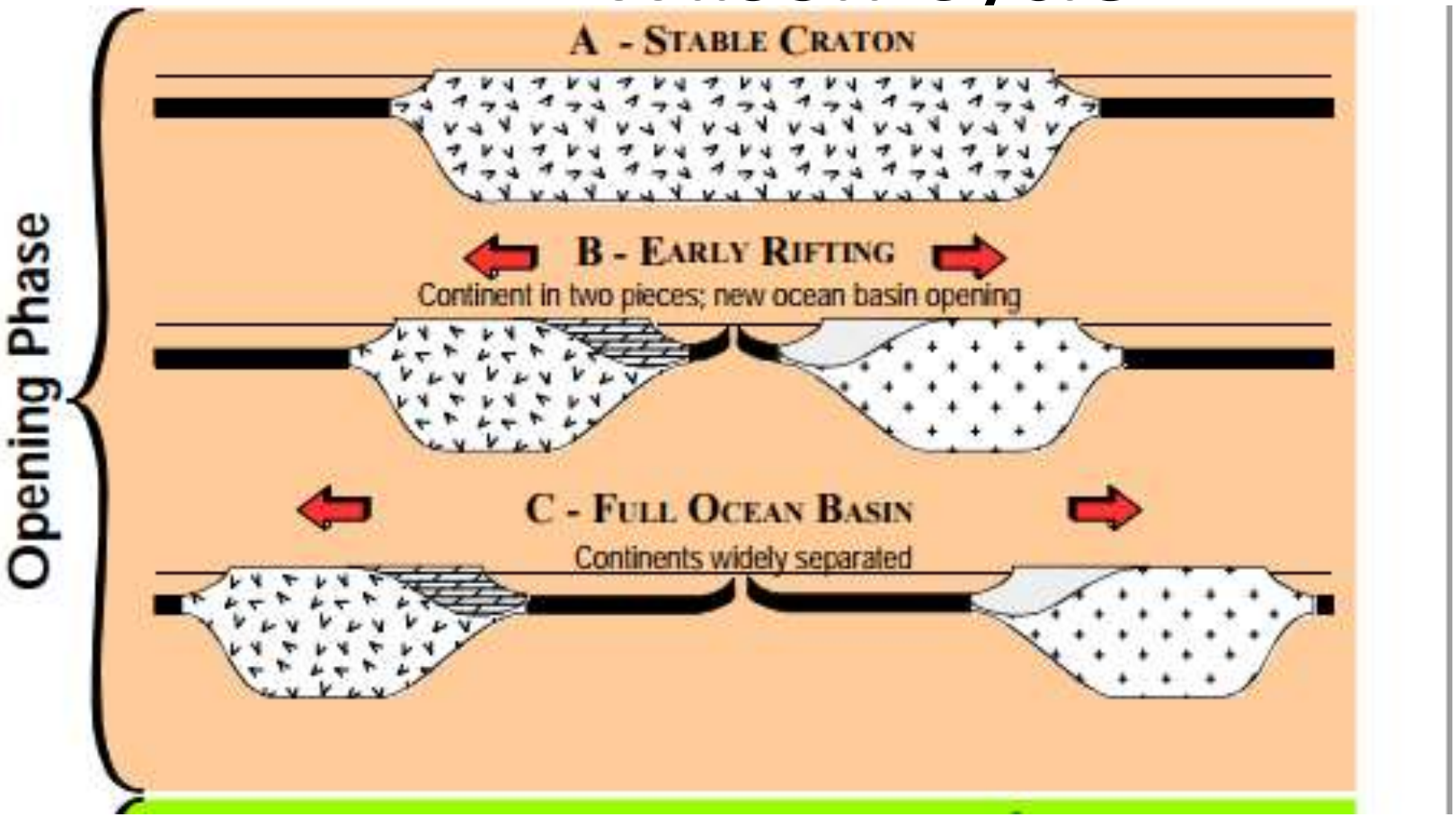


Swamps and Marshes




Karakoram
Hindu Kush
Tibetan Plateau
Afganistan
Pakistan
Himalayas
Indus River
Ganges River
Bramputra R.
Arabia
India
Bay of Bengal
Indus Fan
Arabian Sea
Bengal Fan

