CHAPTER 1: Introduction

Abbreviations

RE: Renewable Energy

RES: Renewable Energy Sources

Textbook published in 2015

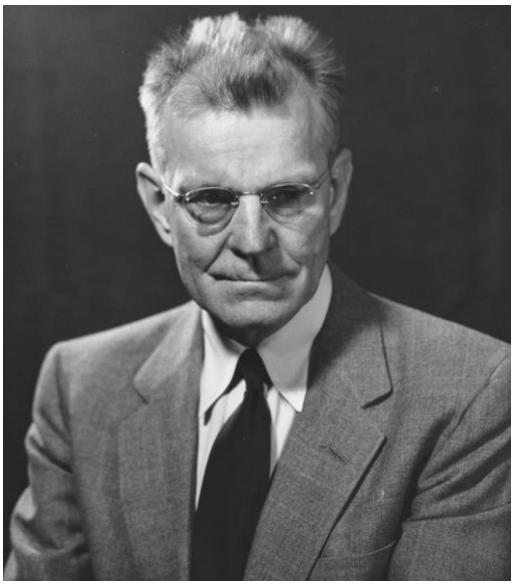
Case studies of the following countries

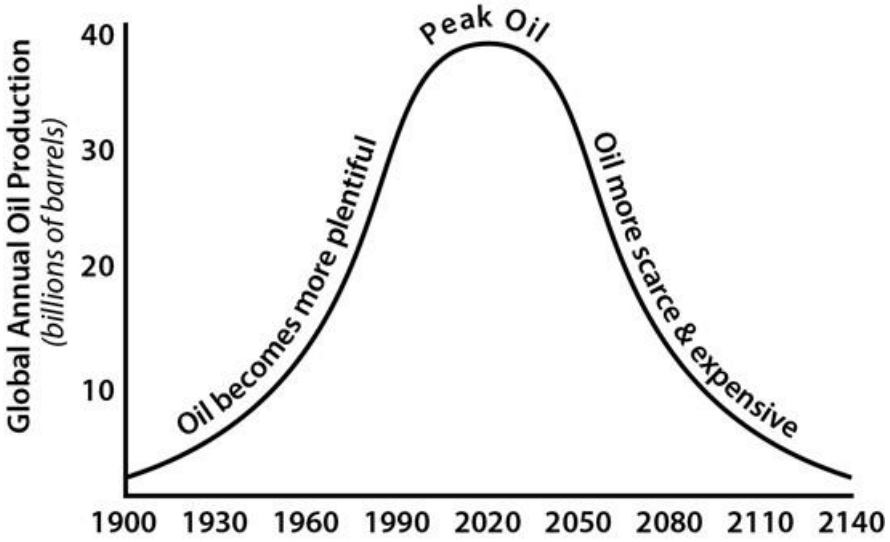
1. Japan
2. China
3. US
4. Germany
5. Denmark
6. Norway

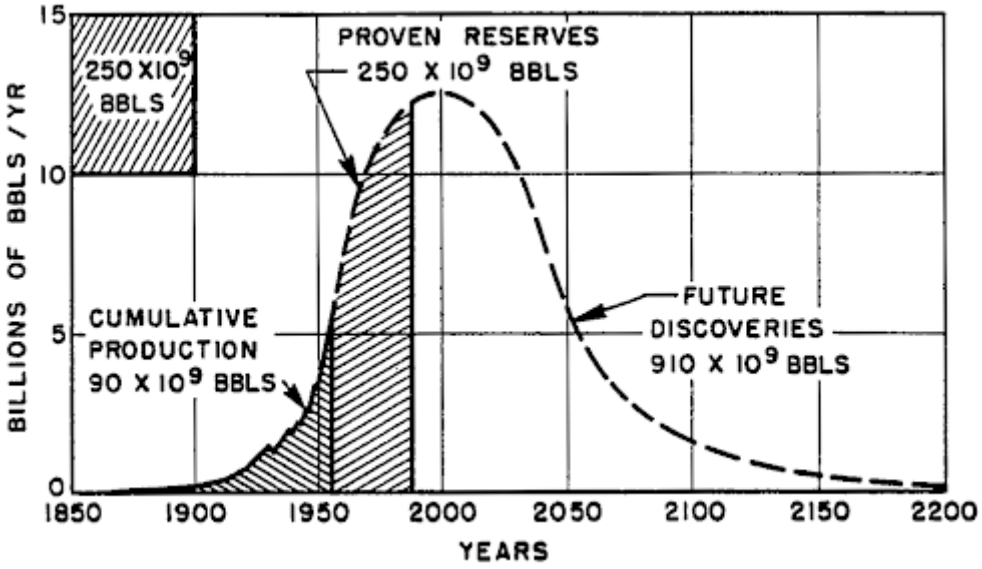
Environmental and energy issues now attract serious attention from very powerful political and industrial actors

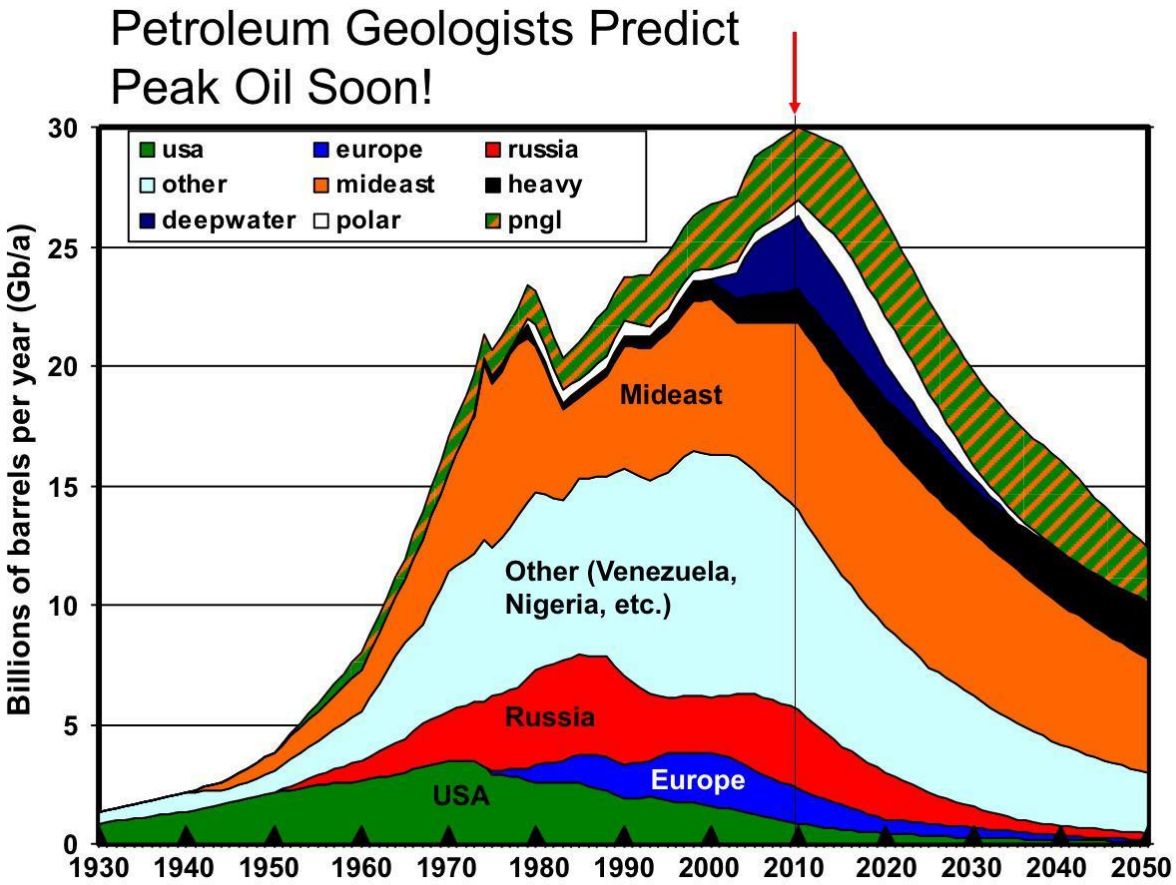
Peak oil

M. King Hubbert: geologist and geophysicist (1903−1989)









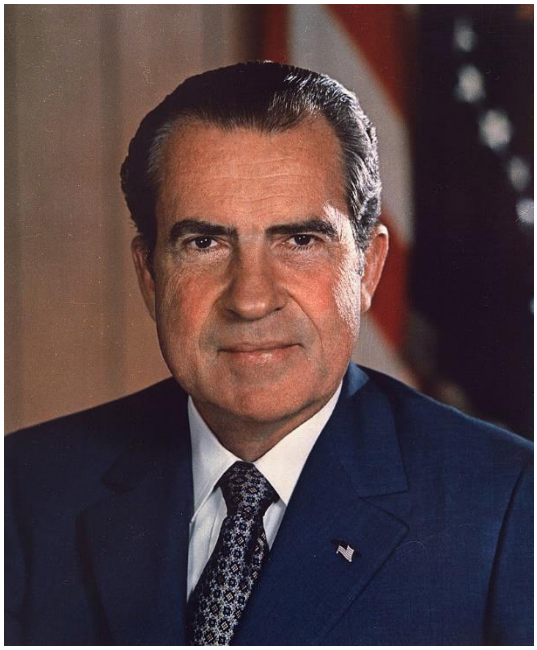
Important issues

Climate change

RE policy

Japan and Germany have gone a long way towards ending their dependence on nuclear power

Every US president since Richard (Milhous) Nixon (1913−1994) has concerned himself with energy security



"Richard Nixon was elected the 37th President of the United States (1969-1974) after previously serving as a U.S. Representative and a U.S. Senator from California. After successfully ending American fighting in Vietnam and improving international relations with the U.S.S.R. and China, he became the only President to ever resign the office, as a result of the Watergate scandal." (https://www.whitehouse.gov/about-the-white-house/presidents/richard-m-nixon/)

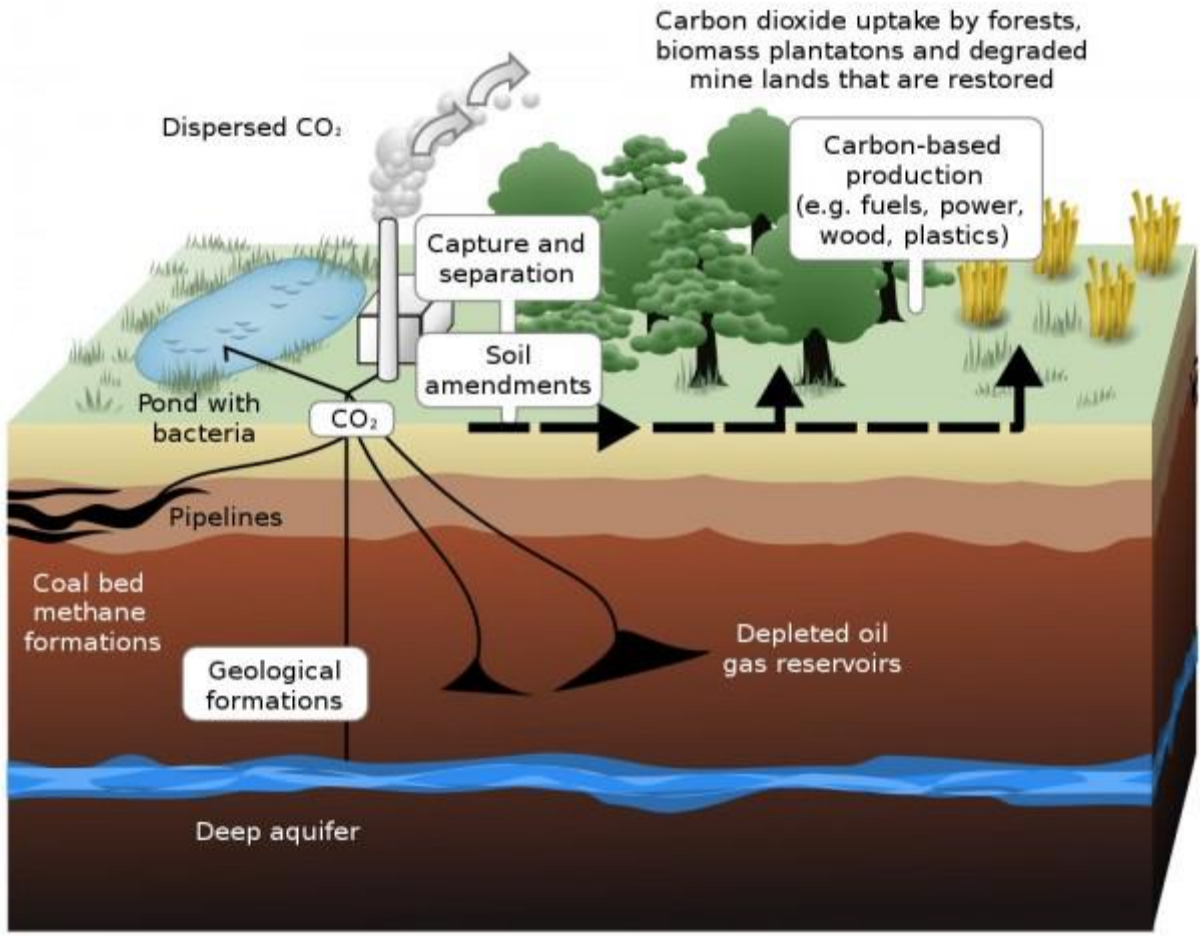
"His presidency is known for a start for diplomacy with China, a slow ending of the Vietnam War, domestic acts (such as OSHA and Environmental Protection) and an era of peace with the Soviet Union (communist Russia)" (https://simple.wikipedia.org/wiki/Richard_Nixon)

President Barack Obama urged the US to make serious investments in clean energy…

…rather than surrendering future clean jobs to Germany and China

Denmark plans to be fossil free by 2050

Norway touts its Carbon Capture Storage (CCS) technology



Even lofty plans and rhetoric provide a suggestion as to

which way the wind blows

what stirs the public imagination

Energy issues are at the forefront of the political discourse

RE accounts for a small part of global final energy consumption and global electricity production