Wilson Cycle



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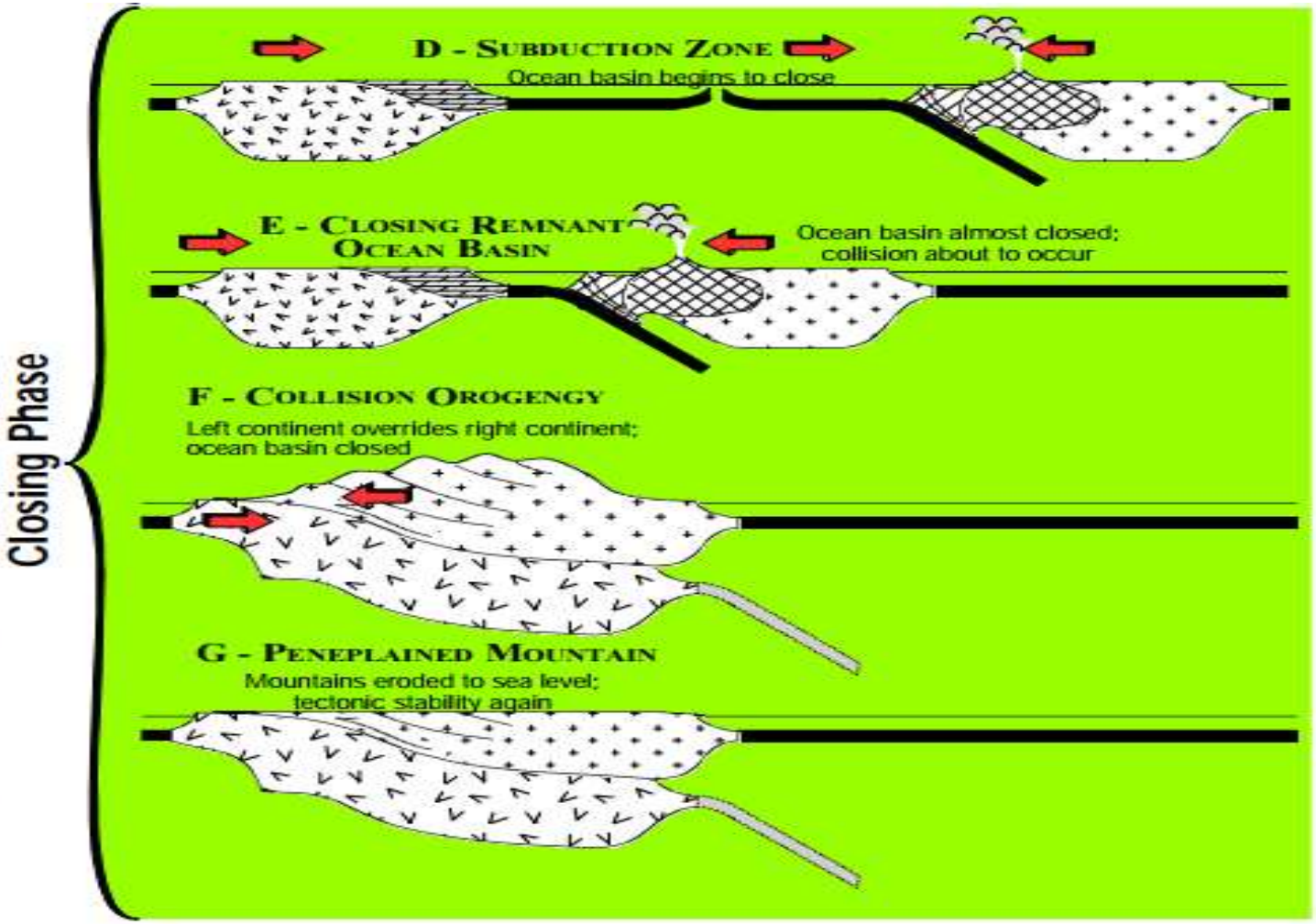
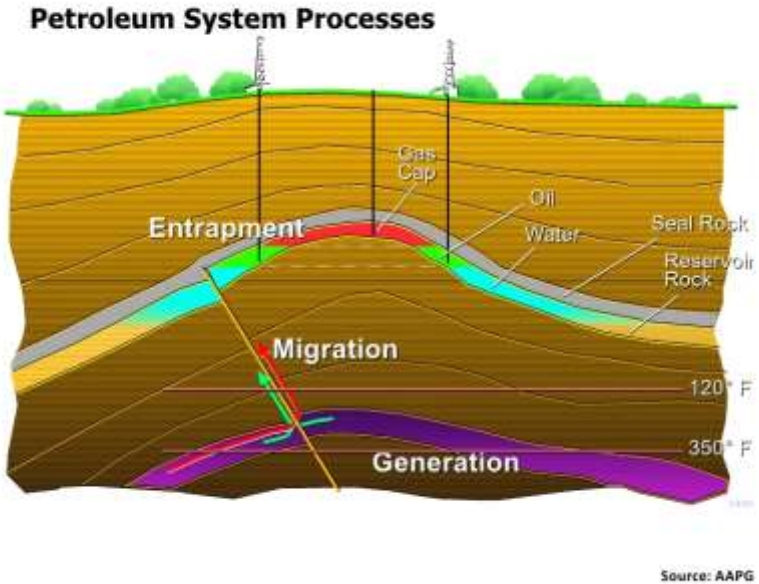