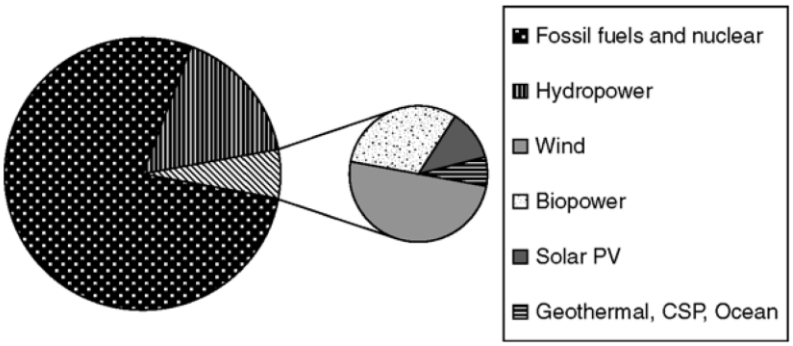
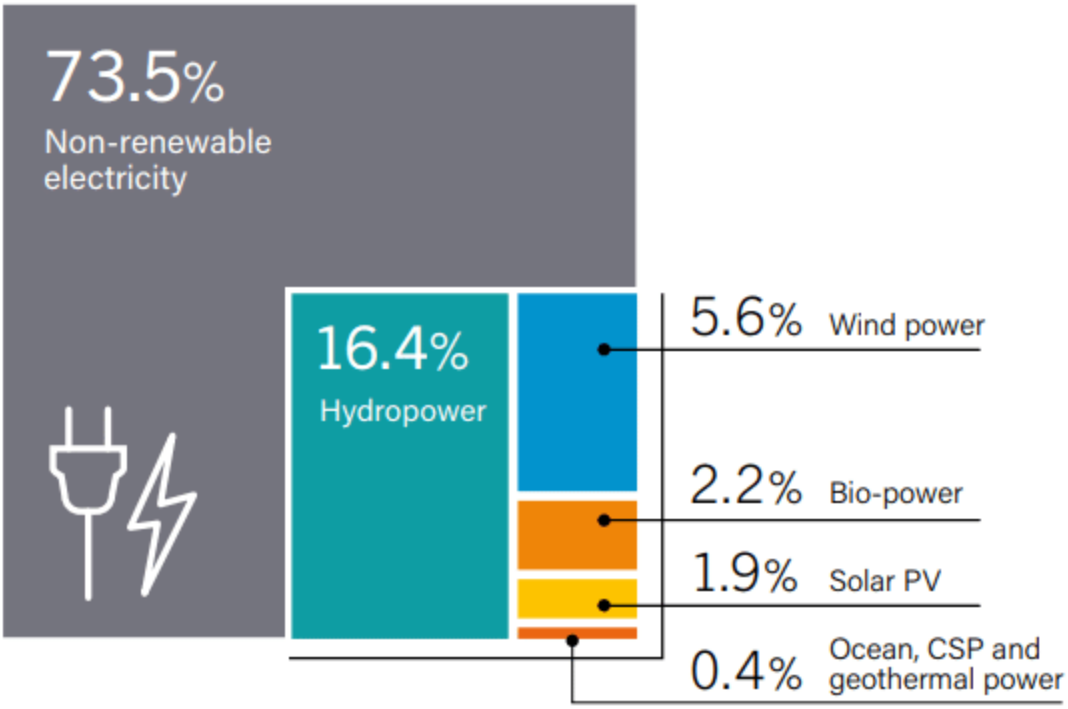


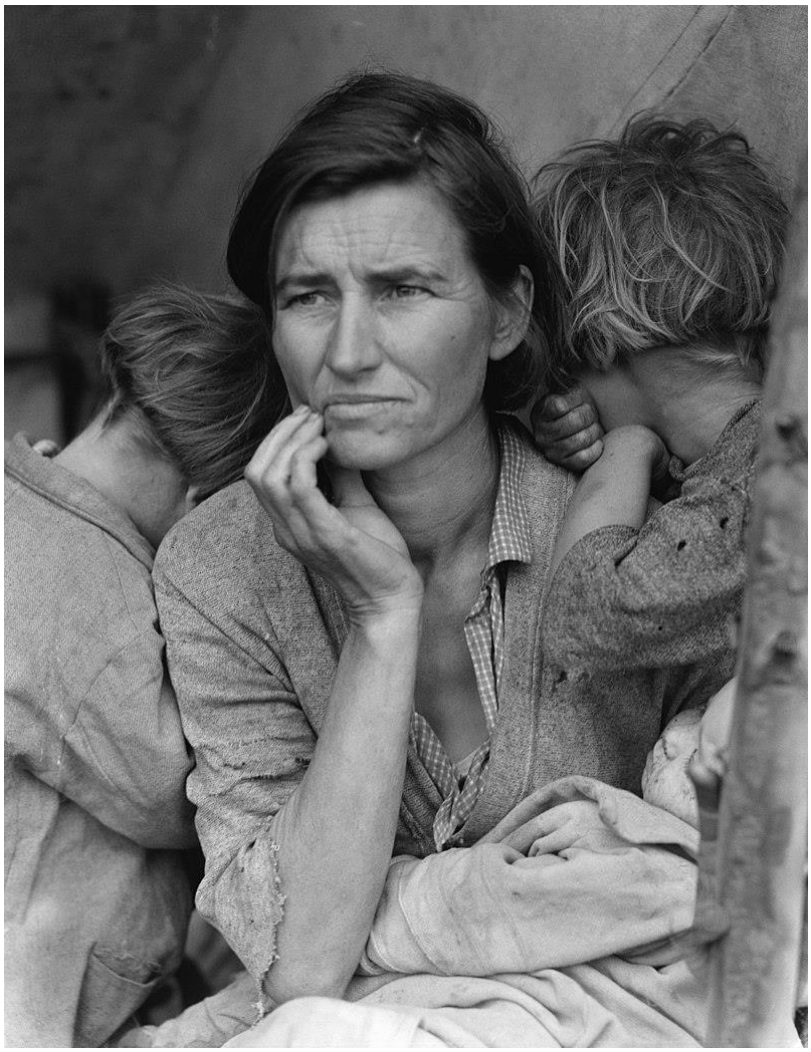
Figure 1.1 Renewable share of electricity production, 2013
Source: REN21 (2014).



Fossil fuels provide a fairly steady three quarters of our energy

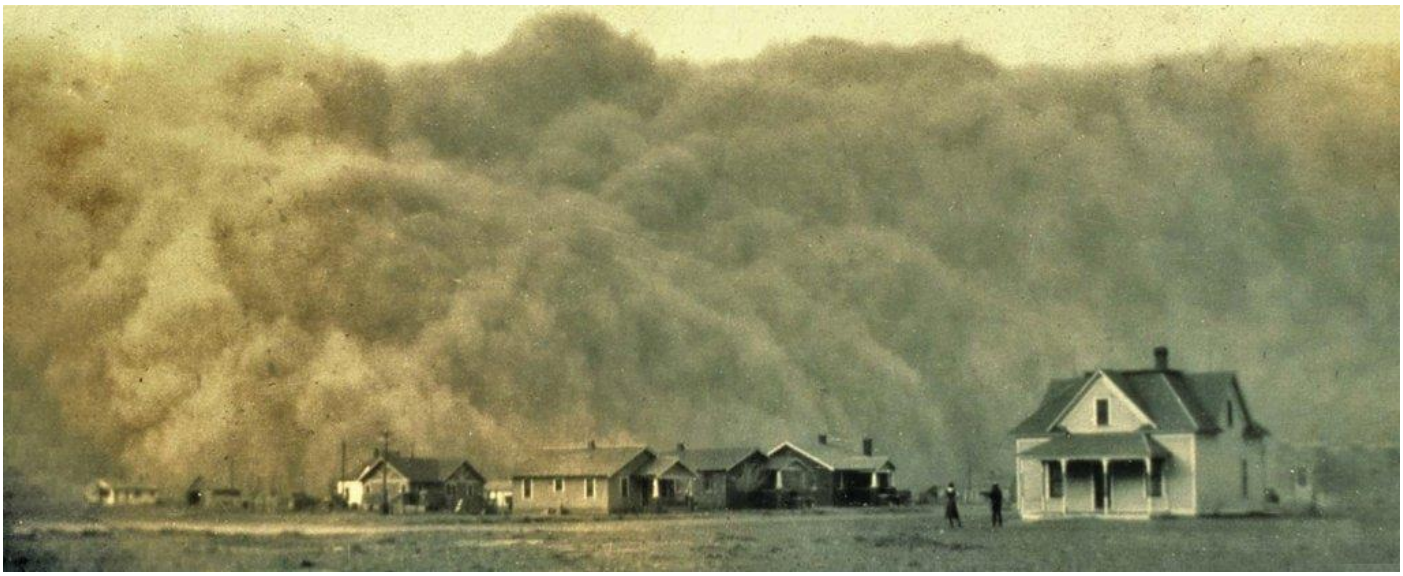
Since 2008 we are in the midst of a financial crisis (recession) which is the biggest economic crisis since the world has faced since 1929 (https://en.wikipedia.org/wiki/Great_Depression)

"… in most countries, it started in 1929 and lasted until the late 1930s."



“Dorothea Lange's Migrant Mother depicts destitute pea pickers in California, centering on Florence Owens Thompson, age 32, a mother of seven children, in Nipomo, California, March 1936” (https://en.wikipedia.org/wiki/Great_Depression#/media/File:Lange-MigrantMother02.jpg)

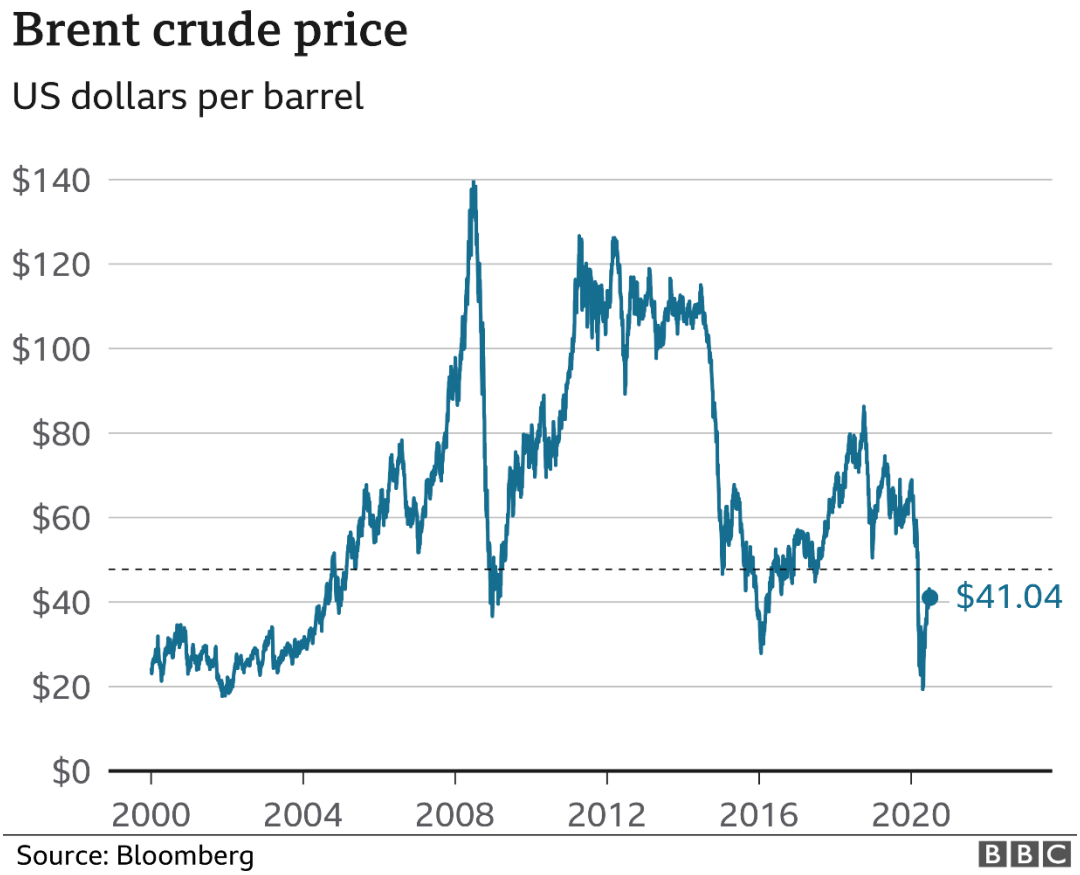
“The Dust Bowl was the name given to the drought-stricken Southern Plains region of the United States, which suffered severe dust storms during a dry period in the 1930s. As high winds and choking dust swept the region from Texas to Nebraska, people and livestock were killed and crops failed across the entire region. The Dust Bowl intensified the crushing economic impacts of the Great Depression and drove many farming families on a desperate migration in search of work and better living conditions.” (https://www.history.com/topics/great-depression/dust-bowl)



Particularly protracted in Europe

We have been slowly adjusting to a world where oil is far costlier than a decade ago

Eventually prices will start rising again



The oil price contributes to the financial crisis

High energy prices are bad for the entire economy

The real energy crisis is more of a drawn-out thing

Peak oil has been a concern for decades

Today's fossil fuel regime cannot last for ever

RE

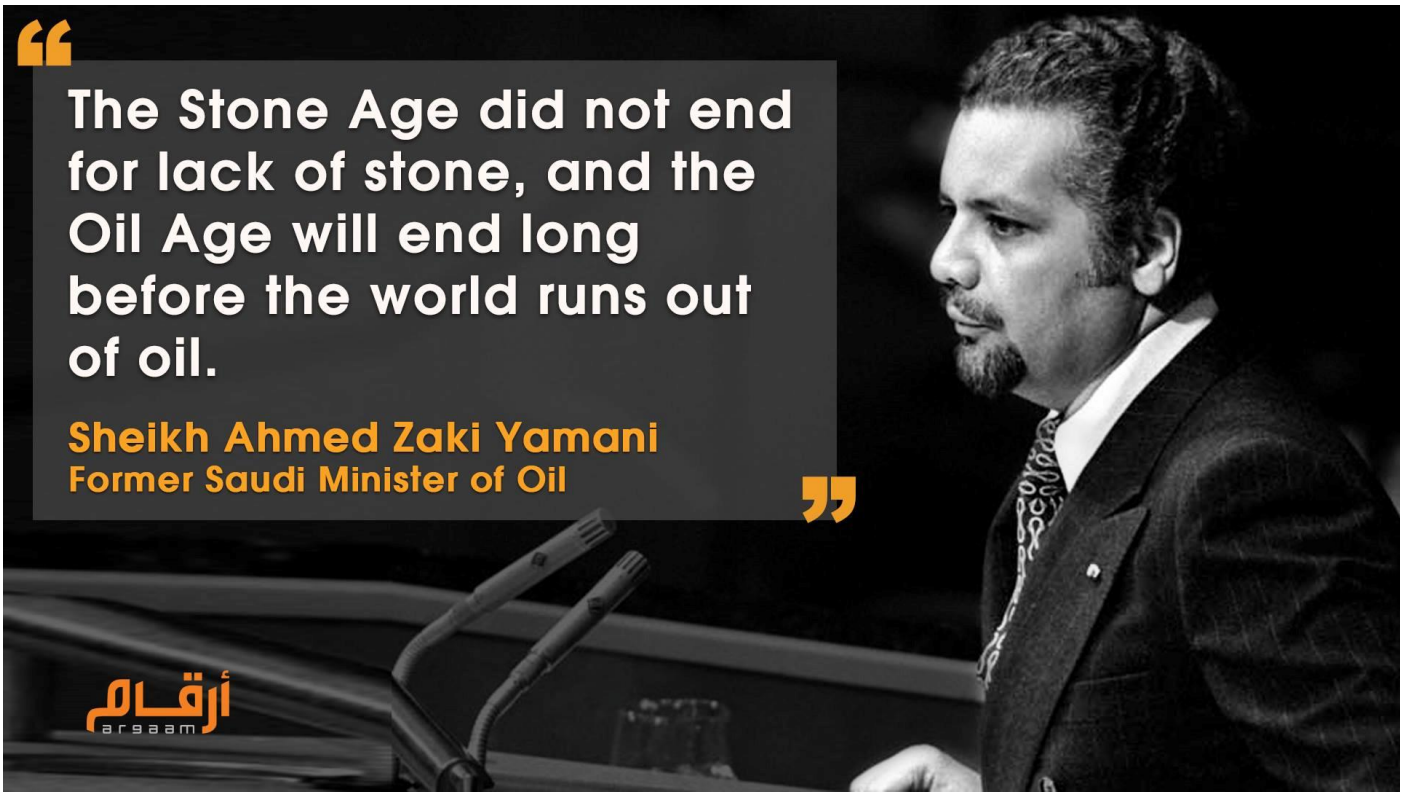
is not the answer to all our worries

could provide us with

more energy

relatively emissions-free energy

new growth industries



Sheik Ahmed Zaki Yamani was born in 1930, and is 90 years old (October 2020)

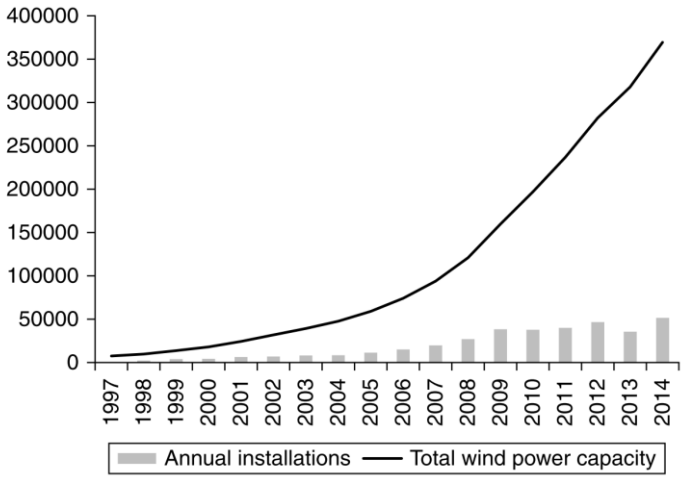


Figure 1.2 Total and annual installed wind power capacity, 1997–2014 (MW)
Sources: GWEC (2015); REN21 (2014).

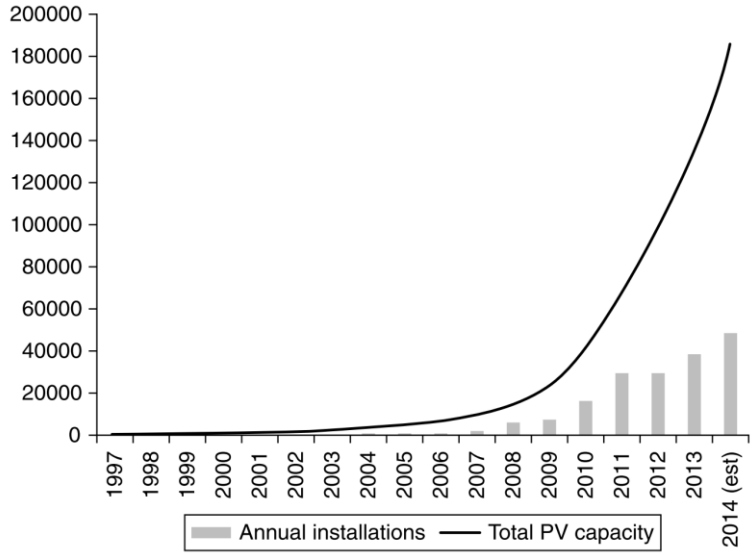


Figure 1.3 Total and annual installed solar PV capacity, 1997–2014 (MW)
Sources: REN21 (2014); *SolarServer* (2015).

Here is what the book argues is untrue:

> If renewable technologies were competitive, the market mechanism would guarantee that RE would be fed into the system in quantities that would guarantee an energy transition

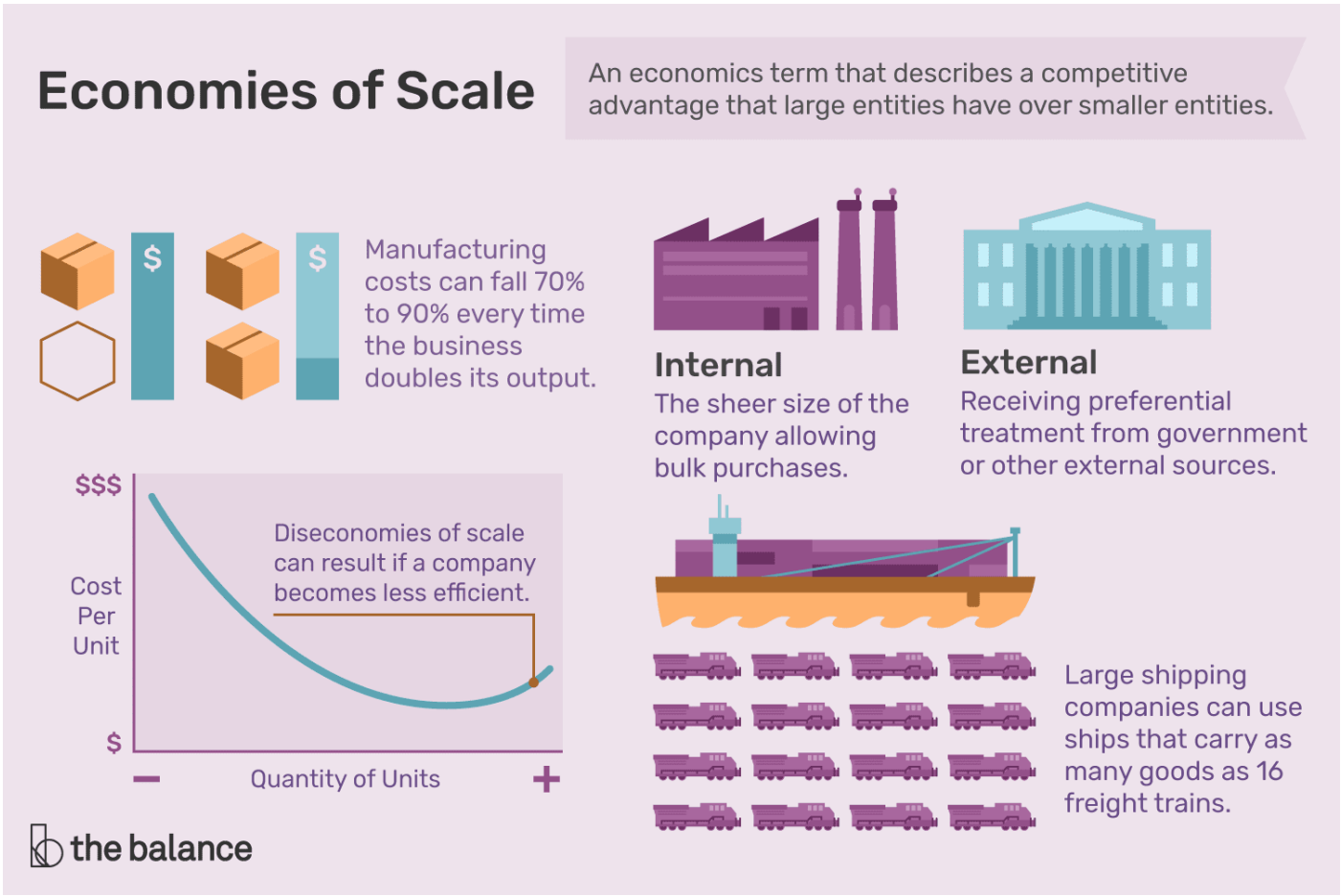
In most countries, the institutional setup often contains a heavy bias in the direction of fossil fuels

There is no guarantee that the energy problem will take care of itself, as Sheikh Yamani suggested

> We may be facing a geopolitical race for the remaining fossil fuel resources

Fossil fuel industries have had far longer to

> develop mature technologies
>
> realize economies of scale



Carbon taxes go some way toward putting a price on externalities

- resulting from Greenhouse gas (GHS) emissions

Ultimately, carbon taxes are

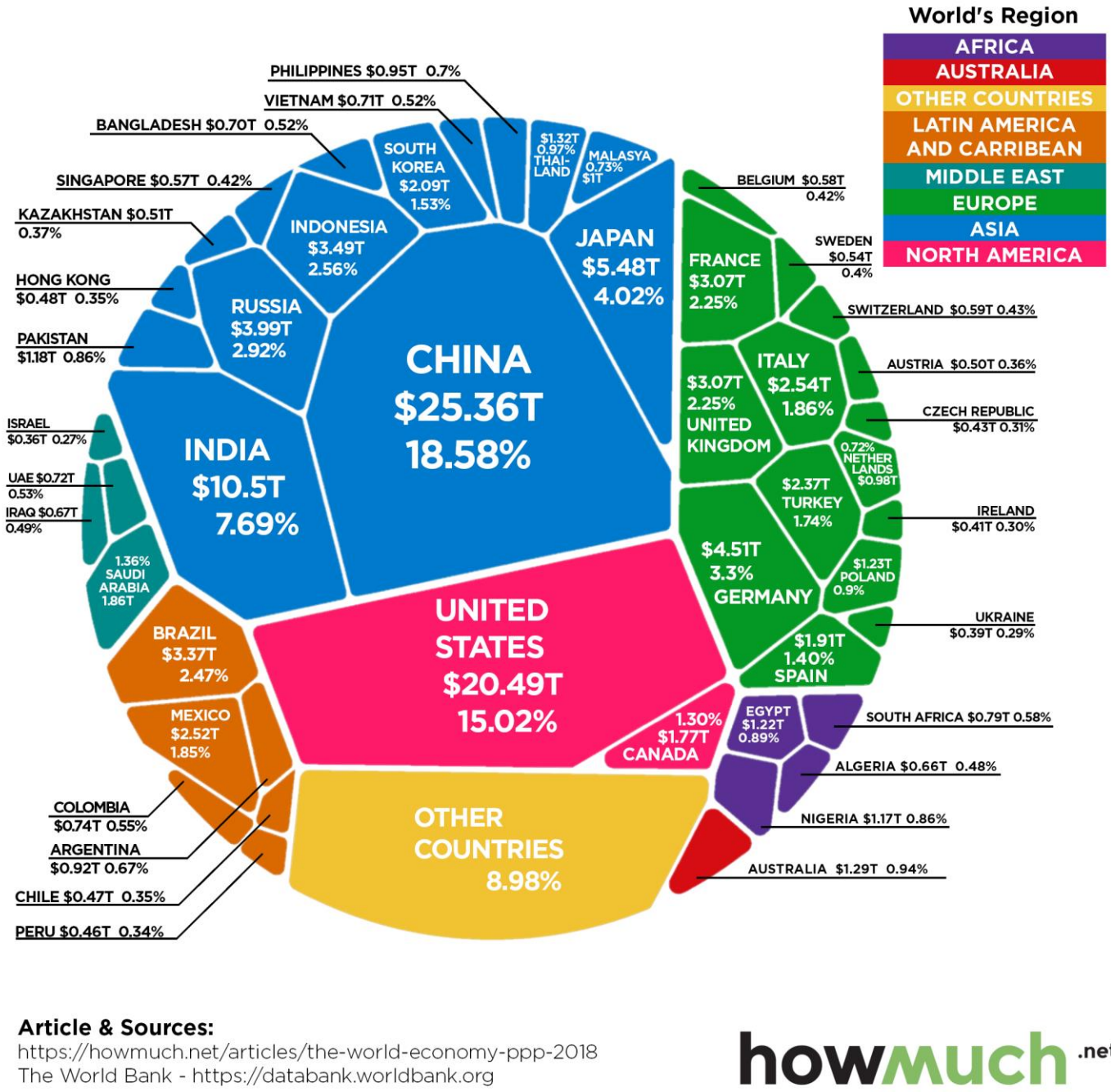
- politically determined
- subject to myriad concerns

If one country sets high carbon taxes …

- … energy intensive companies will flee abroad

High energy and electricity prices are bad for the

- competitiveness of the industry
- purchasing power of common people
  - GDP in Purchasing Power Parities (PPP)



Thus, raising carbon taxes comes at an industrial, economic and political cost

- Politicians are loath to bear it
  - Doing the right thing for the long-haul is a bad political strategy if it costs you the next election

There is no global carbon tax

RE

- has had far less time than fossil fuels to mature its technologies
- Old and trusted industries have had more time to realize economies of scale (as mentioned previously)

Political bias is more subtle, but it is there

Institutional theory tells us that institutions

create stability

are the rule(rs) of the game

lead to path-dependencies

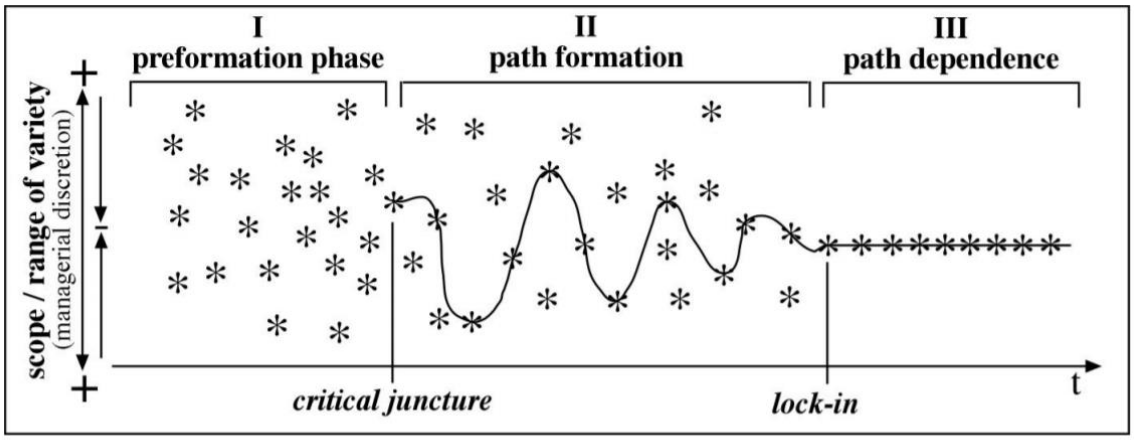


Figure 1: Constitution of a technological or institutional path – The classical model

act as bulwarks against radical change

New and upcoming industries frequently have different needs than established ones, in terms of

knowledge

education

capital

linkages between academia, industry and government

linkages to the political establishment

patenting systems

Robert Gilpin (1930–2018):

> *"Robert Gilpin was a scholar of international political economy and the professor emeritus of Politics and International Affairs at the Woodrow Wilson School of Public and International Affairs at Princeton University. He held the Eisenhower professorship. Gilpin specialized in political economy and international relations, especially the effect of multinational corporations on state autonomy."* (https://en.wikipedia.org/wiki/Robert_Gilpin)

> ...a society can become locked into economic practices and institutions that in the past were congruent with successful innovation but which are no longer congruent in the changed circumstances. Powerful vested interests resist change, and it is very difficult to convince a society that what has worked so well in the past may not work in an unknown future. Thus, a national system of political economy that was most 'fit' and efficient in one era of technology and market demand is very likely to be 'unfit' in a succeeding age of new technologies and new demands. (1996, p.413)

Gilpin, R. (1996) 'Economic Evolution of National Systems', *International Studies Quarterly*, 40(3), 411–31.