Closing Phase
D - Subduction Zone
Ocean basin begins to close
E - Closing Remnant Ocean Basin
Ocean basin almost closed; collision about to occur
F - Collision Orogengy
Left continent overrides right continent; ocean basin closed
G - Peneplained Mountain
Mountains eroded to sea level; tectonic stability again

Sedimentary basins

- A basin is a depocentre in earth .
- Basins are formed due to tectonic plate movement .
- Plates can move away from each other and are called Rifts which can result in a divergent margin basin e.g India and the Arab World.
- Plates can move into each other forming Mountains like Himalayas .
- Plates can move past each other like St Anders fault in SFO.

cond

- In each such case a depocentre can form where the sediments can get deposited .
- Oil is formed in these sedimentary basins
- Planktons and Algae matter under a chemical reaction in anoxic environment forms Kerogen
- These gets buried and under high temperature and pressure forms Oil .
- This oil is lighter than water and moves upwards till they are entrapped


Petroleum System Processes
Gas Cap
Oil
Water
Seal Rock
Reservoir Rock
Entrapment
Migration
120° F
350° F
Generation
Source: AAPG


Polycrystalline Diamond Compact Bit
Natural Diamond Bit
Impregnated Bit
Images courtesy of Hughes Christensen


HITDRILL 1

Fractional Distillation

As the each gas reaches a set different temperature that condenses it to liquid, the liquid is seperated into its own distilling column.

Distillation Column

Gas is passed through to the distillation column.