If the institutional system favors old and established over new and promising but ultimately vulnerable RE actors …

… this is something that the markets will not pick up on

Markets do not automatically allocate enough resources to RE

The naïve take on renewable energy:

The problem with RE is a technological challenge

It will be solved by natural scientists and engineers

Technological progress will run its course

Our textbook is a book on the political economy of RE

Yes, there is a heavy technological component

Yes, RE still have a lot of maturing left

But politics and economics are crucial to understanding RE

There are economic and political constraints affecting the prospects of RE

Understanding energy policy is impossible without understanding the linkages among

the technological

the economic

and the political

Economic problems

RE is too expensive

Political constraints

They are the hardest to penetrate

Politics regularly operates according to a different logic

Actors involved

stakeholders

vested interests

institutions and institutional biases

path dependencies

inherited organizational and institutional cultures

quirks that are country specific

Renewables or bust

The world's proven oil reserves have kept on increasing …

… especially if we take unconventional sources into account

The world is not running out of oil

It is a matter of how eagerly we

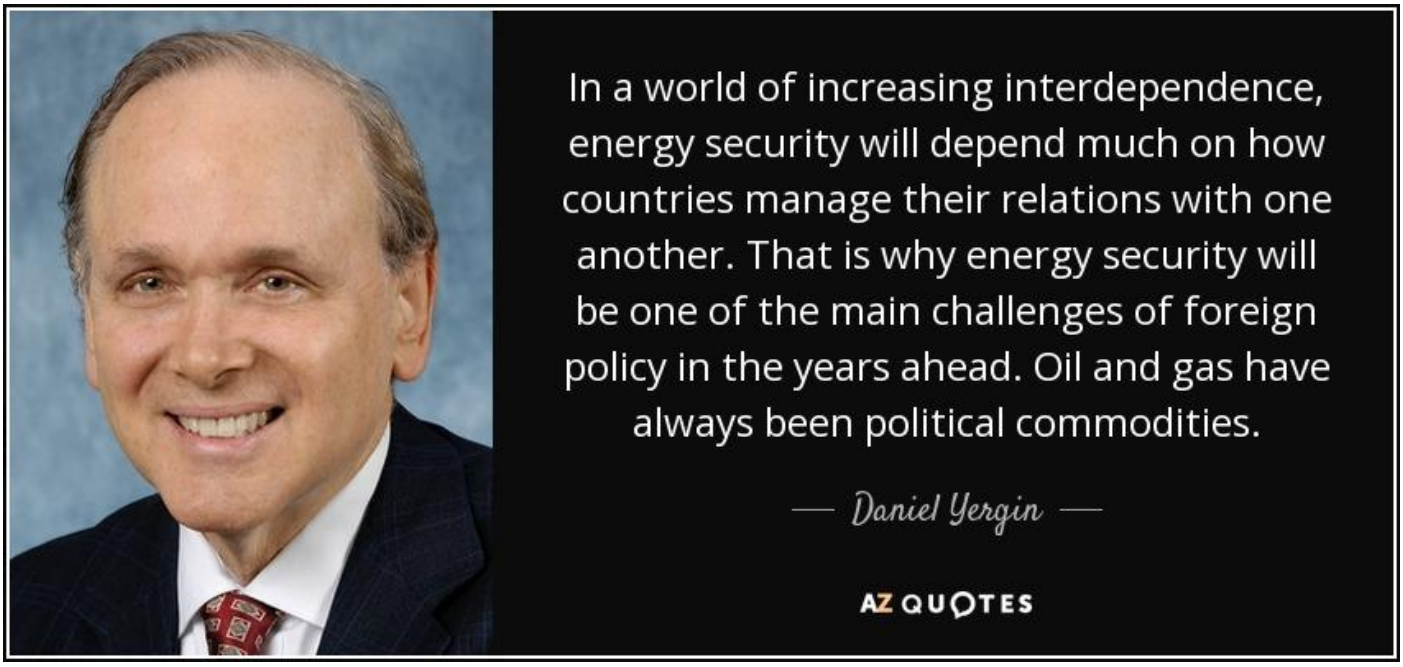
pursue the remaining resources

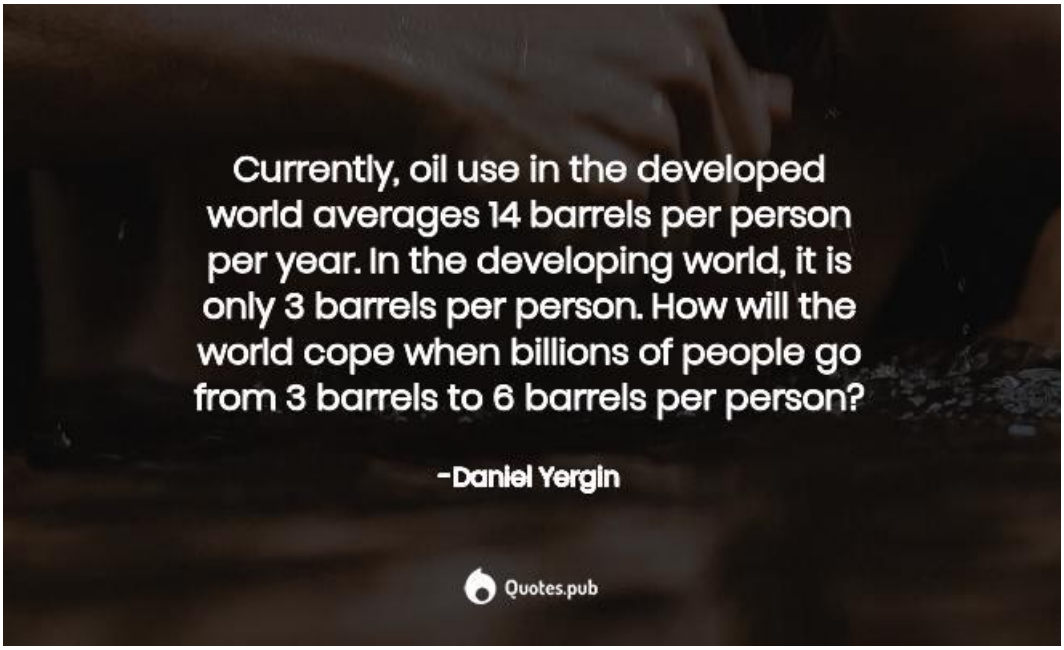
open up new areas for exploration

New technologies can help us extract a higher percentage of petroleum from existing wells

Daniel Yergin

The world is still awash in oil





Bill Gates and Daniel Yergin (3 minutes)

An energy briefing with Daniel Yergin: Market dynamics & natural gas (https://youtuf.be/bZtcL_A6CaM)

On one of his two famous books

Daniel Yergin: The Quest (https://youtu.be/pZCuQy6-dJY)

(bad quality, but definitely worth watching)

Although it is technically true that we are awash in oil …

… the days of *"easy oil"* are gone

Over the next 25 years, easy oil fields will lose 75% of their productive capacity

The present consensus

times peak oil to occur between 2010 and 2030

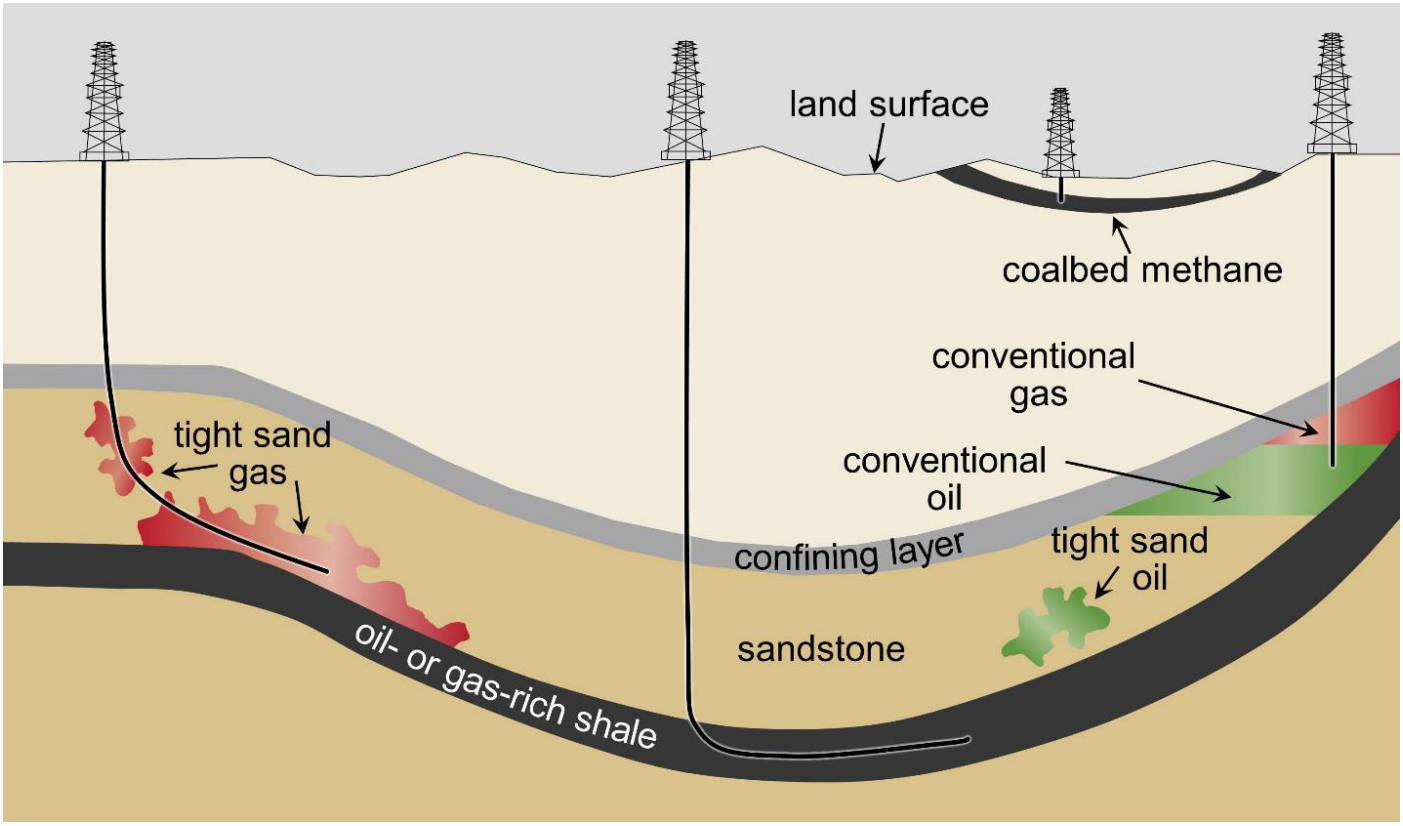
with oil production declining after 2050

Few new fields are discovered anymore

The size of those fields is significantly smaller

The breakthrough in fracking in the US had led to a potential revolution in shale gas and tight (or shale) oil

This could be a game-changer



This revolution has rendered RE less competitive

The US prefers natural gas over coal, so in 2012

it shipped surplus coal to Europe

Coal prices dropped by a third

Does the shale oil revolution

push any notion of peak oil into an indefinite future?

Or does it just breathe extra life into an already waning energy paradigm?

The US to become the world's largest oil producer

If it frees itself from the shackles of environmentalists

demonizing anything that smacks of carbon energy

The petroleum industry asserts that the US had the petroleum reserves of two Saudi Arabias

Keeping production at current levels requires ever more drilling at ever higher costs

Production at the wells typically drops off by

60-90% in the first year of production

80-90% during the first three years

The industry has a vested interest in perpetuating the image of shale as the way forward and as the wonder fuel of tomorrow

US petroleum and drilling interests have deliberately sought to urge US energy policy in the direction of shale

The industry has been losing money

- The top shale gas producers are taking heavy losses and have large debts
- The recent oil price fall is threatening the profitability of a number of tight oil producers

For shale to be a worldwide revolution, it would have to spread to other countries

- For Poland and Ukraine, reducing their dependence on Russia is their biggest concern
- Limited other prospects in Europe, most of the EU countries are reluctant
- The European public opinion prefers RE over shale
- The EU Commission has noted how shale gas causes higher GHG emissions than conventional natural gas

Chinese coal seams are deeper and less assessable than US seams

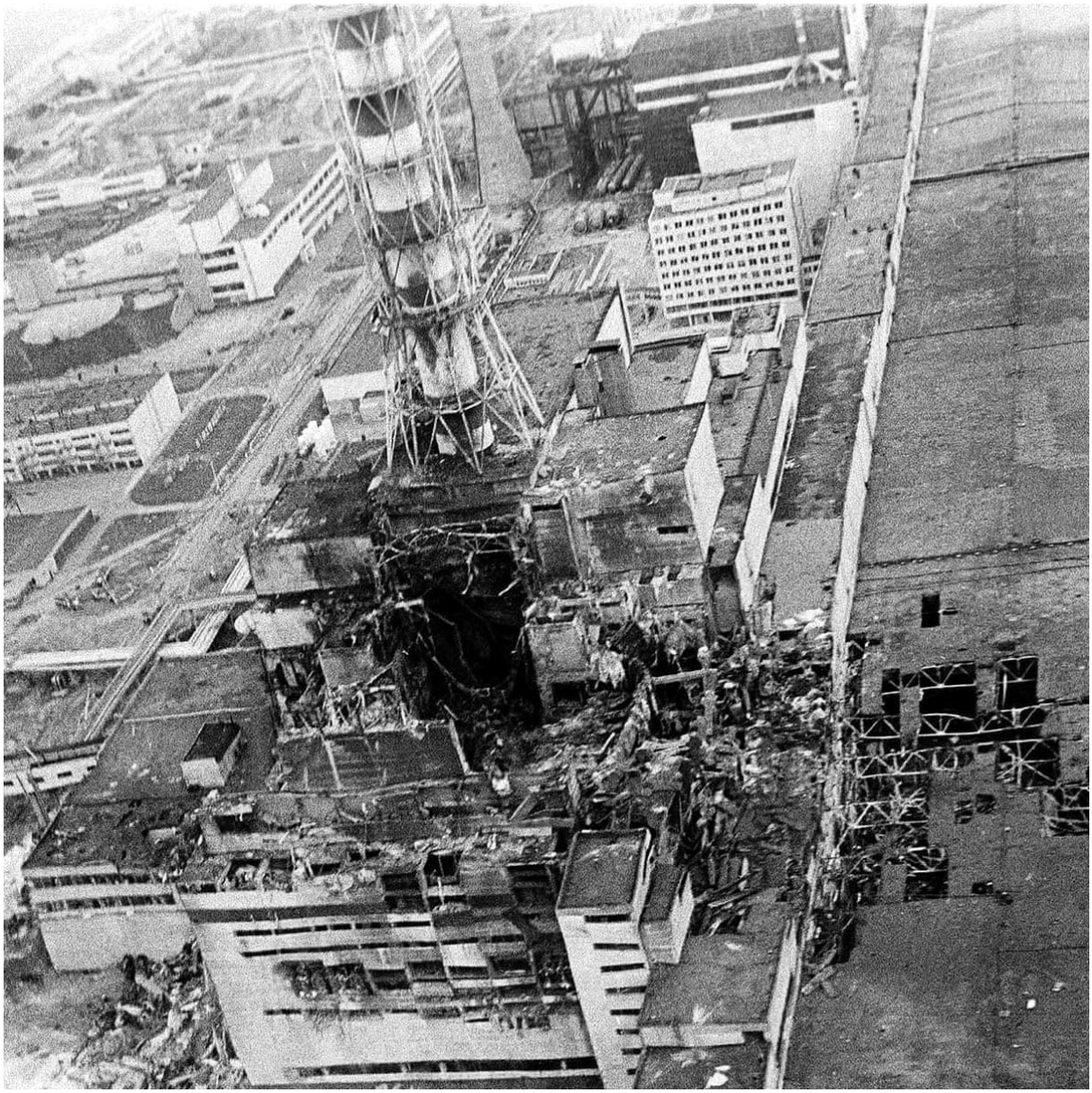
Fracking requires large amounts of water

- Far scarcer commodity in China

Nuclear power is another X-Factor

It has never provided more than 5% of the world's total energy supply

It has dwindled in popularity since Chernobyl



Fukushima led the Germany into giving up nuclear power overnight

But nuclear energy will stay with us for reasons related to

energy

and climate

Fukushima has shown us how much more difficult combating global warming would be if it coincided with a nuclear energy phase-out

The International Energy Agency (https://www.iea.org) expects nuclear energy to

maintain its share of electricity production (around 12%)

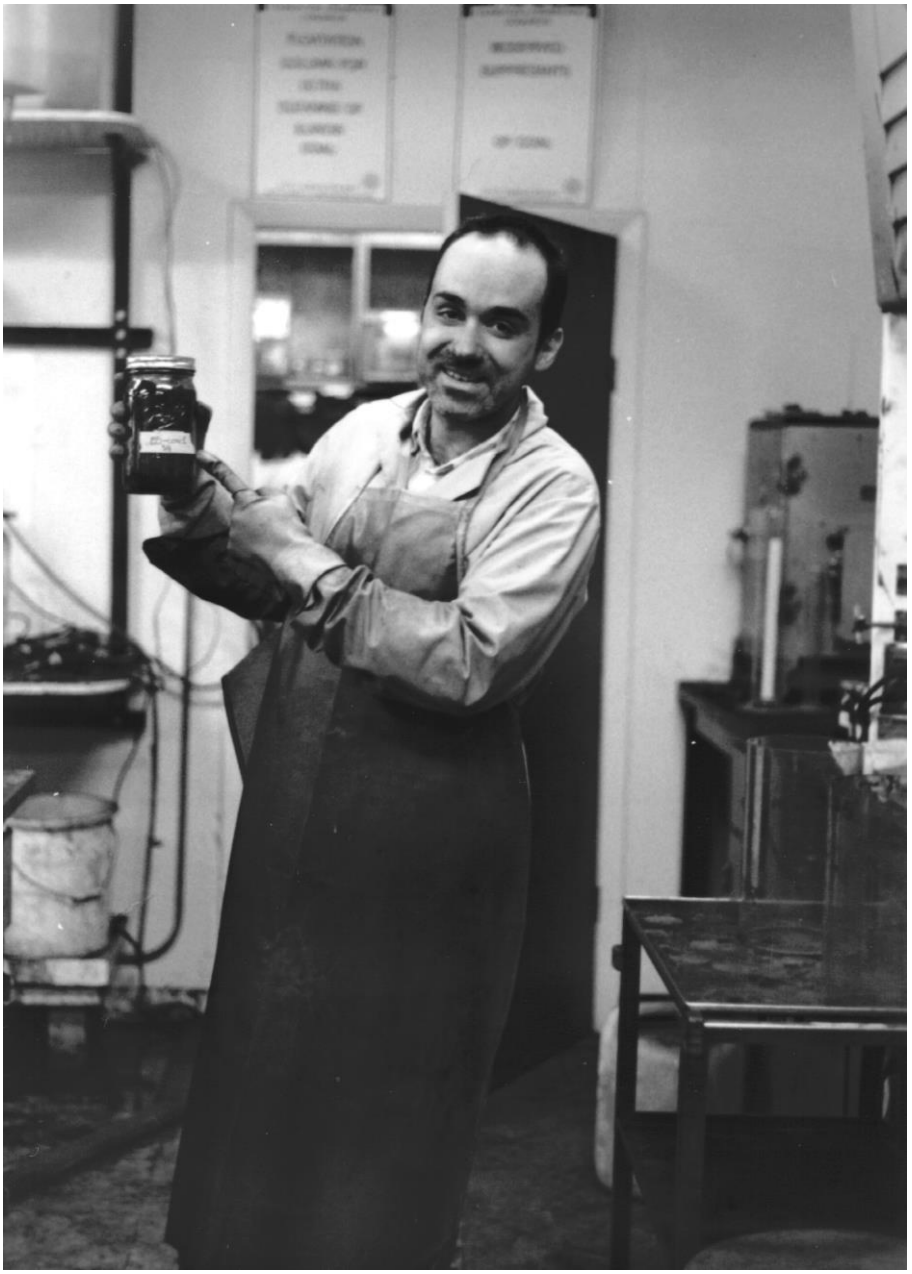
not go beyond that

If nuclear energy started to expand at a rate that would actually make a difference to the world's energy supply …

… our deposits of uranium would not last longer than those of petroleum

The fossil fuel industry is not prepared to give in

The coal industry is among the most powerful vested interest in the US



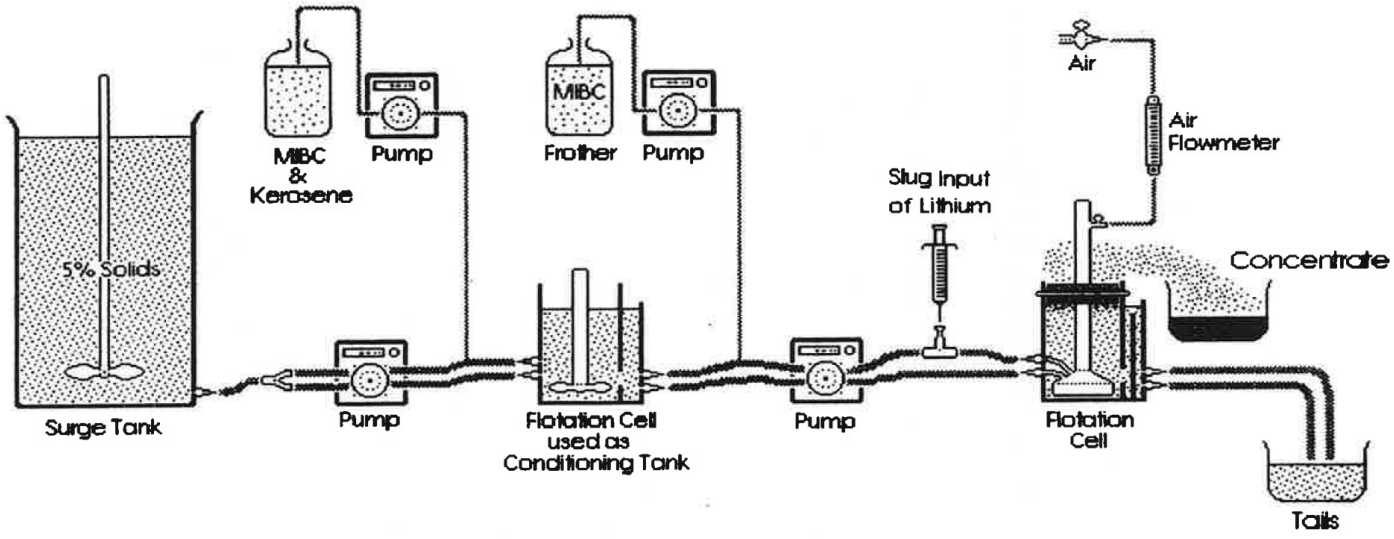


Figure 5.65. Layout of residence time distribution experiments.

Conventional oil and gas will hardly be able to expand much further

Shale gas and tight oil may pick up some of the slack

The potential from Arctic oil and deep-sea drilling is hard to estimate

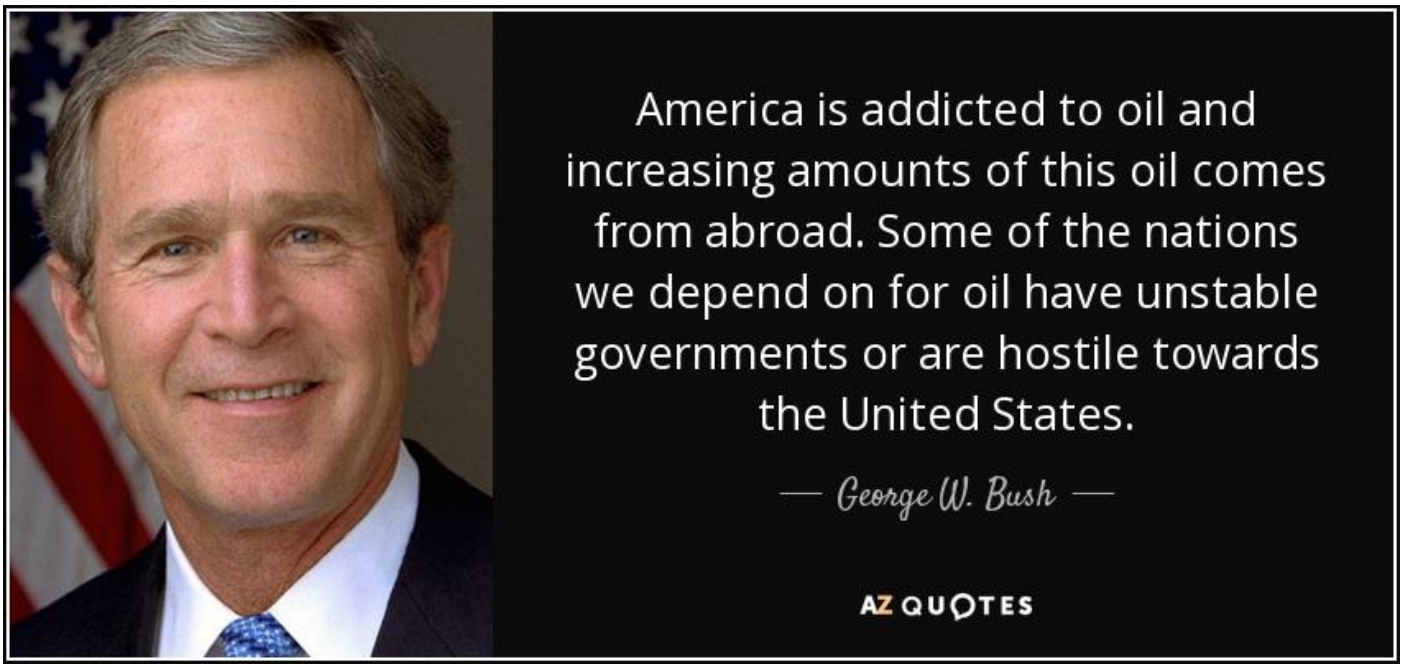
They will be costly no matter

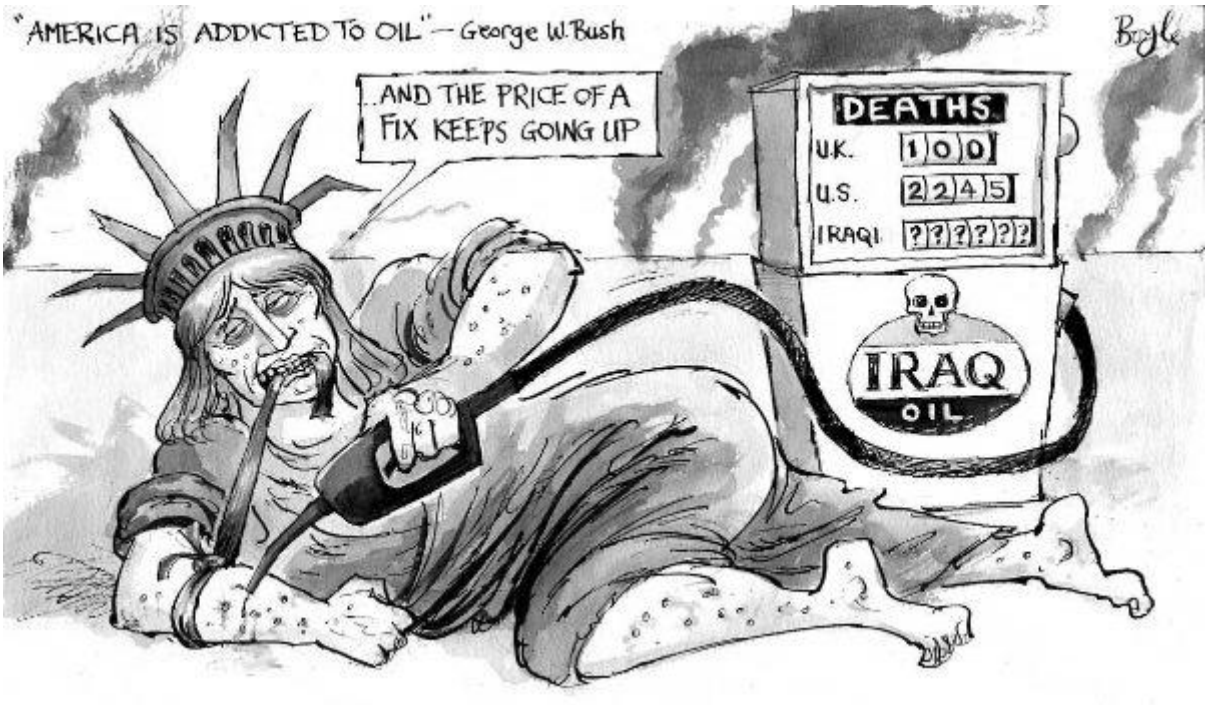
It is hard to see nuclear energy getting a renaissance that will make it the answer to our energy prayers

If not for major breakthroughs in thorium

These considerations leave us with RE

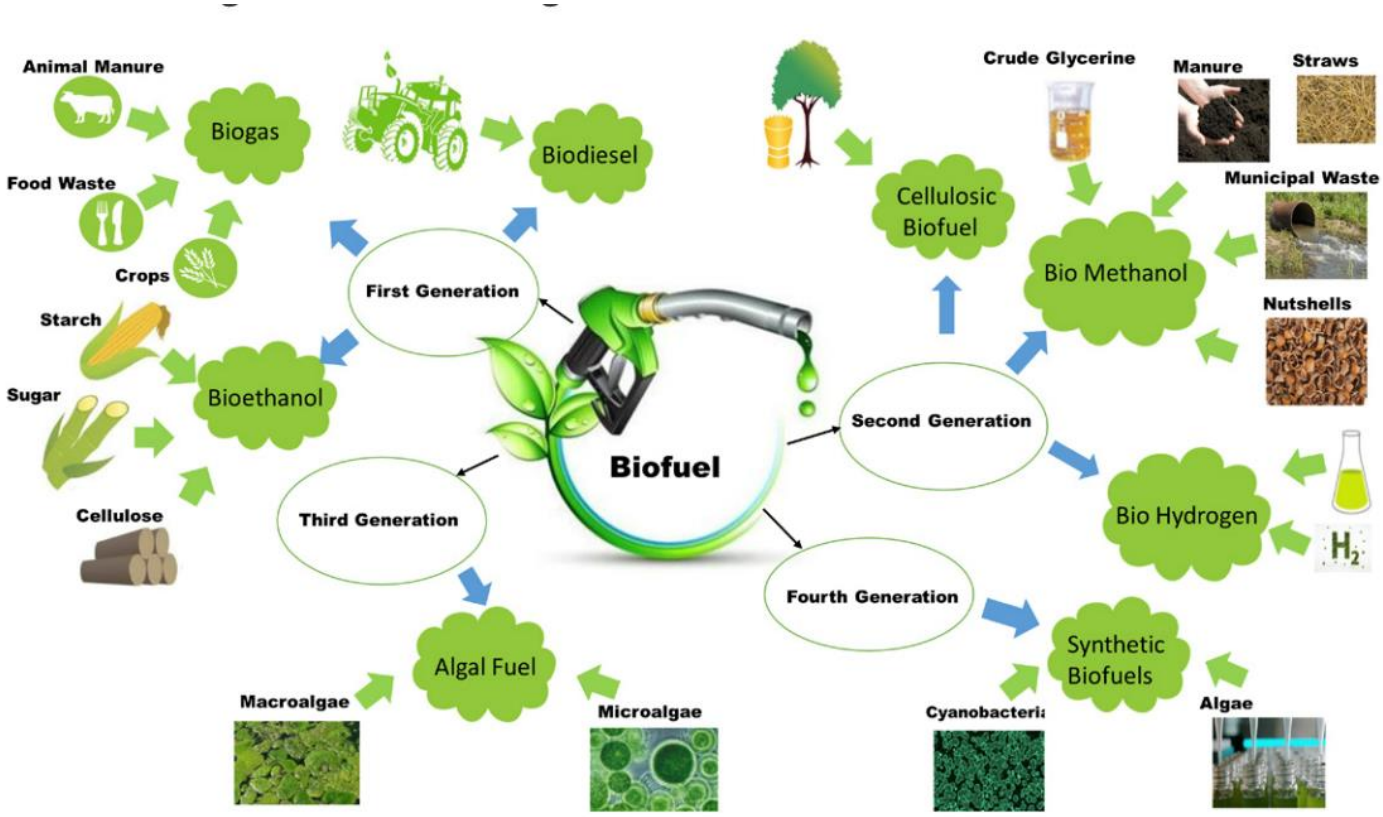
President George W. Bush talked about the American oil addiction





His major solution was biofuels

Increasing our production of biofuels would reduce our ability to produce foods



Hydropower

Is the oldest of all renewable technologies

It will always be available

Beyond developing countries, the potential for expansion is limited

Geothermal and wave energy

have considerable potential

are far more immature than wind and solar

Wind and solar will be the backbone of the RE drive

Why do some countries pursue RE with more enthusiasm and dedication than others?