Crude Oil

Boiler (Used to Change Crude Oil to Gas)

Butane and Lighter Products (<85°F)

Gasoline (85°F - 185°F)

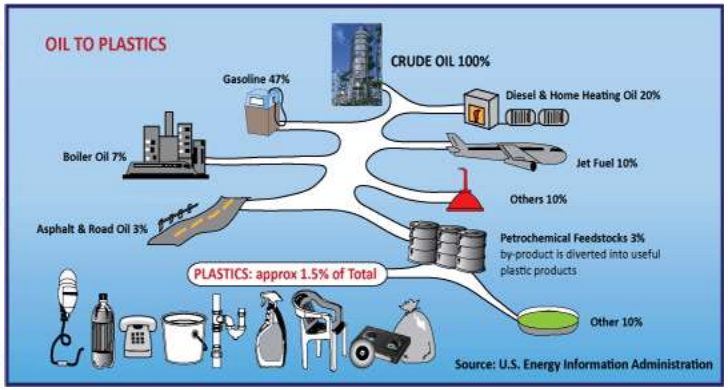
Naphtha (185°F - 350°F)

Kerosene (350°F - 450°F)

Diesel Oil (450°F - 650°F)

Fuel Oil (650°F - 1050°F)

Residue (>1050°F)



Plastics –Positive and Negative

- Durable ,
- Low weight material ,
- Strong as metals .
- Ease in converting to required shape ,
- Appeals aesthetically yet can be subjected to rough use
- Is recyclable..
- **Negative impact of plastic**
- Accumulate as garbage on the planet..
- Bio Non degradable
- Emit fumes which contain harmful chemicals on burning

Plastics…….Science

- Plastics are , synthetics made from OIL , natural gas, wood fibers ,corn and banana peel .
- The essential ingredient being C and H . O, N, Cl, S lend variety to plastics
- Ethylene C2H2 is the common monomer obtained by cracking naptha or lighter fraction like Ethane
- Polymerization is often started by combining the monomers through the use of a *catalyst* -.

cond

- Thousands of monomers combine to form a polymer chain,
- Millions of polymer chains, called resins are formed at the same time.
- Polyethylene resins ,differing in density and weight are sold to plastics factories, as powder, tiny granules, or pellets.
- Additives modify the properties of the material, besides heating melting and shaping for the intended product

cond

- Plastics are classified into two categories
- *Thermoplastics* : Melt when heated, then harden again when cooled.
- *Thermosets,* , on high heat ,cracks or char, ideal for high-heat applications such as electronics and appliances, E -wastage
- 80% of the plastics produced are thermo-plastics ie polyethylene, Polypropylene, Polystyrene and Poly Vinylchoride (PVC)