Will some of the leading economies of the world (as well as some smaller ones) forge ahead and lead the process?

Or is RE doomed?

The story, the arguments, and vested interests

Why is RE promoted by some countries and not by others?

Need to understand the underlying drivers of political economy

The book examines the aforementioned six countries

1. Japan
2. China
3. US
4. Germany
5. Denmark
6. Norway

The book tries to say something systematic about the political economy underpinning the growth of RE

- Information on the political economy of RE is missing from the literature
- The RE literature is dominated by natural scientists (and engineers)
  - They have a better grasp of technological issues
  - They are centered on technical problem solving
    - but they ignore the economic and political aspects of RE policy making

RE is a truly interdisciplinary area

- It is impossible to understand RE without understanding the linkages between
  - the technological
  - the economic, and
  - the political

Let us preview the six countries that are examined

- In Japan, energy policy has been gridlocked by strong vested interests for four decades
  - Fukushima has forced a major re-think of energy policy
  - The photovoltaic (PV) market boomed overnight
  - But PVs have been opted to the detriment of wind power, which has been systematically neglected
- In China, RE has grown faster than anywhere else
  - Any clouds of the horizon are ignored, because this impressive growth keeps everyone happy
- Over the last decade, the US has endured more frequent and more pronounced policy swings than anyone else
  - RE policy has been institutionalized (established), to some extent
  - Legislature gridlocks easily, because it falls prey to the influence of vested interests
  - Pursuing anything more than incremental change is difficult
- Germany is a country with a very robust social and political consensus on environmental protection, nuclear phase-out, and RE
  - A strong RE coalition developed early on
  - This resulted in a rapid-phase in of renewables
  - Eventually, subsidies became very expensive
    - The entire RE support scheme has had to be restructured
  - Now, the German RE story a more open-ended future than most would have anticipated a few years ago
  - https://www.spiegel.de/international/germany/german-failure-on-the-road-to-a-renewable-future-a-1266586.html
- Denmark has been the iconic wind power country
  - It has the greatest wind power density in the world
  - Vestas, Denmark, has the world's biggest wind turbine manufacturer
  - Denmark
    - has one of the most stable support frameworks for RE

derived more of its electricity from wind power than any other major country

Unlike the five other countries, Norway is an energy exporter

It is the world's third largest energy exporter

In addition to petroleum, has an abundance of hydropower

Norway is a story of how RE has fared in a country that

is very energy secure

has very strong vested interests with respect to petroleum extraction

The ambitiousness of a country's RE policies mirror the seriousness of its energy problems

Countries with unsolved energy problems (or an abundance of RE resources) should have more ambitious RE policies

The book suggests that there is more to the story

Vested interests …

… bias political decision making

… wrest away from the state the autonomy to pursue policy independently

Decisions are often biased in the direction of the most powerful interests

For a country that is scarce in energy resources and has weak vested interests …

… it is far easier to initiate RE programs

… because there are fewer opposing interests

Why are vested interests a problem? Here is a first answer

Throughout history, they have always protected themselves by seeking to block

structural change

technological progress

and the rise of challenger industries

Three mechanisms through which vested interests protect themselves
(Mokyr, J., *Level of Riches*, 1990)

(1) Outright physical resistance against new technologies

Strikes, riots, destruction of new machinery

(2) Opposition in the form of laws and regulations restricting the implementation of new technology and erecting barriers of entry

Guild systems, trade unions, labor unions, lobby groups, state monopolies

(3) Shielding against competition and change

Protection, favorable treatment, tariffs, subsidies

Vested interests block the rise of rival industries such as RE

RE industries and technologies have to rise against a backdrop dominated by …

… old and established industries

… fight for their own interests, regulations, subsidies, favorable institutional arrangements

… at the expense of RE

… because the economic pie is limited

Gilpin suggests that new and upcoming industries frequently have different requirements than the old and established industries

The needs of coal, petroleum or nuclear, often come at the expense of the needs of RE

Here is a second answer as to why vested interests are a problem

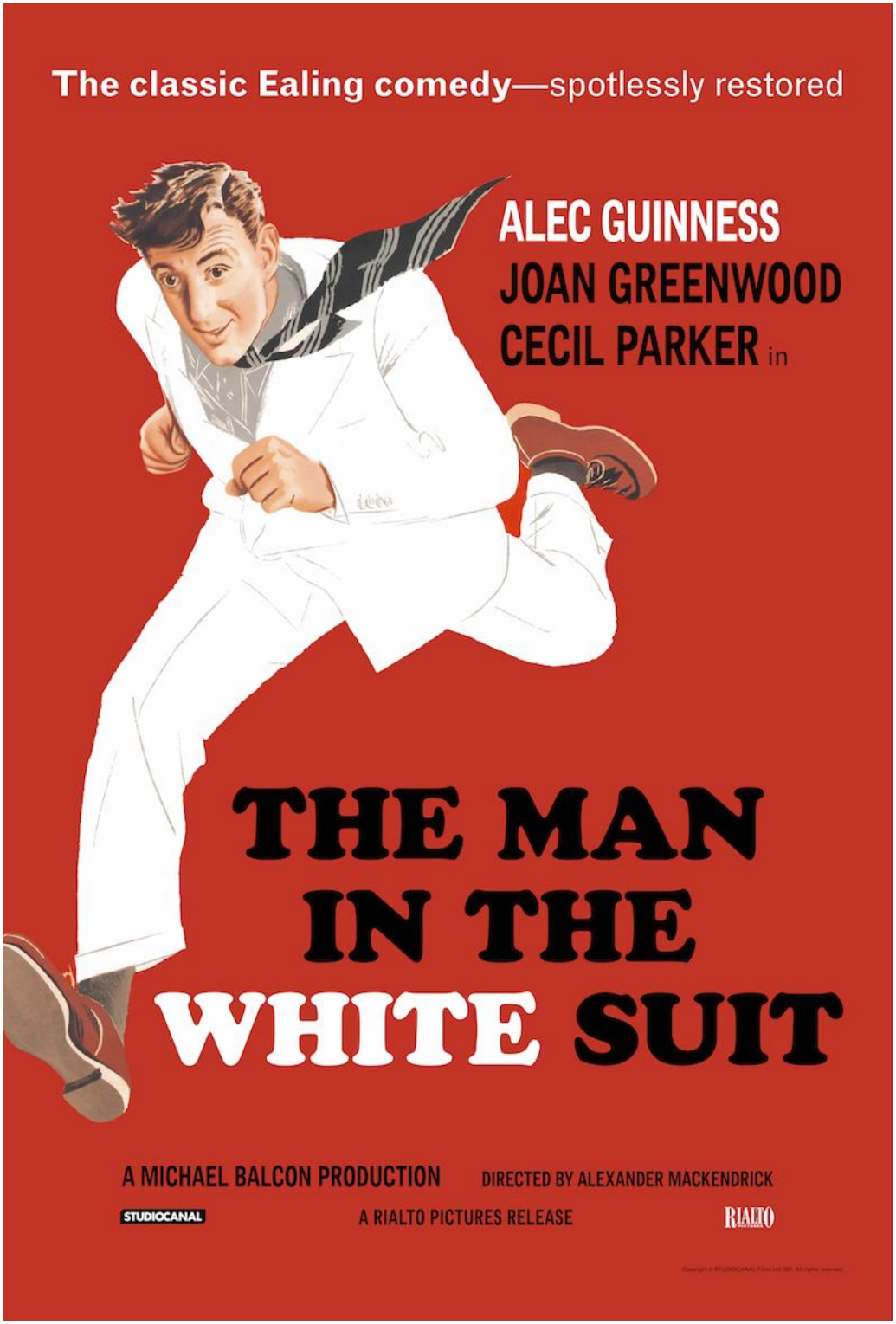
Technological progress is the main driver of structural (economic) change

Without it, we would still be hunter-gatherers, farmers, fisherman or industrial workers

Structural change is essential for long-term growth and development

The cotton textiles industry powered the world two centuries ago

https://thafcc.wordpress.com/2015/06/11/alec-guinness-stars-in-the-best-science-fiction-movie-youve-never-seen/


The classic Ealing comedy—spotlessly restored
ALEC GUINNESS
JOAN GREENWOOD
CECIL PARKER in
THE MAN IN THE WHITE SUIT
A MICHAEL BALCON PRODUCTION
DIRECTED BY ALEXANDER MACKENDRICK
STUDIOCANAL
A RIALTO PICTURES RELEASE
RIALTO

The industries that power the world economy today are not the ones that did the job two centuries ago

Types of economic growth

- Investment-led (Robert Solow)
  - The capital stock accumulates faster than the labor force
- Based on commercial expansion or gains from trade (Adam Smith)
- Based on scale or size effects (Joseph Schumpeter)
  - Increases in the stock of human knowledge, innovation, and technological process
  - Does not lead to diminishing returns

Technological progress fuels growth without diminishing returns

Structural change

- typically stems from breakthrough technological change, which results in the rise of new industries
  - these industries eventually serve as the growth engine of the economy for decades ahead
- Structural change makes a country leap from one economic trajectory to another

Does it make a difference whether you make a billion euros from microchips or potato chips?

- In textbook economic theory it does not, the stimulus to economy is the same
  - https://www.austriancenter.com/potato-chips-vs-microchips/
- Considering the importance of structural change, it makes a big difference
  - https://www.jstor.org/stable/20046816?seq=1
  - https://www.foreignaffairs.com/articles/1994-07-01/microchips-not-potato-chips
  - Making a billion euros from microchips
    - provides productivity improvements to many industries
    - gives rise to new economic activities

Successive waves of technological innovation

last for 50-60 years

Phases in technology development:

Invention = discovery

Innovation = first commercial application

Diffusion = extended use of technology in society

It takes about 50 years to go from invention to innovation:

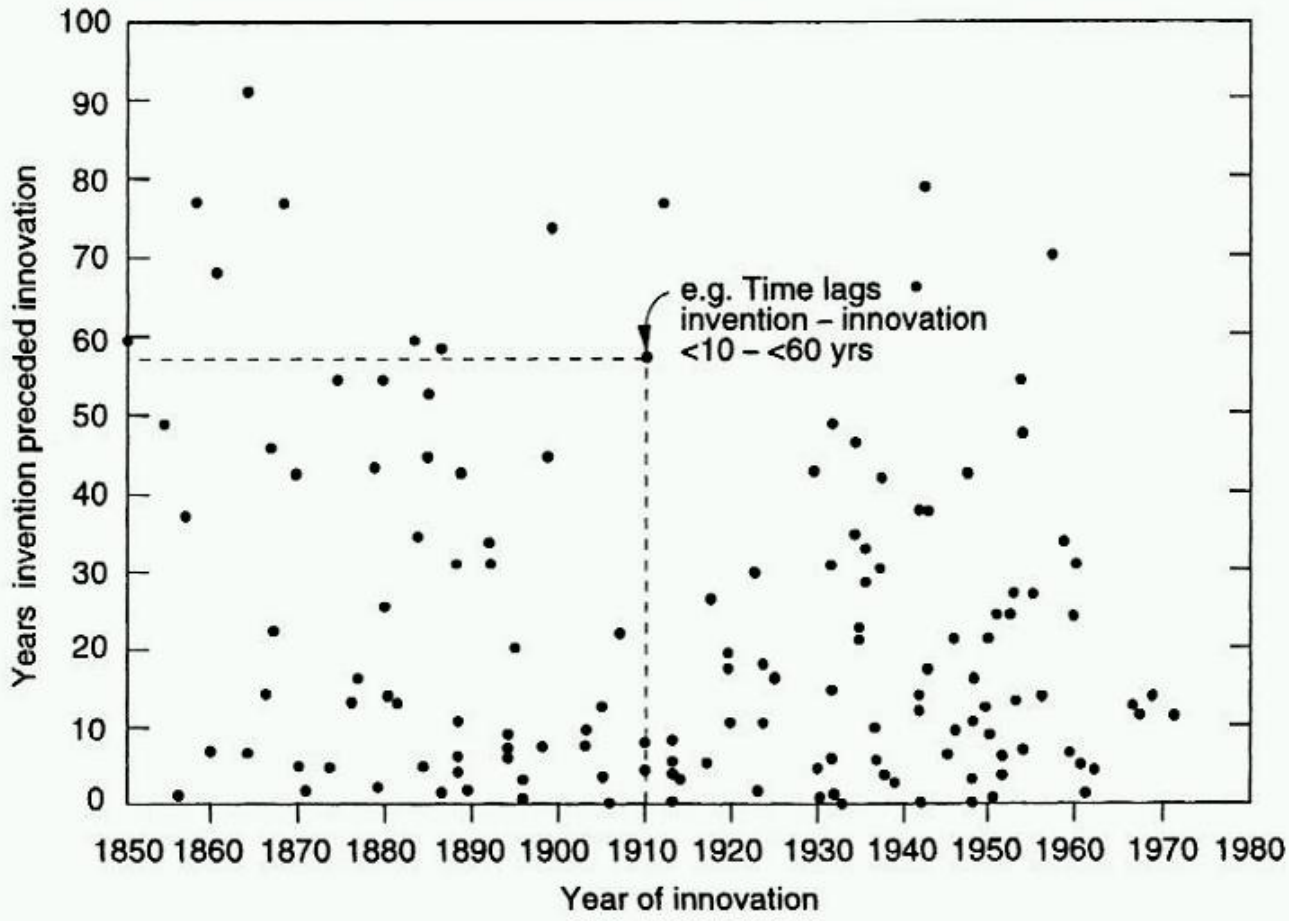


Figure 2.1: Time lag (in years) between invention and innovation of a sample of 140 major innovations introduced in the period 1850–1970. Source: Rosegger (1996:175).[1]

The economic history of the world

is one of core industries

mostly based on new technologies

serving as engines of economic growth

during different historical epochs

Table 1.1 *Transport revolutions in human history*[1]

Era	*Approximate Date*	*Ways of moving people and goods*
Palaeolithic	From ca. 700,000 BP	First migrations of hominids from Africa
	From ca. 100,000 BP	First migrations of modern humans from Africa
	From ca. 60,000 BP	First migrations by sea to Australasia
Agrarian	From ca. 4000 BCE	Animal-powered transport
	From ca. 3500 BCE	Wheeled transport
	From ca. 1500 BCE	Long-distance ships in Polynesia
	1st millennium BCE	State-built roads and canals
Modern	1st millennium CE	Improvements in shipbuilding, navigation
	From early 19th century	Railways and steamships
	From late 19th century	Internal combustion engines
	From early 20th century	Air travel
	From mid 20th century	Space travel

Note: BP = before the present; BCE = before the common era (i.e. before Year 1 in the Christian dating system); CE = common era.

Examples of such epochs:

- Cotton textiles in the late 18th century
- Iron in the early 19th century
- Chemicals in the late 19th century
- Consumer durables in the early 20th century
- Information and communication technologies (in the late 20th and early 21st century)

These waves are driven by the grown of one or a few leading industries

- These industries rise from obscurity to economic prosperity in a short time
- As they saturate, the world goes into economic stagnation and a structural depression
- Schumpeter: The world goes through waves of *"creative disruption"*
  - Depression
    - destroys old firms and industries
    - leads to the creation of new ones

In any economy, strong forces seek to

- prevent structural change
- preserve the status quo

As an economic sector becomes economically prosperous

- it typically becomes politically influential
- securing arrangements and institutions that are beneficial to itself
  - rather than the economy at large

Institutional stability leads to institutional rigidity

- Vested interests seek to preserve the institutional status quo that worked so well for them during the past
- The more a country depends on one or a few industrial clusters, and the greater their dominance …
  - … the more likely that the state grants them the institutions and the arrangements they desire

If the economy is controlled by vested interests

- it loses the ability to change, adapt, and shift the status quo

There is no such thing as a level playing field

- A whole vested interests structure protects and shelters the existing actors of the (established) system
- Politically, economically, and institutionally, the established actors hold all the advantages
- New industries often find themselves constrained by vested interests
  - using their influence to sway policy decisions in their favor
- Creative disruption is blocked
  - This leads to the silting up of institutional rigidities in the political economy

New and vulnerable industries

- easily end up in a situation where they are blocked by a political and economic system that favors the old and established actors of the system
- will need some form of backing to rise in the presence of long-established powerful actors

After a long and roundabout answer, we come to the energy industry

The energy history of the world resembles the industrial history

- Energy transformations mirror structural changes in the industrial economy

There is a long and well-documented correlation between energy and long-term economic growth and development

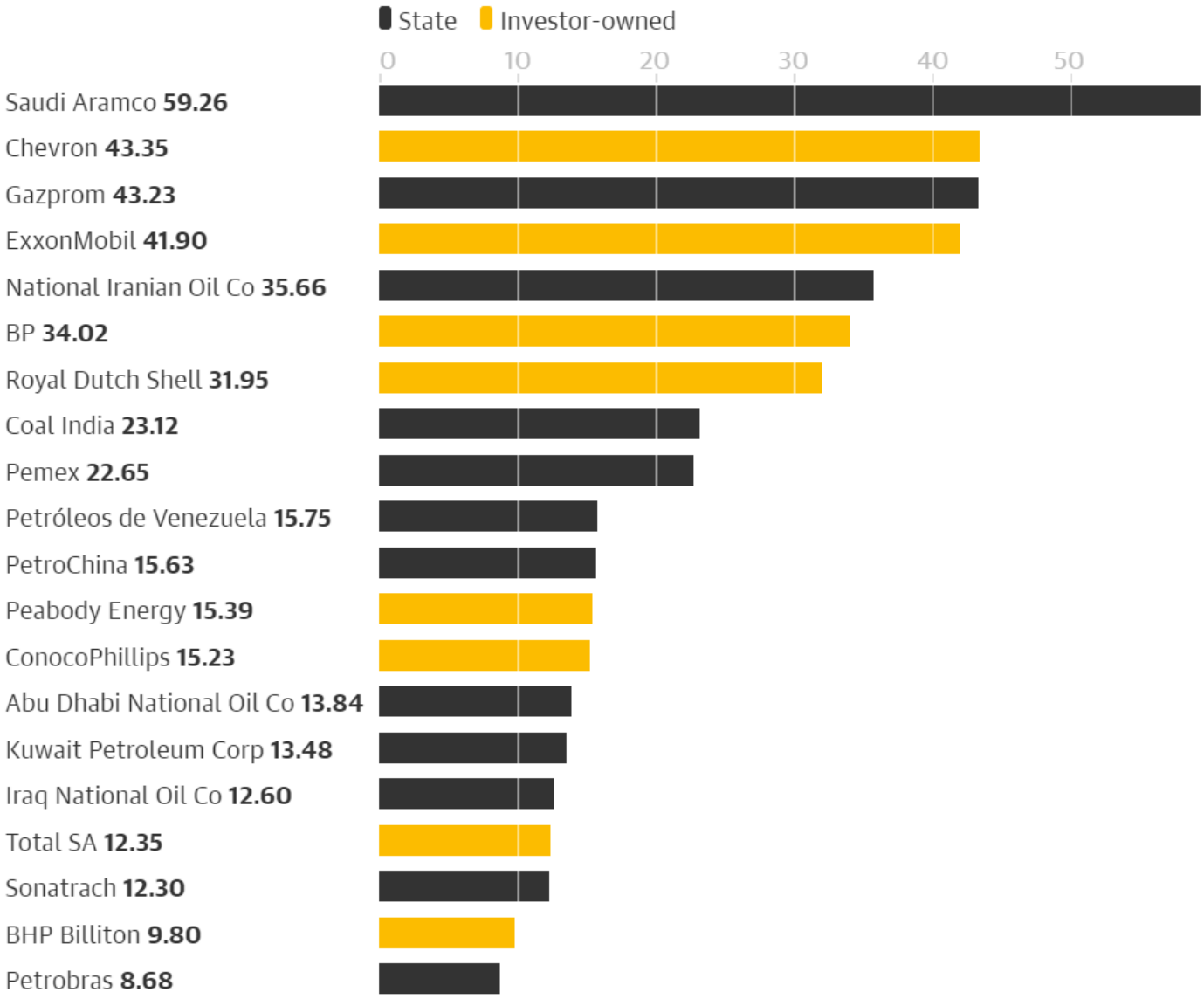
- Steam power, electricity, and oil have been essential to long-term growth
- Industrial waves have been supported by the discovery and exploitation of a new resource that provided abundant energy
  - Through technological progress, new resources became more exploitable and much cheaper
- The early industrial revolution was powered by water
  - which then gave way to coal and steam power
- Electricity revolutionized the world of energy from the 19th century onward
- Since the 20th century, petroleum (oil) has been the life-blood of the world economy
- Nuclear power has been a stillborn transformation confined to no more than 5% of the world's energy supply due to
  - accidents like Chernobyl and Fukushima
  - problems with the storage of nuclear waste

RE is the latest energy transformation, tentative but with great potential for being momentous

- it is a low carbon transformation
- it shifts away from the current fossil fuel paradigm
- Powerful and influential forces are working against it
  - Energy companies are the world's biggest giants
    - (with car makers and mining companies)
    - https://www.theguardian.com/environment/2019/oct/09/revealed-20-firms-third-carbon-emissions
    - https://www.theguardian.com/sustainable-business/2017/jul/10/100-fossil-fuel-companies-investors-responsible-71-global-emissions-cdp-study-climate-change

The top 20 companies have contributed to 480bn tonnes of carbon dioxide equivalent since 1965

Billion tonnes of carbon dioxide equivalent



Guardian graphic | Source: Richard Heede, Climate Accountability Institute. Note: table includes emissions for the period 1965 to 2017 only

These companies

- had the necessary time and resources to secure for themselves favorable
  - institutional setups
  - regulatory arrangements
- have the politician's ear
- wield enormous political influence

The kind of innovation that flows from such companies

- Fails to be transformational and disruptive
  - The EU in particular lacks innovation
- Is only incremental

Governments send to investors signals that capital will keep accruing

to old technologies

rather than new basic innovations and potential transformations and disruptive technologies

In many countries, there is a strong institutional bias in favor of the present energy structure which is based on

fossil fuels and nuclear energy

big centralized energy utilities that distribute electric power to

thousands of industries

millions of households

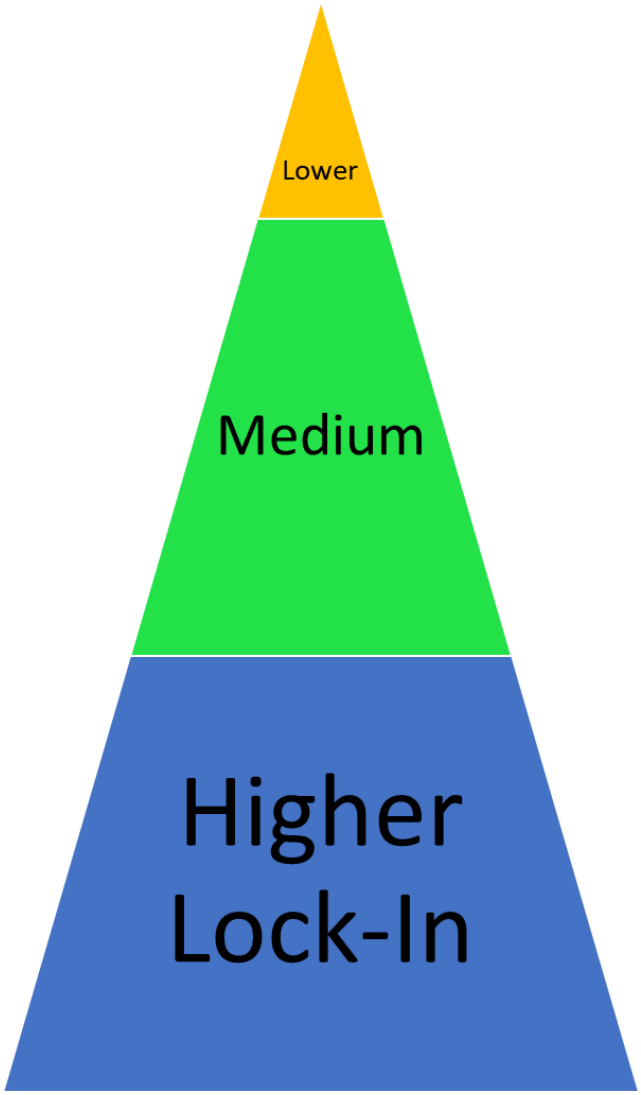
These are called Techno-Institutional Complexes (TICs)

Large technological systems embedded through

feedback loops between technological infrastructure and institutions

Once locked in (remember path dependency), they are not easily replaced

- Google
- Local retail stores
- Amazon
- eBay
- Expedia
- Your bank
- Social networks
- Broadband providers
- New durable goods
- K-Cups, printer cartridges, vacuum filters, e-cigs
- Tax software
- Operating systems
- Email address
- Game consoles
- Word processing, spreadsheets
- Blogging platform
- Cloud computing platform.
- Any enterprise software platform
- Block chains



Today's petroleum companies are

the biggest industrial giants of the planet

part of a TIC that perpetuates a fossil fuel-based infrastructure

This results in a carbon lock-in

It takes political action beyond market mechanisms to

displace a TIC

implement a new energy structure

RE would have to rise

against a locked-in energy structure

populated by the world's biggest industrial giants

actors that have had years to influence the system

that they are now an intrinsic part of

Whether RE is the next big wave or not, we need to analyze

the vested-interest structures of countries

the extent to which they are seriously and actively pursuing policies of structural change

their path dependencies

An analysis of RE that takes the international political economy as a starting point

Must take into account the linkages between

technology

economics

policy

Explain the rise (or the absence) of renewables in terms of

the underlying dynamics of the political economy of a country

Must realize that a proper treatment of RE means

inscribing it in a political economy tradition

focusing on structural change

The rise of RE belongs to a class of phenomena that have happened again

Through history, RE is only one of a series of industries and energy providers that

have had transformational potential on the global economy

Much work must be done inductively

Investigating the extent to which political elites have been receptive to the needs of RE

Whether RE is at the mercy of policies designed to prevent changes in the status quo

Country specific variations in RE policies

necessitate case studies of countries

The case for renewables and the state of the renewable realm

Chapters in the textbook examine

1. Japan
2. China
3. US
4. Germany

5. Denmark
6. Norway

These chapters present some statistics

I will not cover that part of the introductory chapter

RE has a major growth potential

It remains uncertain whether RE will constitute the main growth wave of the future

Joseph Schumpeter (1883-1950) was

one of the most influential economists of the 20th century

popularized the term *"creative disruption"*

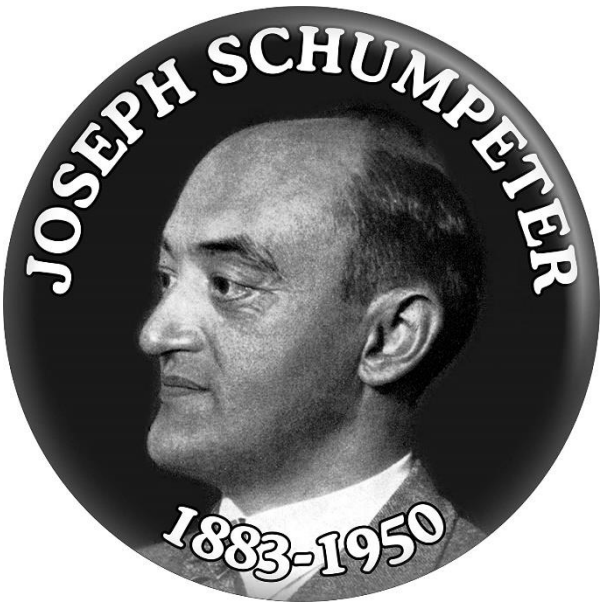
the finance minister of German-Austria in 1919

a Professor in Harvard University (1932-1950)

"… no serious businessperson can ever completely relax. Someone, somewhere, is always trying to think of a way to do the job better, at every point along the value chain. Whatever has been built is going to be destroyed by a better product or a better method or a better organization or a better strategy … business is a Darwinian process, and Schumpeter often likened it to evolution. The creative destruction can occur within a large innovative company (Toyota, GE, Microsoft), but it's much more likely to happen with start-ups, particularly since they now have so much access to venture capital."

https://hbswk.hbs.edu/item/rediscovering-schumpeter-the-power-of-capitalism

Schumpeter was skeptical about the ability of politicians to pick industrial winners



Schumpeterian growth is related to innovations

Schumpeter thought that

politics too often became business

politicians were essentially political entrepreneurs

searching for policy innovations that satisfy particular interest groups and voters

their number one priority was trying to win the political game (next elections)

RE constitutes a cluster of interesting and promising industries

RE has decades of technological progress and prowess ahead

It may be argued that we are bumping against the planet's physical limits

for the first time in our history

Serious environmental problems of the past were regional

the Great Smog of London (December 1952, lasted for 5 days)

https://www.history.com/news/the-killer-fog-that-blanketed-london-60-years-ago

Such regional problems could be solved with technological measures

e.g. tall chimneys

Now problems have become global

More stringent regulations will be enforced on polluting industries

Industries that can provide energy without greenhouse gas (GHG) emissions will become more competitive

RE will be a part of the effort to address these global problems

RE will not replace fossil fuels in the short term

Only hydro can compete in price with fossil fuels without government subsidies

Fossil fuel prices are likely to increase

RE prices are likely to drop

In any case, RE has a long way to go before it becomes

cheap

abundant

Much evidence testifies to the strong growth of RE

Wind power has been growing by an average of 24% from 2000 to 2014

Solar PVs have been growing by more than 40%

Massive drop of costs for PV cells and modules

For the few years before 2014, roughly half or more of the new electric capacity installed worldwide had come from RE

EU is the frontrunner

A decade before 2014, fossil fuel generation accounted for more than 80% of annual capacity additions

Too green for its own good?