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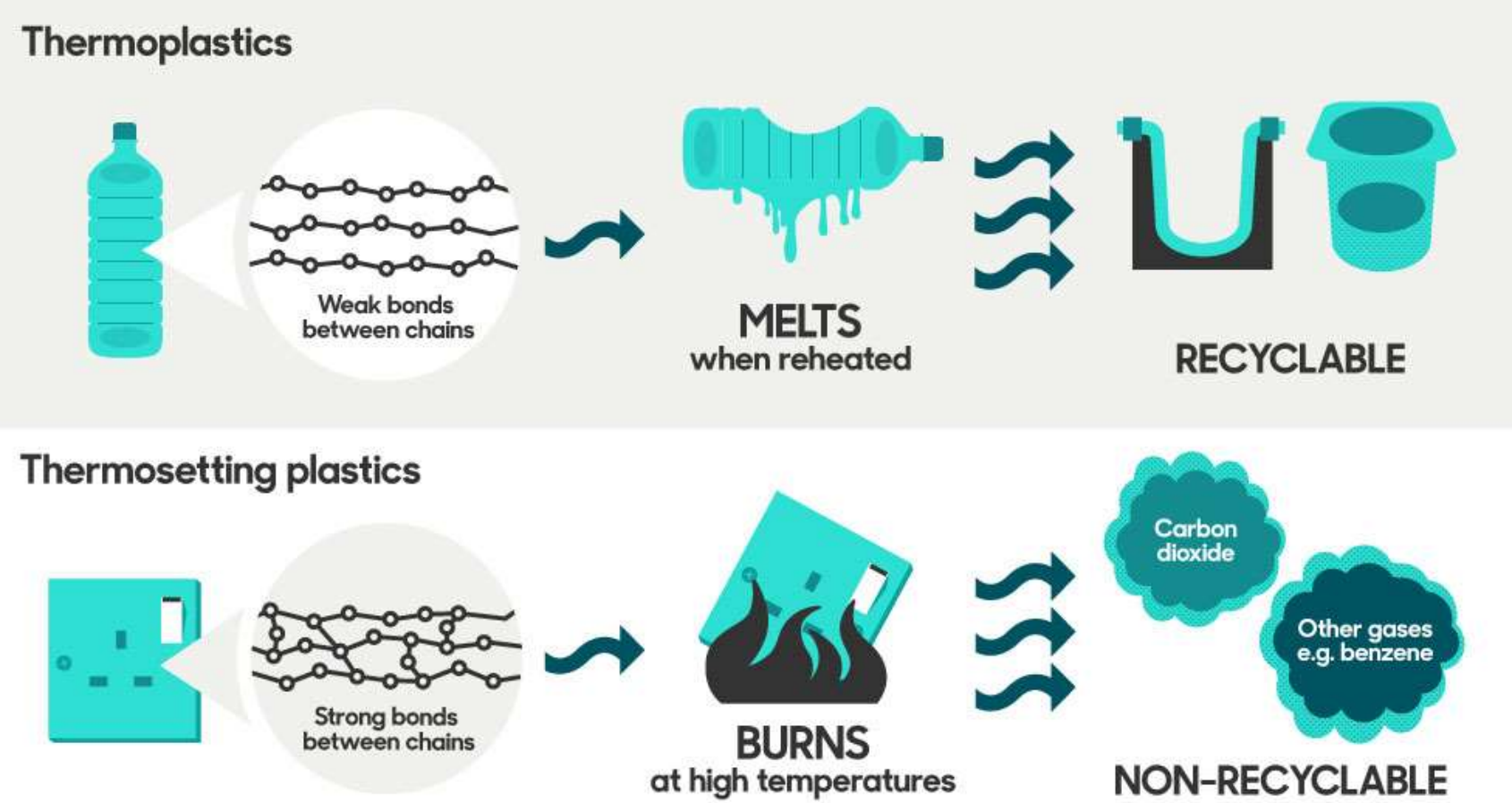

Thermoplastics
Weak bonds between chains
MELTS when reheated
RECYCLABLE
Thermosetting plastics
Strong bonds between chains
BURNS at high temperatures
Carbon dioxide
Other gases e.g. benzene
NON-RECYCLABLE

Thermoplast Plastic

- Thermo- plast granules or resins are molded under high temperature and pressure.
- After cooling the mold is opened and plastic is formed.
- Thermoplastics have long, linear polymer chains that are only weakly chemically bonded, or connected, to each other.
- When a thermoplastic object is heated, these bonds are easily broken, explaining why they can readily be remolded and reshaped into other products

Thermosets

- Thermosets are formed by curing linear polymers ,which involves high pressure ,temperature and catalyst .
- Thermosets are hard to recycle, but today there are methods of crushing the objects into a fine powder form for use as fillers in reinforced thermosets.
- In thermosets , the linear chains are crosslinked - strongly chemically bonded.
- This prevents a thermoset plastic object from being melted and reformed.