In the US, approximately half of all electricity capacity additions in 2012 were renewable

2013 was a particularly bad year for RE in the US for political reasons

COMMENTS

Why the United States Does Not Have a Renewable Energy Policy

by E. Donald Elliott

E. Donald Elliott is Professor (adj.) of Law, Yale Law School, and Senior of Counsel, Covington & Burling LLP.

For good or ill, the United States seems more like a western European country every day, but the contrast could not be starker when it comes to renewable energy policy. Many countries in Europe get over one-third—and some, over one-half—of their electricity from renewable sources such as wind and solar. Europeans across the political spectrum support government policies to promote renewal energy, but government support for renewable energy is deeply controversial in the United States. In their first presidential debate, Mitt Romney famously attacked Barack Obama for "picking losers" by spending $90 billion to promote green energy.[1] Why doesn't the United States have a renewable energy policy like those in Europe? The answers lie deep in our political structure and political culture, as well as our natural endowment of huge resources of fossil energy, including shale gas and unconventional oil.

energy sources.[2] That compares with only 12% in the United States, and of that total, about 10% is hydropower, so we in the United States are actually in the range of only about 2% of our electricity coming from non-hydro renewable energy sources, as opposed to 45% in Portugal. A number of other countries in the European Union (EU) also have renewable energy numbers comparable to Portugal's,[3] and one sees many windmills dotting the countryside.

On the surface, the renewable energy gap between the United States and the EU is surprising in that every president of the United States since Richard Nixon has declared as a national goal of the United States to end our addiction to imported petroleum.[4] President Obama in his 2011 State of the Union address made moving to a clean energy economy one of the signature aspects of his presidency.[5] But even his initiatives were designed primarily to promote the development of new green energy *technologies*, not to

Interesting thoughts in the above paper on RE policy in the US

Structural impediments

(a) Fragmented authority

(b) Separation of powers (divided government)

One party controls one house of the US Congress and the Presidency

The US Congress is bicameral

House of Representatives

Senate

The other party controls the other house of the US Senate

(c) Changing policies

(d) Unrepresented future generations

Transgenerational justice

Cultural impediments

(a) The “right” to cheap energy

(b) Free market ideology

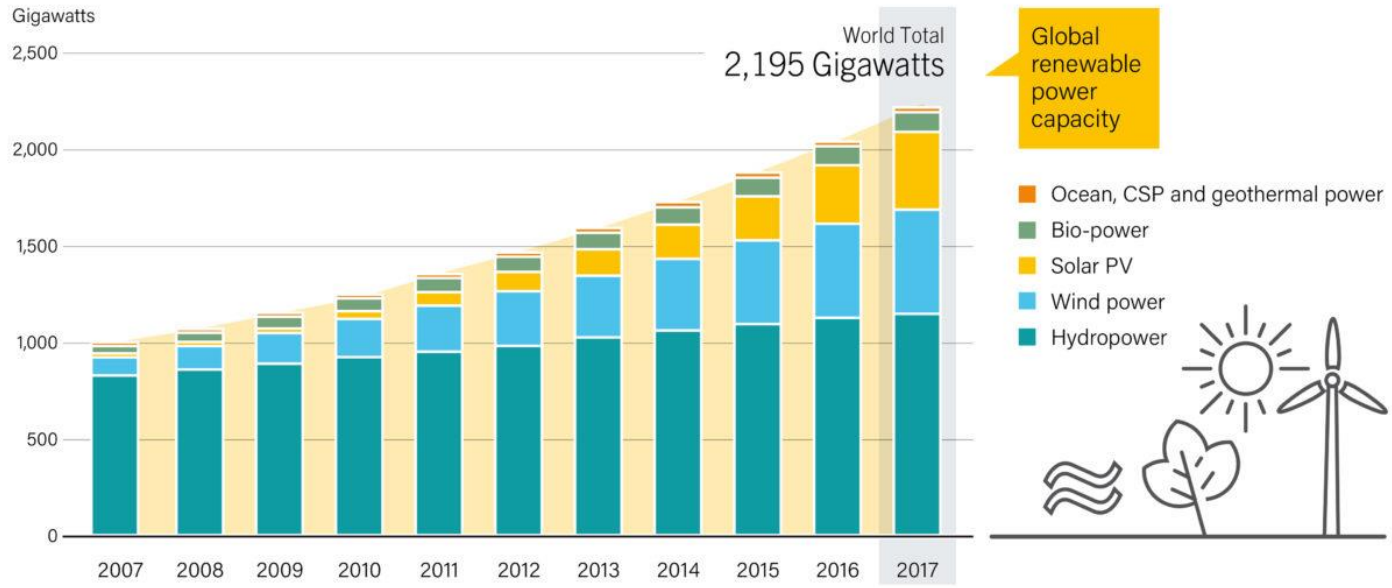
(c) Less concern about climate change

Much of the world’s total RE capacity is hydropower

Wind power has been the most popular form of RE

PVs are competing since 2013

Global Renewable Power Capacity, 2007-2017



REN21 RENEWABLES 2018 GLOBAL STATUS REPORT

On p. 25 of our textbook, the author starts a comparison of the countries examined in the following chapters

For wind power the grid net is a problem

With the rapid expansion of wind turbines, countries have problems feeding ever larger quantities of renewable energy into the net

lack of infrastructure

delays in grid connections

curtailment in electricity generation

In several countries, the expansion of renewable energy has run ahead of the expansion of the grid system

Lots of primary wind and solar power has been lost

the grid has not had the capacity to absorb it

Grid parity is the holy grail of RE

Grid parity is the point at which an alternative energy source is able to generate electricity for the same levelized cost as the electricity that is available on a utility's transmission and distribution grid

To what extent is RE competitive without subsidies?

The answer is complicated and has contingencies

What is 'grid parity' and what does it mean for renewable energy and the renewable transition

https://youtu.be/KUlDuTVQxdw

Solar is Freedom answers: What is grid parity?

https://youtu.be/8D-ctA_YC_0

Grid parity is not easy to define

Electricity values vary considerably in different locations

So, grid parity is more easily achieved in countries with expensive electricity

The US has cheaper electricity than most European countries

There are also differences in how well suited different locations are to wind and solar

Germany had the world's highest installed PV capacity (2014)

Yet it receives far less sun than most of the US

So, solar power is less effective in Germany

Grid parity will take longer to achieve than California

There are differences between retail and wholesale prices

Retail prices are far higher than wholesale, particularly in PV

Individual customers (prosumers) face retail prices

A utility faces wholesale prices

As of 2014, PV was competitive with retail (not wholesale) prices in

Germany

Italy

Spain

10 US States

19 more countries were projected to reach retail prices for solar in 2014

but some countries have longer transmission distances than others

The US was projected to reach retail parity for wind in 2016

Grid parity is not far off

For RE to compete, it needs to be both

competitive in price

able to produce power predictably all day and all year

If much wind (or solar) power is added in areas that are already abundant in wind (or solar)

days that are calm (or cloudy) will yield major intermittency problems

The transmission net must be good enough to transmit power from areas with wind or sun

Or significant standby capacity will be needed as a backup

There are mismatches between

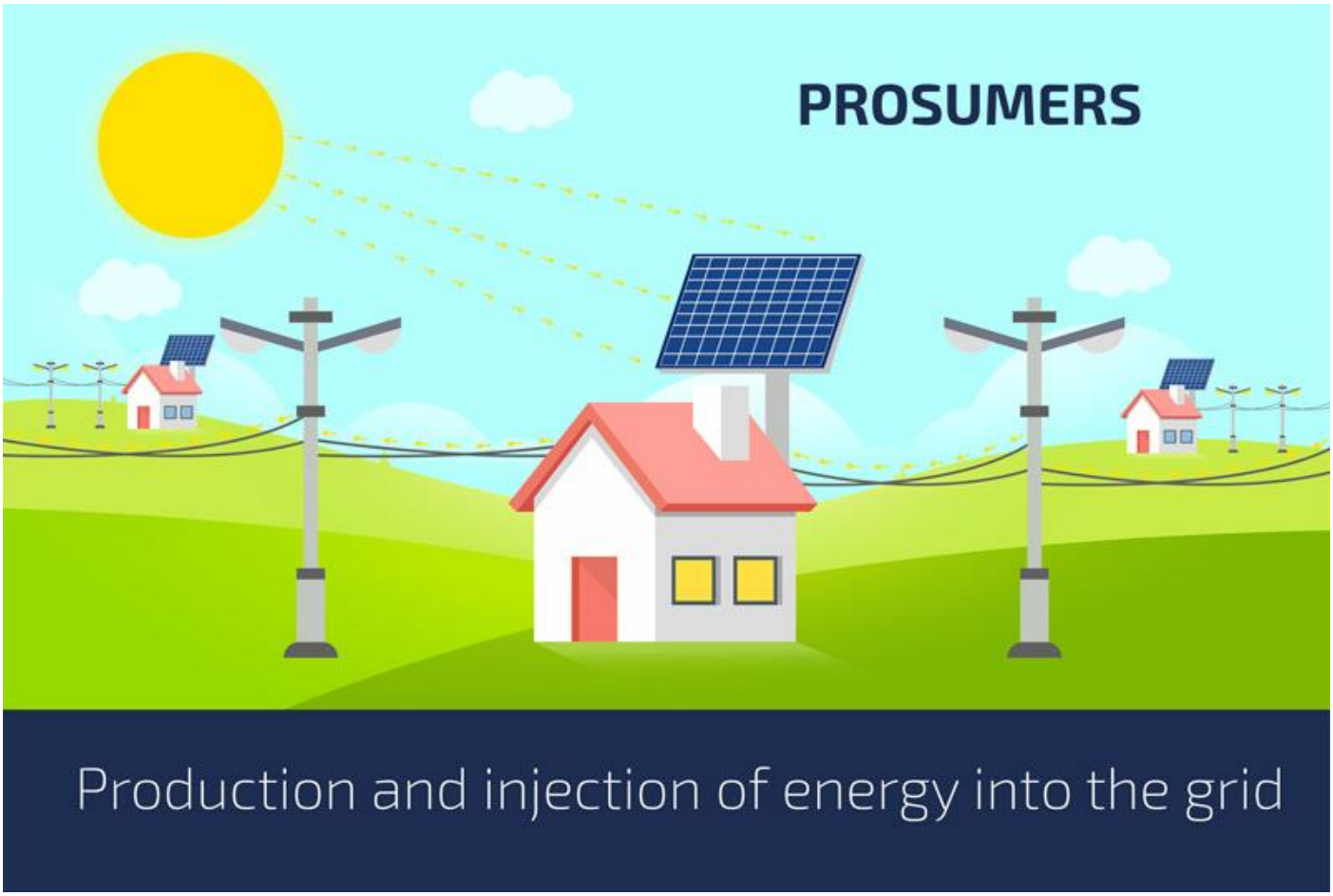
the electricity that RE provides

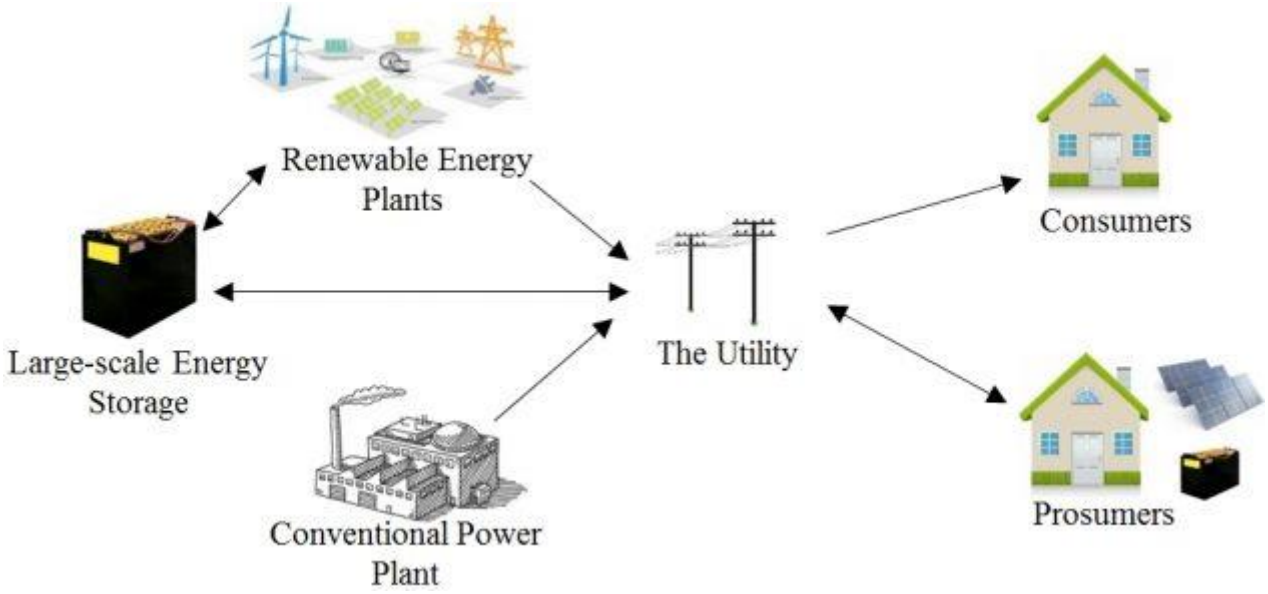
what the utilities are able to feed into the grid

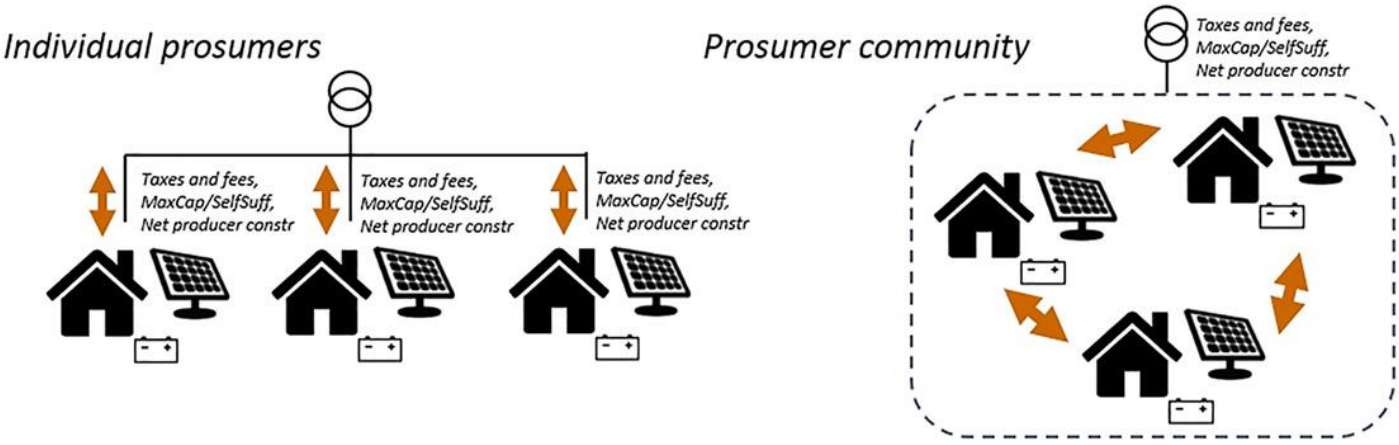
This mismatch must be solved for any energy transformation to take place

Yet, this mismatch provides a source of disruptive change

growth of prosumers = energy consumers who produce their own power







In that sense, PV is the most disruptive of the RE technologies

- Allows consumers to produce their own power
  - In 2014, Germany had 1.4 million PV producers

The utilities represent a top-down approach

- large infrastructures
- large cross-continental transmission lines
- large electricity storage systems
- long planning times

PVs represent a bottom-up approach

- decentralized challenge
- electricity is produced locally
  - by individual consumers

In countries that have achieved retail grid parity

- it makes sense for consumers to produce their own power
  - rather than purchasing it from utilities
- A completely different and rapidly expanding model of electricity generation will grow

The world is not at a point where a prosumer revolution has occurred, but prosumers

- represent the greatest challenge for utility companies (that have dominated the electricity market for the past century)
- provide major potential for creative disruption and a transformation of the entire utility sector

p. 26