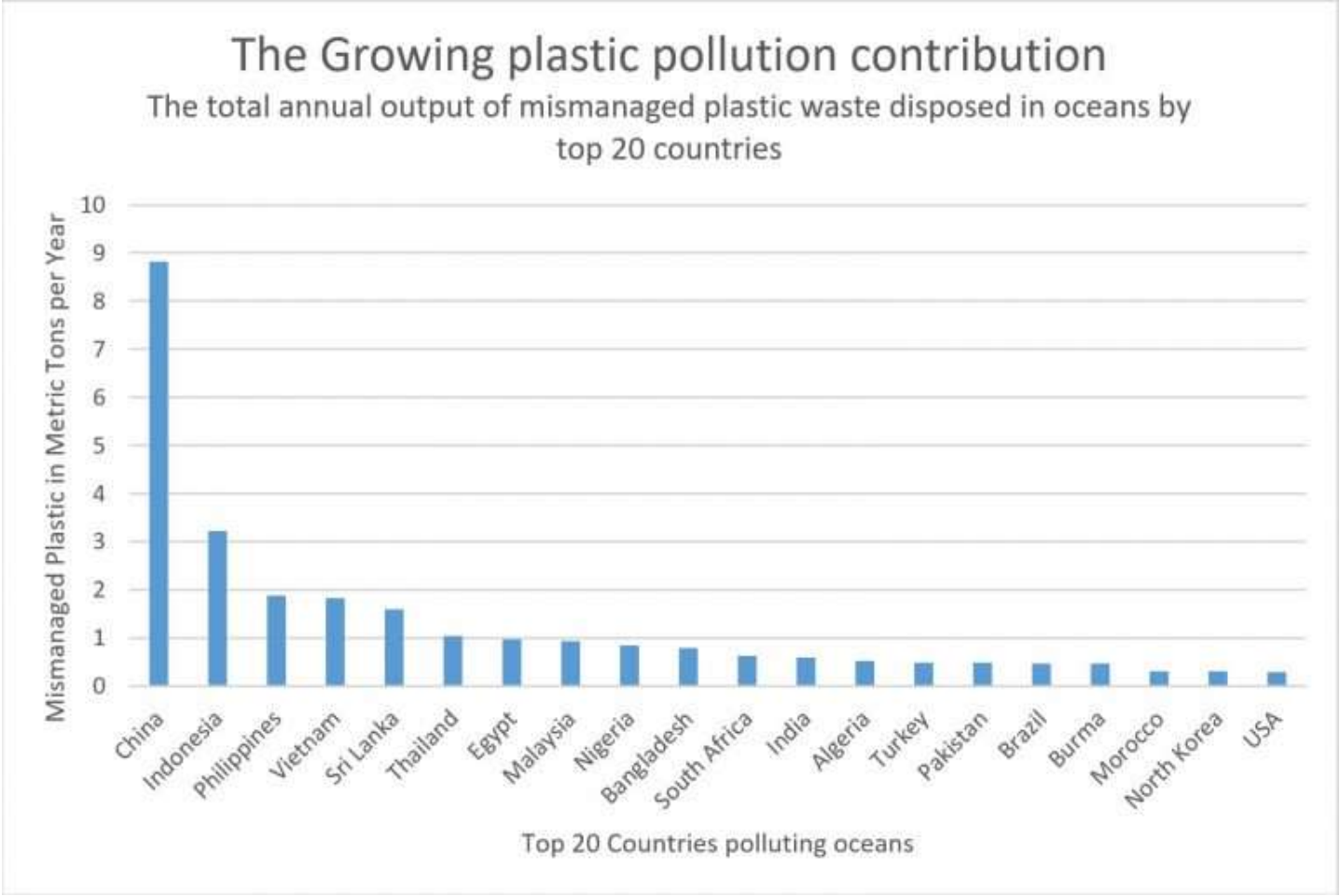
Bioplastics

- **Bioplastics** are plastics derived from renewable biomass sources, such as vegetable fats and oils, corn starch, or microbiota.
- **Bioplastic** can be made from agricultural by-products and also from used plastic bottles and other containers using microorganisms.
- Bioplastics are biodegradable and microorganisms can break it into CO2 and H2O.

Plastic Pollution.... few facts

- 8.3 b tons of plastics has been produced …..Dr Roland Geyer, and team in 2015.
- 6.3bn tons is now waste
- 79% of that is in landfill or the natural environment.
- 9.1m tons in 2015 ends up in sea .
- Seven of the EU Member States plus Norway and Switzerland recover more than 80% of their used plastics.
- These countries adopt an integrated waste and resource management strategy to address each waste stream with the best options.
- India generates 25000 t/d of plastic waste ,atleast 10000 t/d is non recycled .
- Single use plastics should necessarily be bio plasts.

Ocean polluting countries



Marine Pollution

- 95 percent of plastic polluting the world's oceans comes from just 10 rivers …..Dr Christian Schmidt
- Yangtze - East China Sea, Asia
  Indus - Arabian Sea, Asia
  Yellow - Yellow Sea, Asia
  Hai He - Yellow Sea, Asia
  Nile - Mediterranean Sea, Africa
  Ganges - Bay of Bengal, Asia
  Pearl - South China Sea, Asia
  Amur - Sea of Okhotsk, Asia
  Niger - Gulf of Guinea, Africa
  Mekong - South China Sea, Asia

Plastic Pollution

- Deaths of Over a million seabirds every year,
  Over 100,000 marine mammals

Earth Day 2018 ……End Plastic Pollution

THANK YOU

Summarising

- Fossil fuel will continue to be the dominant fuel in the world ,
- Contrary to what was predicted we shall reach peak demand and not peak oil .
- Amongst fossil fuel ,Coal will be dominant fuel in the coming decades in India.
- Plastics are synthetically generated through polymerisation of mainly ethylene derived from cracking lighter fractions and naptha.

cond

- Thermoplastics can be reshaped and remolded and recycled while thermosets gets charred when heated .
- Bio plasts could be a substitute for the single use plastics .
- Recycling of plastics is far too less and today plastic waste is threatening food chain and marine life .
- Integrated waste management like in EU is the need of the time

Recyclable home plastics

Number 1 • *PETE or PET (polyethylene terephthalate)*

IS USED IN . . . . . microwavable food trays; salad dressing, soft drink, water, and beer bottles

STATUS . . . . . hard to clean; absorbs bacteria and flavors; avoid reusing

IS RECYCLED TO MAKE . . carpet, furniture, new containers, Polar fleece

Number 2 • *HDPE (high-density polyethylene)*

IS USED IN . . . . . household cleaner and shampoo bottles, milk jugs, yogurt tubs

STATUS . . . . . transmits no known chemicals into food

IS RECYCLED TO MAKE . . detergent bottles, fencing, floor tiles, pens

Number 3 • *V or PVC (vinyl)*

IS USED IN . . . . . cooking oil bottles, clear food packaging, mouthwash bottles

STATUS . . . . . is believed to contain phalates that interfere with hormonal development; avoid

IS RECYCLED TO MAKE . . cables, mudflaps, paneling, roadway gutters

Recyclable home plastics

Number 4 • *LDPE (low-density polyethylene)*

IS USED IN . . . . . bread and shopping bags, carpet, clothing, furniture
STATUS . . . . . transmits no known chemicals into food
IS RECYCLED TO MAKE . . envelopes, floor tiles, lumber, trash-can liners

Number 5 • *PP (polypropylene)*

IS USED IN . . . . . ketchup bottles, medicine and syrup bottles, drinking straws
STATUS . . . . . transmits no known chemicals into food
IS RECYCLED TO MAKE . . battery cables, brooms, ice scrapers, rakes

Number 6 • *PS (polystyrene)*

IS USED IN . . . . . disposable cups and plates, egg cartons, take-out containers
STATUS . . . . . is believed to leach styrene, a possible human carcinogen, into food; avoid
IS RECYCLED TO MAKE . . foam packaging, insulation, light switchplates, rulers

Number 7 • *Other (miscellaneous)*

IS USED IN . . . . . 3- and 5-gallon water jugs, nylon, some food containers
STATUS . . . . . contains bisphenol A, which has been linked to heart disease and obesity; avoid
IS RECYCLED TO MAKE . . custom-made products

Petrol (Delhi) vs Brent